CLINICAL ASPECTS OF ADULT IDIOPATHIC EPISTAXIS

by

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ERRATUM

Wurman et al., 1987 appears twice on page 27, this should read Wurman et al., 1988.

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LIST OF PUBLICATIONS ARISING FROM THIS WORK

McGarry G.W. (1991) The nasal endoscope in adult epistaxis; a preliminary evaluation. *The Journal of Laryngology and Otology*, **105**, 428-431.

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McGarry G.W. & Moulton C. (1993) The first aid management of epistaxis by accident and emergency department staff. *Archives of Emergency Medicine*, **10**, 298-300.

McGarry G.W., Gatehouse S. & Hinne J. (1994) Alcohol and epistaxis. *British Medical Journal*, **309**, 640.

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Chiu T., Shaw-Dunn J. & McGarry G.W. (1996) Woodruff's Plexus and adult posterior epistaxis. *Clinical Otolaryngology*, (Abstract). In-press.

TABLE OF CONTENTS Page

Section 2 — Page

Aspects of the management of adult epistaxis

LIST OF TABLES

List of Figures

SUMMARY

Epistaxis is the most frequent reason for adult emergency admission to otolaryngology units in the United Kingdom. Despite it's prevalence the aetiology of epistaxis is poorly understood and most cases are ***idiopathic***. In addition management of the condition involves numerous untested treatment strategies backed by a literature consisting almost entirely of case reports, anecdote and review articles. Few aetiological factors or treatment strategies have been the subject of prospective research.

This thesis used a series of prospective research studies to examine aspects of the **aetiology** and **management** of adult idiopathic epistaxis. Data was prospectively collected on admissions to the otolaryngology department of Glasgow Royal Infirmary.

All clinical work was performed on a defined population of ***adult*** (20 years or older), ***idiopathic*** epistaxis patients identified by exclusion of cases with a known cause for their bleeding (trauma, surgery, tumours, anticoagulant medication, blood dyscrasia, haemophillia, hereditary haemorrhagic telangiectasia).

Findings

1. Aetiology

A. *What is Woodruff's plexus? (Chapter 3)*

Woodruff's (1949) naso-nasopharyngeal plexus was investigated by endoscopic photography, anatomical microdissection and histological analysis. The plexus

was shown to be a superficial venous plexus with no significant arterial or arteriolar component. Thus, contrary to existing literature, the plexus is unlikely to be important in adult epistaxis.

B. ***Which blood vessels are involved in adult posterior epistaxis? (Chapter 3)***

50 consecutive adult idiopathic posterior epistaxis admissions were studied. 70% were bleeding from the nasal septum and 30% from the lateral nasal wall. Woodruff's plexus was the site of bleeding in only 8%. The excess of septal bleeding points was statistically significant ($p<0.001$, Binomial test of proportions). These findings contrast with existing literature which suggests that posterior epistaxis is a condition of the lateral nasal wall and Woodruff's plexus.

C. ***Is alcohol use associated with adult idiopathic epistaxis? (Chapter 4)***

The potential aetiological role of alcohol was investigated in a prospective case control study (140 patients and 113 controls). A greater proportion of patients than controls were found to be regular drinkers (45% versus 30%, $p<0.025$) and patients were more likely to have consumed alcohol in the 24 hours prior to admission (45% versus 27%, $p<0.01$). These findings were supported by significant differences in the quantity of alcohol consumed by patients and controls. A possible explanation for the association between alcohol and idiopathic epistaxis implicates haemostatic abnormalities induced by moderate to high levels of alcohol intake.

D. ***Are non-steroidal anti-inflammatory drugs associated with adult epistaxis? (Chapter 5)***

Non-steroidal anti-inflammatory drugs (NSAID) are a group of commonly used medications with profound anti-haemostatic effects. NSAID use in 126 epistaxis patients was compared with 122 controls. 44% of epistaxis patients used NSAID compared to 19% of controls ($p<0.001$). Comparing reasons for NSAID use in patients and controls showed similar proportions were prescribed by a general practitioner (62% patients versus 65% controls). The remainder used self administered proprietary aspirin (38% patients and 35% controls). Aspirin (prescribed and self administered) accounted for 73% of NSAID used by patients and 74% by controls. The excess proportion of patients using NSAID suggested a possible role in the aetiology of adult epistaxis.

E. ***Do adult idiopathic epistaxis patients have occult abnormalities of haemostasis? (Chapter 6)***

Associations between alcohol and NSAID and epistaxis suggest a mechanism involving systemic haemostatic impairment. This study investigated haemostatic function in 50 consecutive idiopathic epistaxis cases. Alcohol and NSAID use was recorded and in vivo haemostatic testing performed with a Simplate® device. Simplate results were compared to a reference range (normal = < 10.5 minutes). 46% of patients had abnormal bleeding times (> 10.5 minutes). Bleeding time duration correlated with alcohol use, being longest in patients who consumed between 1 and 10 units of alcohol per week ($p<0.001$). No significant effect of NSAID use was found.

F. ***Are nasal septal abnormalities associated with adult epistaxis? (Chapter 7)***

Nasal septal abnormalities are widely believed to cause epistaxis. Septal anatomy was compared in 123 epistaxis patients and 123 controls. There was no difference in the incidence or direction of nasal septal deviation in the patients and controls (54% versus 53%)(X^2=0.0, p=1.0). This study did not identify an association with septal abnormalities.

2. Management

G. ***How aware are accident and emergency department staff of the first aid management for epistaxis? (Chapter 9)***

Digital pressure over the ala nasi (the Hippocratic method) is the recognised method of first aid in epistaxis. Awareness of the correct application of this most basic step in management was surveyed in a major accident and emergency department. Of 115 members of staff (medical, nursing and paramedical) surveyed only 33% knew the correct technique. 66% of trained nursing staff did not know the correct technique! The findings support the observation that on reaching hospital, patients often receive inadequate initial treatment, resulting in continued bleeding and unnecessary specialist referral.

H. ***How do epistaxis balloon catheters work and could their design be improved? (Chapter 10)***

The intranasal configuration of the three most frequently used epistaxis balloons was studied using radiological and anthropomorphic techniques in four human

cadavers. In general balloon dimensions and volumes were excessive. Balloons did not contour to the nasal cavity but prolapsed into the nasopharanyx and oropharanyx. Design modifications based on anatomical data recommend shorter balloons aimed at choanal occlusion rather than tamponade.

I. ***Are direct endoscopic treatments feasible in adult posterior epistaxis? (Chapter 11)***

A prospective randomised controlled trial of 50 consecutive cases compared traditional treatment (packing and balloons) with endoscopically guided direct haemostasis. Endoscopic haemostasis was superior to traditional management in immediate control of bleeding, prevention of re-bleeding and requirement for general anaesthesia. In-patient stay was shorter in the endoscopic group (mean 2.7 days *v* mean 4.5 days, $p<0.05$). The results show that endoscopic haemostasis is clinically feasible and offers advantages over traditional methods. This research has led to the development of endoscopic diathermy technology for use in out-patient management of adult epistaxis.

Overall Conclusions

The septal arteries have been shown to be the main site of adult posterior epistaxis, casting doubt on the importance of Woodruff's plexus. Important aetiological associations between alcohol, NSAID and epistaxis have been confirmed and a possible haemostatic mechanism for the effect of alcohol has been demonstrated. Nasal septal deviations have not been confirmed as important in the causation of adult idiopathic epistaxis.

Deficiencies in first aid management by hospital staff have been identified and flaws in the design of epistaxis balloon catheters highlighted. Thus, non-specialist treatment of epistaxis may be improved by education of accident and emergency staff and improved design of nasal balloon catheters.

The theoretical ideal of direct endoscopic haemostasis in posterior epistaxis has been shown to be clinically feasible, efficacious and worthy of further study.

Chapter 1

Introduction

"The observations that follow, relate to the haemorrhage of the nostrils. Some of them have reference to the cure, nor are taken from the dead body; and others were taken from the dead body, but not where they ought to have been chiefly made; I mean in the nose".

(Morgagni, 1761)

1.1 Epistaxis

Epistaxis is the term for bleeding from the nose and the condition and techniques employed for its management have been the subject of medical texts from the time of Hippocrates in 5 BC (Shaheen, 1967). Epistaxis is a symptom which may range from mild, childhood recurrent nose bleeds to life threatening arterial haemorrhage which occurs almost exclusively in adults. Although nose bleeds can occur as a complication of an underlying systemic disease they are more often a spontaneous event without obvious cause.

When faced with a condition which has a wide spectrum of presentations it would seem logical to classify the various sub-types and clinical patterns which occur. However, a review of the literature on epistaxis failed to reveal a single well-structured classification scheme. Most authors employ a system of classification based on presumed causation. This cause-related approach has led to the repeated publication of long lists of putative aetiological factors such as the 39 causes in **Table 1.1** from Ogura and Senturia (1949). It is surprising that despite the number

of conditions which are said to give rise to epistaxis most cases arise spontaneously, in the absence of underlying disease, and are of unknown aetiology. This deficiency in our knowledge of the aetiology of epistaxis was highlighted by Stell (1977) who pointed out that a cause could only be identified in 15% of cases, leaving 85% of cases with the label of ***idiopathic epistaxis***

Table 1.1

Causal factors in epistaxis after Ogura and Senturia (1949)

A. Inflammatory
Acute coryza (vigorous blowing)
Rhinitis sicca
Ozena

B. Traumatic
Fracture of nose
Ulceration of septum due to picking
Post-operative
Instrumentation of sinuses
Foreign bodies

C. Mechanical
Deviated nasal septum
Nasal polyps

D. Disturbances of circulation
Hypertension
Arteriosclerosis
Nephritis
Telangiectasis

E. Blood dyscrasias
Polycythaemia
Leuccamia(sic)
Purpura haemorrhagica
Haemophilia
Splenic anaemia
Anaemia

F. Infectious diseases
Rheumatic fever and
rheumatic heart disease
Scarlet fever
Whooping cough
Smallpox
Diptheria, nasal
Typhoid and paratyphoid fever

G. Granulomata
Tuberculosis
Syphilis (Gumma of nose)
(Congenital syphilis)
Lupus erythematosis

H. Neoplasm
Benign
Malignant

I. Vitamin deficiency
Scurvy
Vitamin K deficiency

J. Miscellaneous
Metabolic disease
Liver disease
Vicarious menstruation
Chemical poisoning
(Chrome, mercury, phosphorus)
Salicylism
"Endogenous factors"

Idiopathic epistaxis

Patients with idiopathic epistaxis form the largest and most clinically significant group and within this group two distinct patterns of presentation can be identified; childhood and adult epistaxis (Shaheen, 1967). In children the nosebleeds are venous, often recurrent and seldom severe (Maceri, 1986; Shaheen, 1967; Stell, 1977). Adult idiopathic epistaxis is a condition of the elderly and is typified by a single spontaneous, arterial bleed arising from vessels situated in the posterior part of the nasal cavity (Shaheen, 1967). The severity of the bleeding encountered in adults is a reflection of the rich arterial blood supply which the nose receives from branches of both the internal and external carotid arteries (Burnham, 1935; Shaheen, 1967; Zuckerkandl, 1892). Thus, unlike childhood epistaxis, the adult variant is associated with significant blood loss and a small but definite risk of mortality (Juselius, 1974; Lepore, 1993). This was highlighted by Lucente (1972) who observed that epistaxis was second only to malignancy as a cause of death in otolaryngology patients.

In addition to the risk of mortality, adult epistaxis is associated with a high and economically significant level of morbidity. This morbidity is a result of the need for prolonged hospital treatment and the invasive nature of the existing methods for controlling epistaxis. Therapeutic procedures currently in use include various forms of nasal packing and arterial ligation operations. These treatments require concomitant administration of antibiotics and potent analgesics and are associated with a high risk of exacerbating pre-existing cardiac and respiratory disease (Bone, 1990; Sessions, 1973; Stell, 1977).

Epidemiology of adult epistaxis

Epistaxis in adults is a disease of the elderly with a peak incidence between the ages of 60 and 69 years (Stell, 1977). The condition affects both sexes with a possible slight male predominance and there is a marked seasonal variation with epistaxis being commoner in the winter months (Juselius, 1974; Maceri, 1986; Nunez et al, 1988; Small & Maran, 1984; Stell, 1977). This seasonal variation is well recognised as case clustering occurs in otolaryngology wards with the onset of cold weather in the winter months but the reasons for this are unknown.

Despite the large number of conditions which are believed to be associated with epistaxis, few aetiological agents have been subjected to scientific evaluation. This reliance on untested clinical associations is a consistent feature of current knowledge of the causation of epistaxis.

Management

Treatment of adult epistaxis is difficult because the bleeding is frequently from an artery situated in the most posterior and inaccessible part of the nasal cavity. The posterior reaches of the nasal cavity are difficult to examine and this is especially so during active bleeding. A result of this difficulty in examination has been the development of a range of ***indirect*** methods for control of the bleeding (Pearson, 1983). These methods rely on achieving haemostasis by techniques which do not require identification of the bleeding vessel and they have been the mainstay of therapy for many hundreds of years (Morgagni, 1761). All indirect treatment strategies rely on some form of tamponade, either via gauze packing or balloon catheters. This approach necessitates patients being admitted to hospital for a

variable number of days until bleeding is controlled and it is deemed safe to remove the packing or balloon catheters (Pearson, 1983). In addition, there is a significant risk of side effects and of treatment failure in the form of re-bleeding, which has been reported to occur in as many as 52% of patients (Schaitkin et al, 1987). When re-bleeding does occur, following indirect therapy, surgical intervention may be required. This operative intervention takes the form of septal surgery or ligation of the arterial supply to the nasal cavity both of which result in increased morbidity, mortality and economic burden (Bone, 1990; Cumberworth et al, 1991; Pearson, 1983).

Health care implications

The prevalence of epistaxis and the need for prolonged hospitalisation places considerable economic demands on otolaryngology services. In a single year epistaxis admissions accounted for 3066 inpatient bed days in the Greater Glasgow Health Board area, which serves a population of approximately 800,000 (Nunez et al, 1988). Once admitted, epistaxis patients require close monitoring, antibiotic and analgesic medication and in the subgroup of cases who re-bleed, expensive and invasive surgery may be required (Bone, 1990). The significance of epistaxis on health care resource management was stressed by Small and Maran (1984) when they observed that epistaxis is the commonest cause of emergency admission to an otolaryngology ward and that the length of hospital stay is less of an effect of the severity of the condition than a reflection of the particular management strategy selected to treat the patient. It is important, therefore, that the selection of a treatment strategy should be based on the principals of evidence-based medicine, but to date this aim has not been achieved. For example, some otolaryngologists

elect to treat epistaxis using nasal packing and, if bleeding persists or recurs, they simply replace the packing and will do so on a number of occasions until the bleeding is controlled. Others initially treat with nasal packing but regard continued or recurrent bleeding during admission as an indication for surgical intervention, such as arterial ligation or septal surgery. This choice between arterial ligation and septal surgery is another area of controversy and even when ligation has been chosen the vessel to be ligated remains a subject of debate.

1.2 Literature review

The literature on epistaxis and associated subjects was reviewed in two stages. In the first stage the ***type*** of literature was studied using a structured analysis of a ten-year sample of published work. This analysis, by classification of type of publication, was performed to evaluate the proportion of the literature that could be used to make scientifically valid conclusions. The second phase of the literature review consisted of a summary of the ***content*** of the published work. This second phase revealed the current state of knowledge and opinion on aspects of epidemiology, aetiology and management of epistaxis.

Literature on related subjects, such as alcohol and platelet dysfunction or aspects of nasal septal anatomy, was reviewed separately. The results of this review process for the non-epistaxis research are discussed in the relevant chapters.

Review by classification of type of publication

Method

As a first step in the structured review of the literature on epistaxis, a computerised literature search was carried out. Using the Medline database a search was performed for original articles with the word Epistaxis in the title.

The search period for epistaxis papers was between 1984 and 1994. This was augmented by a manual search using references and cross-references obtained from textbooks, review articles and other publications. Whilst much of the important work in this subject was carried out prior to the 1984 initiation date for the Medline search, a review of this recent ten year period of published work was

intended to gauge the types and direction of epistaxis research. From this study of the published work over ten years the following classification system was developed to facilitate analysis of the available literature:-

1. Case report: A report of a single, interesting, clinical case, for example, "Metastatic choriocarcinoma presenting as epistaxis" (Singh, 1992).

2. Report of treatment method (no control group): Papers dealing with a novel method of management of epistaxis. This type of paper usually describes a treatment technique without a formal evaluation of its efficacy, for example, "The avitene pack, a new method to control epistaxis" (Keen, 1986).

3. Review: These publications summarise existing therapeutic practices and aetiological theories based on the author's clinical experience and the literature of the time, for example, "Epistaxis management: conservative and surgical" (Bratton, 1984).

4. Aetiology study (no control group): Groups of clinical cases are presented along with case history details. Authors identify salient features of the history and attribute aetiological importance to these features. No attempt is made to estimate the occurrence of the same features in non-epistaxis controls. An example of this type of work is the paper by Poulsen (1984) reporting the clinical features of thirty nine cases of epistaxis.

5. Aetiology study (prospective, case-control design): Studies designed to test a possible aetiological association using formal prospective case-control design are scarce in the epistaxis literature. Only one study fitting this description had been published in ten years (Watson and Shenoi, 1990). Prior to this the work of Shaheen stands out as the only other research in this important category (Shaheen, 1967).

6. Treatment study (prospective, controlled design): Studies designed to compare treatment methods using a randomised controlled trial design are almost non-existent in epistaxis research to date. Attempts at this type of paper often use retrospective or historical control groups and include confounding factors such as dissimilar management strategies in addition to the technique being compared.

Results

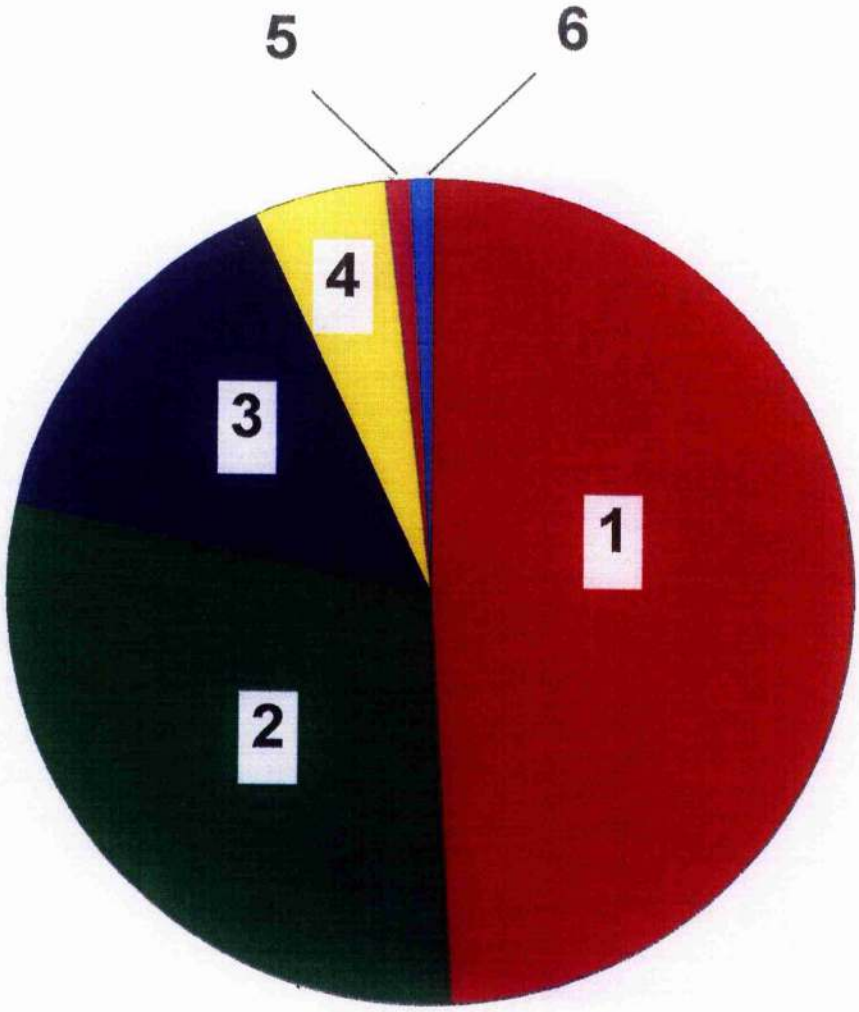
Types of publications

Two hundred and twenty two papers were published between 1984 and 1994. Using the above method of classification (1-6) the ten year period of published literature was analysed and the results are shown in **Figure 1.1**. It is immediately apparent that whilst there are numerous papers on epistaxis very few have used a prospective study design and consequently much of the literature has to be interpreted with caution.

The problem of poor study design in epistaxis research was identified in an excellent review article written thirteen years ago by Pearson (1983). Pearson (1983) pointed out the difficulty of achieving a rational treatment policy due to the absence of an understanding of the basic pathophysiology of the condition. He also commented that he was unable to interpret claims for the efficacy of various treatment strategies due to the absence of prospective randomised evaluations. It seems that the published research of the last ten years has failed to change the situation and that Pearson's criticisms remain just as valid today.

Figure 1.1

Pie chart showing content of literature by type of publication (n=220).



1. Case Report 108 (49%)
2. Report of Treatment (No controls) 64 (29%)
3. Review 33 (15%)
4. Aetiology Study (No controls) 11 (5%)
5. Aetiology Study (Prospective Controls) 2 (1%)
6. Treatment Study (Prospective Controls) 2 (1%)

Review of literature content

Despite the weaknesses identified by the above analysis it is possible to draw some conclusions on the nature of adult epistaxis by reviewing the literature. Much of the literature has already been discussed in Section 1.1 but a further review serves to highlight the salient features of the condition and its treatment. The literature can be summarised under the headings of demography, aetiology and management.

Demography

Most publications on the subject of epistaxis discuss all types of epistaxis as variants of the one condition. However, the literature clearly acknowledges the existence of a distinct adult sub-type (Maran & Lund, 1990; Shaheen, 1967; Stell, 1977). Within the adult subgroup a large proportion of patients are categorised as idiopathic (Juselius, 1974; Maran & Lund, 1990; Ogura & Senturia, 1949; Pearson, 1987; Shaheen, 1967; Stell, 1977).

The features of the adult idiopathic group appear uniform across various publications. The condition affects both males and females but there is a slight male predominance which is revealed in all of the larger studies on the subject (Juselius, 1974; MacKenzie, 1884; Maran & Lund, 1990; Stell, 1977). It is consistently observed that the peak age of presentation is in the seventh decade of life and that there is a consistent and significant excess of cases during Autumn and Winter (Juselius, 1974; Nunez et al, 1988; Shaheen, 1967).

Aetiology

The literature contains numerous references to aetiological factors in epistaxis. Studies of aetiological factors tend to include all forms of epistaxis and all age groups, making it difficult to draw clear conclusions about the idiopathic subgroup. Indeed, while the existence of a large idiopathic subgroup was acknowledged these patients had never been studied as an entity prior to the work of this thesis.

The causes of epistaxis have been considered to be either local or systemic and within the systemic causes cardiovascular reasons are prominent (Juselius, 1974; Shaheen, 1967). The role of hypertension in the aetiology of epistaxis has been the subject of much debate in the literature. Population studies using case-control design support the conclusion that hypertension is not in itself causal but simply exacerbates epistaxis when it occurs (Mitchell, 1959; Shaheen, 1975; Weiss, 1972).

Studies of aetiological factors in epistaxis have tended to focus on young individuals with recurrent epistaxis. Among the factors investigated in childhood epistaxis are septal deviations, mucosal microvascular changes and familial hyperlipdeamia (Clarke et al, 1990; Beran & Petruson, 1986; O'Reilly et al, 1996). The few studies that examine aetiological factors in adult epistaxis have concentrated on the role of non-steroidal anti-inflammatory drugs (NSAID) as a cause of platelet dysfunction in vitro (Watson & Shenoi, 1990, Livesey et al, 1995).

Many studies have tried to address the question of which vessels are involved in epistaxis. In general these studies have confirmed that adult posterior epistaxis is an arterial condition but disagreement exists on whether the sphenopalatine or ethmoidal arteries are responsible or indeed whether the condition arises from the nasal septum or lateral nasal wall (Anderson et al., 1982; El'silimy et al., 1993; Jackson & Jackson, 1988; Lepore, 1993; Milczuk et al, 1991; O'Leary Stickney et al., 1992; Padgham, 1990; Premchandra, 1991; Rosnagel et al., 1973; Woodruff, 1949; Wurman, 1998).

Treatment

Treatment of epistaxis can be summarised under the headings of local cauterising agents, nasal packing techniques, arterial ligation techniques and recently developed endoscopically guided direct therapy.

Direct local anaesthetic cautery is the principal treatment used in anterior epistaxis where it is applied directly to the bleeding point. As such this therapy is efficacious and its role is accepted and non-contentious.

Nasal packing has evolved over the centuries to become the mainstay of treatment in adult epistaxis (Morgagni, 1761; Shaheen, 1967; Stell, 1977). Whilst the literature agrees that nasal packing has an important role to play in the management of epistaxis it also points out that packing is associated with discomfort, a high incidence of treatment failure and a large number of

complications such as sepsis, hypoxia, pressure necrosis and sinusitis (Elwany et al., 1986; Maceri, 1986; Pearson, 1983; Sessions, 1973).

The first case of arterial ligation for epistaxis was reported by Bartlett and McKittrick in 1917. Since that first ligation of the common carotid artery, arterial ligation has become standard treatment for patients who fail with packing. There is, however, controversy over whether the anterior ethmoidal artery, the internal maxillary artery or the external carotid artery should be ligated (Lepore, 1993; Juselius, 1974). Part of the reason for this disagreement over which vessel should be ligated is the lack of a sound patho-physiological basis for this procedure (Maceri & Makielski, 1984; MacKenzie, 1884; Pearson, 1983; Rosnagel et al., 1973; Schiatkin et al, 1987; Ward, 1980).

As an alternative to arterial ligation, some surgeons advocate embolisation of bleeding vessels. However, embolisation is a procedure with a high incidence of complications and it has, therefore, not gained wide acceptance (Hicks & Vitek, 1989; Van Wyck et al., 1982; Beo et al, 1985; Wehrli et al, 1988).

Following the development and general acceptance of rod lens nasal endoscopy there has been a move towards direct endoscopic control of posterior epistaxis. Work in this area was initiated by Wurman (1987) and as a result of Wurman's publication and in part due to the publication of work derived from this thesis, this particular treatment seems to be gaining in popularity (Elwany et al., 1996; McGarry, 1991; Premchandra, 1991; O'Leary-Stickney et al, 1992; Wurman et al., 1987; Wurman, 1996).

1.3 Background to present work

Hypotheses and questions

The work in this thesis was undertaken to investigate a number of clinically important areas in the aetiology and management of adult idiopathic epistaxis. The research is presented in two sections. Section 1 investigates questions **A** to **F** which concern the possible aetiological factors in epistaxis. In Section 2 questions **G, H** and **I** examine problems in clinical management.

Section 1. Aetiology

Studies were performed to investigate the following aspects of the aetiology of epistaxis:-

A. What is Woodruff's plexus? (Chapter 3)

B. Which blood vessels are involved in adult idiopathic epistaxis? (Chapter 3)

C. Is alcohol use associated with adult idiopathic epistaxis? Chapter 4)

D. Are non-steroidal anti-inflammatory drugs associated with adult epistaxis? (Chapter 5)

E. Do adult idiopathic epistaxis patients have occult abnormalities of haemostasis? (Chapter 6)

F. Are nasal septal abnormalities associated with adult epistaxis? (Chapter 7)

Section 2. Management

This section of the thesis considers current problem areas in the treatment of epistaxis using studies designed to investigate the following questions:-

G. How aware are accident and emergency department staff of first aid management for epistaxis? (Chapter 9)

H. How do epistaxis balloon catheters work and could their design be improved? (Chapter 10)

I. Are direct endoscopic treatments feasible in adult epistaxis? (Chapter 11)

1.4 Definitions, patients and methods

Definitions

All of the patients studied were suffering from adult idiopathic epistaxis. For the purpose of the thesis adults were defined as subjects older than 20 years. This age was chosen to exclude childhood and adolescent cases and to ensure inclusion of those adult cases that occur earlier than the normal onset.

The idiopathic subgroup was identified by excluding all cases who exhibited an known cause for their epistaxis. The exclusion criteria are shown in **Table 1.2.** All of the patients who were studied had been admitted to the otolaryngology ward of Glasgow Royal Infirmary. Age, referral to otolaryngology, requirement for in-patient management, and absence of exclusion criteria (Table 1.2) defined the study population. Thus, patients who were managed by accident and emergency department staff and those who were not admitted to hospital were not studied.

Table 1.2

Exclusion criteria used throughout to identify the idiopathic subgroup

Craniofacial trauma
Nasal surgery within 6 months of epistaxis onset
Nasal tumours
Anticoagulant medication
Haemophilia (and other coagulation factor abnormalities)
Haematological malignancy
Thrombocytopaenia ($<100x10^9/l$)
Hereditary Haemorrhagic Telangiectasia

Patients and methods

Aetiology studies

Details of all adult idiopathic epistaxis admissions to the otolaryngology department of Glasgow Royal Infirmary were prospectively recorded on a database proforma. Following admission, a structured questionnaire was administered by a member of admitting medical staff. This data collection was supervised by the author, who checked and completed entries and entered the data into computer.

The proforma recorded basic biodata and descriptive information pertaining to the episode of epistaxis. This included time of onset of bleeding, side of bleeding, past medical history and drug history. In addition to the basic dataset a number of specific questions examined areas being investigated by individual studies (Stone, 1993). For example, the patients' use of non-steroidal inflammatory drugs was investigated by recording the compound used, the reason for use and whether it was prescribed or self-administered medication. Similarly a structured alcohol history was taken from those patients who were part of the study of alcohol and its relationship to epistaxis. A summary of the questions asked and information recorded for each patient are listed in **Table 1.3** and a copy of the proforma is included in **Appendix 1.**

This patient database is the foundation of the research reported in Chapters 2 to 7 **(B,C,D,E,F)**. The number of patients on the database enlarged with each consecutive admission. Thus, at different times during the data accumulation

period sufficient numbers of patients existed to allow certain studies to be performed or concluded. Studies were therefore carried out on chronological subsets of the database, with the result that the number of subjects in each of the reported studies is different. The fact that each of the patient subsets in the studies differ only in their time of presentation can be verified by comparing the demographic data presented in each chapter with that for the whole group.

Table 1.3

Core questions forming database questionnaire

1. Name
2. Age, date of birth
3. Hospital number
4. Sex
5. Side of bleeding
6. Time of onset of bleeding
7. Time of hospital admission
8. Medical history (free text)
9. Drug history (free text)
10. Non-steroidal anti-inflammatory drug use (compound, reason, prescribed or self administered)
11. Septal anatomy (structured classification)
12. Alcohol history (structured classification)
13. History of upper respiratory tract infection
14. Location of bleeding vessel
15. Full blood count
16. Simplate bleeding time estimation (haemostasis study)

Control groups

For the studies investigating hypotheses **C**, **D** and **F** appropriate, non-epistaxis, control patients were selected from contemporaneous otolaryngology admissions. The controls were matched to patients for age, sex and time of admission. Controls with previous history of epistaxis were excluded. The control patients were suffering from otolaryngological conditions which had no known relationship to epistaxis (mainly otological and laryngological disease). The biodata and suitability for comparison of each of the control groups is discussed in the relevant chapters of the thesis (Chapters 4, 5 and 7).

Non- control aetiology studies

Hypotheses **A** and **B** were examined via prospective clinical and anatomical research which did not require control patients. Hypothesis **E** was tested with an in vivo test of haemostasis for which a normal reference range was available. This standard reference range obviated the need for control patients in this study.

Management studies

Patients studied in the management section of the thesis were not part of the database. Question **G** was investigated by a survey of accident and emergency department staff. Study **H** employed cadaveric and radiological techniques to investigate intranasal balloon catheters. Study **I** involved consecutive adult idiopathic epistaxis cases, who were randomly allocated to one of two treatment strategies. Thus in Study **I** both the patients and controls were suffering from idiopathic adult epistaxis.

1.5 Structure of thesis

The demography of the study group is presented in Chapter 2. Studies investigating questions and hypotheses **A** to **I**, are presented in chapters which conform to the basic structure of: **background, aims, patients and methods, results and discussion.**

SECTION 1:

THE AETIOLOGY OF ADULT IDIOPATHIC EPISTAXIS

Chapter 2

Demography of study group

"..in the year 1200 there was a great mortality of men, in the space of twenty four hours, in Tuscany and Romandiola, by a flux of blood from the nostrils."
(Morgagni 1761)

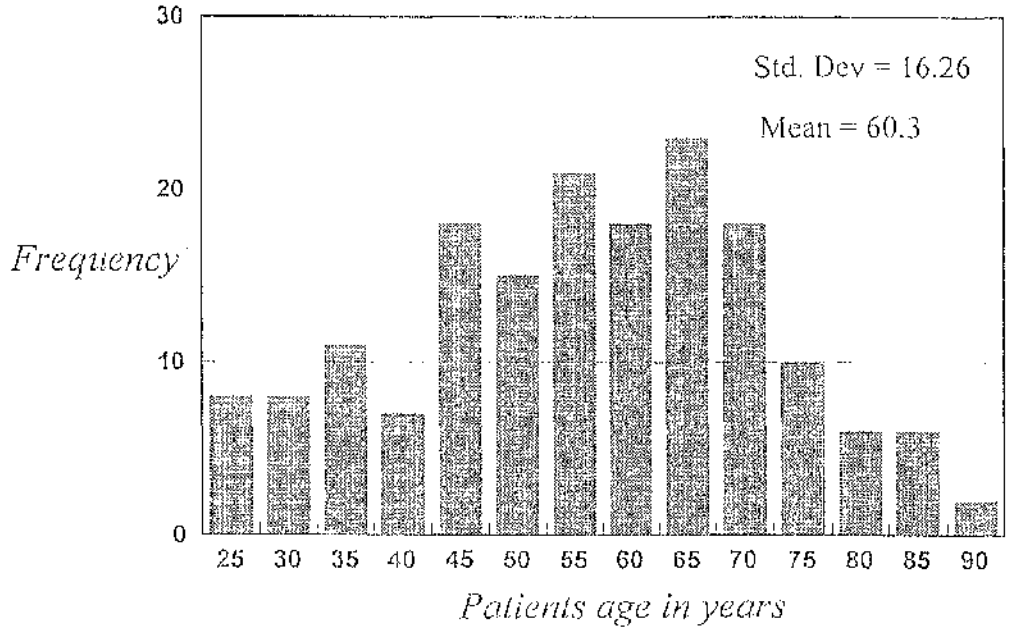
During the three year data accumulation period, 233 adult patients were admitted to the otolaryngology unit of Glasgow Royal Infirmary suffering from epistaxis. Glasgow Royal Infirmary has a population catchment area of 160,000 (Glasgow Royal Infirmary Trust Statistics Division) thus the annual incidence of admission for epistaxis was 36 per 100,000. This figure is similar to the annual admission rate of 29 per 100,000 quoted by Small and Maran (1982) based on a study of patients in the geographically adjacent Edinburgh area. Within the 233 admissions, 179 satisfied the entry criteria for the study (Table1.2). This group of ***idiopathic epistaxis*** patients represented 77% of the total admissions with epistaxis during the study period. The exclusion of 23% from the idiopathic category is consistent with the proportion of such patients reported by Stell (1977). The basic demography of the study group is presented below.

2.1 Age, sex, side of bleeding

The mean age of the study group was 60.3 years with a range of 23 to 93 years and a standard deviation of 16.2 years (**Figure 2.1**). This age distribution is very similar to that found by other authors studying adult epistaxis. For example Stell reported that the peak age of incidence was between 60 and 69 years and 71% of the patients studied by Juselius were older than 50 years (Juselius, 1974; Poulsen, 1984; Stell, 1977; Watson and Shenoi, 1990). There were 108 (60%) males and 71 (40%) females in the study group. Stell (1977) had commented on this apparent slight male predominance (60% male) as had Juselius (1974) (58% male) but other authors including Nunez et al (1988) and Small and Maran (1984) failed to find any sex difference (Juselius, 1974; Nunez et al, 1988; Small and Maran, 1984; Stell, 1977). Possible reasons for this slight male predominance are discussed in the chapters dealing with actiological factors.

Figure 2.1

Histogram of age of subjects studied



Side of bleeding

The side of bleeding was recorded for all patients (**Table 2.1**). In one case the side of bleeding was unknown due to the presence of a gross anterior septal deflection and brisk bleeding presenting in the nasopharynx. Patients (6%) who are recorded as bilateral epistaxis are explained by the observation that during a severe arterial epistaxis, blood will often pass into the nasopharynx and then out through both nostrils and the mouth. This appearance of bleeding through both nostrils is well recognised in clinical practice and is taken as an indication of the high rate and volume of haemorrhage. True simultaneous, bilateral idiopathic epistaxis, although theoretically possible, has never been reliably reported and in the authors view must be extremely rare. The absence of any side predilection (right 47%, left 46%) is consistent with previous published work and could perhaps be seen as further evidence against local nasal factors being important in the aetiology of the condition (Shaheen, 1967).

Table 2.1

Distribution of bleeding side in idiopathic epistaxis cases

Side of bleeding	% cases
Right	47
Left	46
Both	6
Unknown	1
	100

2.2 Duration of hospital stay

The length of time which an epistaxis patient spends in hospital is a function of the severity of the bleeding and of the efficacy and type of management strategy employed. For each of the study patients the duration of stay was calculated taking the date of admission and the date of discharge as full days. The purpose of recording this data was to assess the effects of different management strategies on in-patient stay. This subject is discussed in more detail in Chapter 11 where in-patient stay was an outcome variable in a study of two different management strategies.

The mean in-patient stay was 3 days with a range of 1-21 days and a standard deviation of 2.7. This mean is shorter than that found by Schaitkin et al, (1987) and other authors who report mean in-patient stays of between 5 and 6 days (Nunez et al, 1988; Poulsen, 1984; Schaitkin et al, 1987). The shorter mean stay in the Glasgow Royal Infirmary group may reflect the adoption of more effective treatment strategies following the findings of the study which is reported in Chapter 11. The prolonged hospital stay which occurred in some of the patients is, however, a reminder of the level of morbidity associated with adult epistaxis.

Chapter 3

The blood vessels involved in adult epistaxis

"..and having called to mind, that he had generally seen, in dissections, the blood vessels extremely turgid about that part where the alae nasi are join'd with the bone, about a fingers breadth, more or less, from the bottom of the nostrils; he began to suspect that the blood then flowed from those vessels".

(Morgagni, 1761)

3.1 Background

In order to manage adult epistaxis, the otolaryngologist must possess a clear understanding of the vascular anatomy of the nose. This knowledge is particularly important if direct forms of haemostasis are to be attempted. It is also essential for decision-making when traditional methods of treatment fail and ligation procedures are being considered. In addition, it is possible that an understanding of the vessels most commonly involved may provide insight into possible aetiological mechanisms.

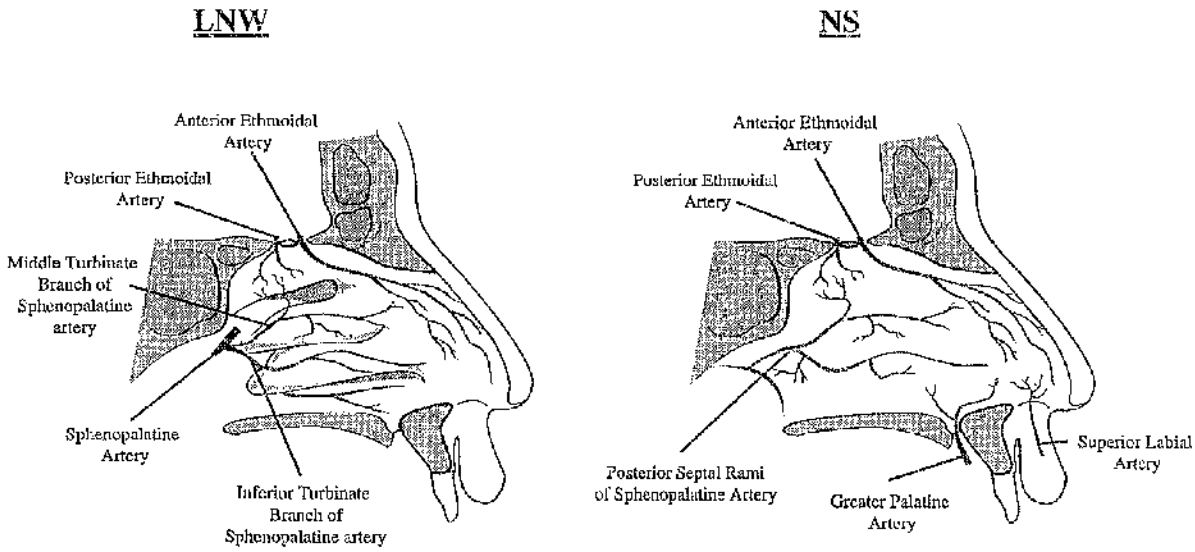
This chapter reviews the vascular anatomy of the nose and uses this as a framework for examining the following areas of clinical debate:

1. What is meant by the term ***posterior epistaxis***?
2. What is Woodruff's plexus and is it of importance in adult epistaxis?
3. Which blood vessels most frequently give rise to epistaxis?

3.2 The blood supply of the nose

Figure 3.1

Diagram of the arterial supply of the nasal cavity. Lateral Nasal Wall (LNW), Nasal Septum (NS).



Arterial supply

The arterial supply to the nose is derived from both the internal and external carotid arteries, via a system of branches which anastomose to form a plexus at the anterior inferior part of the nasal septum (Lepore, 1993; Shaheen, 1967; Zuckerkandl, 1892). This plexus of vessels on the anterior nasal septum was identified as a clinically important and frequent site of haemorrhage by the American physician James Little in the Hospital Gazette in 1879 and further commented upon one year later by the German physician Kiesselbach (McKenzie,

1914). As a result of these descriptions the area on the anterior part of the nasal septum, just behind the mid-point of the columella, is now known as Little's area or Kiesselbach's plexus.

Although reliable data does not exist it is widely held that the vast majority of nose bleeds arise in Little's area (Pearson, 1983; Stell, 1977; Josephson et al., 1991). Despite the frequency with which Little's area is the site of epistaxis, it is of relatively minor importance since effective management seldom poses a problem due to the ease of performing direct cautery in this area. Thus, although of overall numerical importance, bleeding from Little's area does not account for a high proportion of cases admitted to hospital. Bleeding from larger more posteriorly situated arteries is of greater clinical significance due to the rate and volume of blood loss and the difficulty associated with achieving haemostasis.

The vessels in Little's area in the anterior part of the nasal cavity are small and participate in a rich anastomotic network. In the posterior nasal cavity, however, the blood vessels are larger and anastomoses are less frequent, and the relative contributions of both the internal and external carotid systems are more identifiable. Because of this each of the carotid contributions should be considered separately.

The external carotid artery

The external carotid artery supplies the nasal cavity via the facial and maxillary arteries. The facial artery contribution is small supplying only the most anterior part of the nasal septum via the superior labial branch. The contribution from the

maxillary artery is more important and is delivered via the sphenopalatine artery and the greater palatine artery. The greater palatine artery is of similar importance to the facial artery, contributing only to the most anterior part of the nasal septum and alar region. The sphenoplatine branch of the maxillary artery is the largest of the nasal branches from the external carotid and is the principal supply to the nasal septum and lateral nasal wall.

The sphenopalatine artery enters the nasal cavity through the sphenopalatine foramen and immediately divides into posterior septal and posterior lateral divisions. The posterior lateral divisions in turn give rise to the inferior turbinate and middle turbinate arteries (Williams, 1995). The anatomy of these vessels was studied in detail by Howard Burnham (1935) who examined 2,400 anatomical sections of the lateral nasal wall and whose work remains the most definitive reference on this subject. In his monograph Burnham describes how the inferior and middle turbinate arteries, which are branches of the posterior-lateral division of the sphenopalatine artery, run for part of their course within bony tunnels in the turbinates. In a later work Shaheen (1967) postulated that these bony conduits could reduce the likelihood of these arteries being involved in epistaxis. The posterior septal branch of the sphenopalatine was previously referred to as the long sphenopalatine artery. This vessel supplies the nasal septum and takes an undulating course antero-inferiorly in the mucoperichondrium, without any *protective* bony conduit.

The internal carotid artery

The nasal contribution from the internal carotid artery is derived from the anterior and posterior ethmoidal branches of the ophthalmic artery. They arise from the ophthalmic artery within the orbit and run infero-medially through respectively named bony foramena to reach the nasal cavity in the region of the fovea ethmoidalis, high in the nasal vault. Having entered the nose the ethmoidal arteries branch to supply the septum and lateral nasal wall and form anastomoses with small branches from the terminal divisions of the sphenopalatine artery.

Internal and external carotid territories

The internal carotid artery supplies, via the ethmoidal vessels, a small area of nasal septum situated high in the nasal cavity and an adjoining area of the superior lateral nasal wall. The finding by Shaheen (1967) of a branch from the sphenopalatine artery to the superior meatus and superior turbinate is evidence that the area of nasal cavity which is supplied solely by the ethmoidal arteries is very small indeed. The remainder of the nasal septum and lateral nasal wall is supplied by the external carotid system via the sphenopalatine artery with a small contribution at the anterior part of the septum from the superior labial and greater palatine branches.

The relative importance of the external carotid (sphenopalatine) and internal carotid arteries (ethmoidal) in the blood supply of the nose was studied by Shaheen (1967). Using angiographic techniques and anatomical dissection, he showed that the area of nasal cavity supplied by the ethmoidal arteries was much

smaller than previously thought and that the anterior ethmoidal artery was absent in 14% of cadaver dissections. His conclusion that the internal carotid contribution is relatively unimportant was supported by the observation that the sphenopalatine artery is consistently the largest artery in the nasal cavity.

Venous drainage

The venous pathways of the nose follow the arterial vessels within the mucosa. The exception is the periarterial venous cuff surrounding the intra-osseus portions of the inferior and middle turbinate arteries. The veins drain through the sphenopalatine foramen to the pterygoid venous plexus and eventually to the internal jugular vein. In the anterior parts of the nasal cavity venous drainage follows the superior labial and greater palatine arteries to enter the facial vein and external jugular system

3.3 What is *posterior* epistaxis ?

Despite detailed knowledge of the vascular anatomy of the nose there is considerable disagreement over which vessels are most frequently involved in adult epistaxis. If we exclude those cases which arise anteriorly in the easily identified Little's area, we are left with bleeding which has previously been labelled as ***posterior*** epistaxis. This term posterior epistaxis is frequently used in the clinical setting to describe bleeding from a site behind Little's area and is often used to describe a bleeding point which has not been located during the course of examination and treatment.

Pearson (1983) attempted to standardise the use of the term posterior epistaxis by suggesting that it should be taken to imply an arterial bleeding point which could not be located despite examination of the nose using headlight illumination, vasoconstrictors and suction apparatus. While this definition is a clinically useful one a more robust definition could be to define nosebleeds as either arising from Little's area (anterior) or from other sites (posterior). Problems arise when using a *Little's area* based classification due to the imprecise nature of Little's area which has never been more accurately defined beyond descriptions of an area at the anterior inferior septum centred about half an inch from the lower border of the middle of the columella (McKenzie, 1914).

In an attempt to further standardise the use of the term ***posterior epistaxis***, the author has defined ***anterior*** epistaxis as that which arises from a bleeding point placed anterior to the plane of the piriform aperture. The term posterior epistaxis is

reserved for bleeding originating from the nasal cavity posterior to the piriform aperture. For the purpose of the study reported in this chapter this definition has been applied.

3.4 Woodruff's plexus

Another area of debate is the importance of what has become known as Woodruff's plexus (Pearson, 1983; Woodruff, 1949; Wurman, 1988). In 1949 Woodruff described a plexus of prominent blood vessels lying just inferior to the posterior end of the inferior turbinate. He commented on how this naso-nasopharygeal plexus was the most frequent site of adult epistaxis and described 14 cases of bleeding from this area (Woodruff, 1949). Woodruff observed that the plexus appeared to be a venous plexus but nonetheless thought it important in what was at that time know as *cardiovascular epistaxis* and is now know to be a condition associated with arterial bleeding. The plexus described by Woodruff is often seen during rod lens endoscopic examination of the nose but it is apparently a superficial venous plexus and is, therefore, unlikely to be of significance in adult, arterial epistaxis. **Figure 3.2** is an endoscopic photograph showing the site of Woodruff's plexus and this can be seen to be the same area shown diagrammatically by Woodruff (1949) in his initial publication **(Figure 3.3).**

Figure 3.2

Endoscopic photograph of Woodruff's plexus (right)

IT, inferior turbinate

NP, nasopharynx

WP, Woodruff's plexus

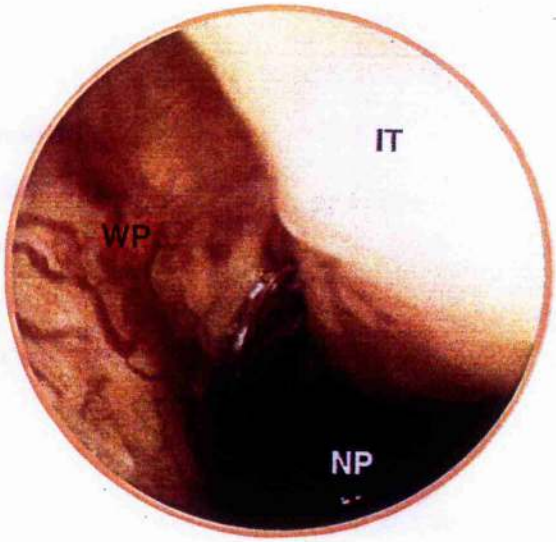
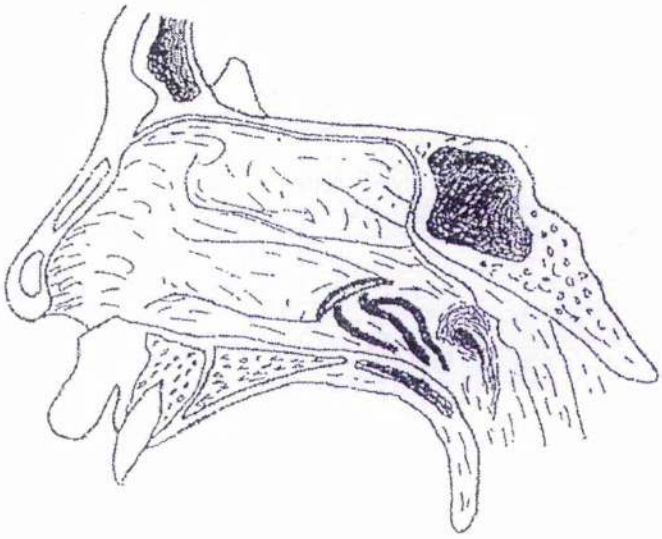


Figure 3.3

Diagram of Woodruff's plexus from the original publication. Reproduced with kind permission of Laryngoscope (Woodruff, 1949).



As a result of Woodruff"s publication, many authors in the American literature have seemed content to nominate Woodruff"s plexus as the principal source of posterior epistaxis despite the absence of any evidence to support this contention (Pearson, 1983; Lepore, 1993). Evidence for this unchallenged repetition of perceived wisdom can be seen in the poor understanding of the subject in major text books such as the 1993 edition of Head and Neck Surgery-Otolaryngology (Lepore, 1993). In this textbook Woodruff's plexus is described as a major site of epistaxis but erroneously placed in Little's area both in the text and in a diagram (Lepore, 1993).

Shaheen (1967) attempted to study and define Woodruff's plexus by anatomical dissection but he was unable to identify the plexus in naso-ethmoidal blocks. In an attempt to study this subject in more detail the author has collaborated in a study of Woodruff's plexus with Drs John Shaw-Dunn and Tor Chiu of the Department of Anatomy of the University of Glasgow. The author's involvement in this study was to raise the questions, initiate the investigation and act as supervisor to Dr Tor Chiu who carried out the microdissection and histology.

Method

Woodruff's plexus was studied in 18 cadaveric heads by anatomical microdissection and histological analysis. Six heads were injected using latex and Indian ink as part of whole body injections. Three of the heads were selectively injected through the external carotid artery and maxillary artery in order to ensure maximal perfusion of the nasal vasculature. The remaining nine heads were not

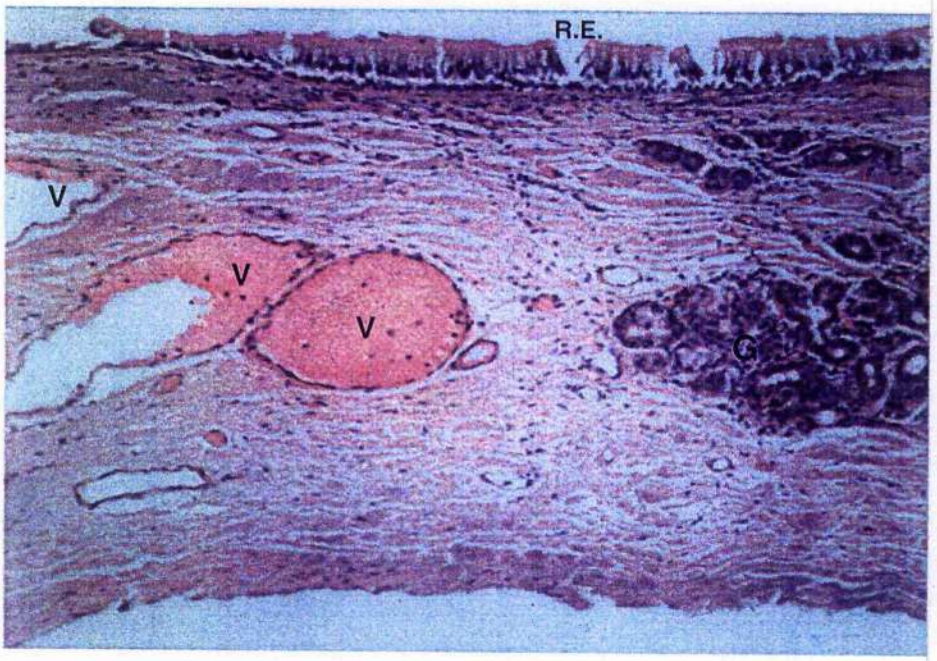
injected. Microdissection was performed using a Watson Barnet dissecting microscope at 25 times magnification.

Sections of lateral nasal wall in the region of Woodruff's plexus were harvested from four of the cadavers and from this material 14,000 microscopy sections were cut at 10 micrometers. The sections were stained using Haematoxylin and Eosin and examined using high and low power light microscopy by Dr Tor Chiu and Dr John Shaw-Dunn.

In the microdissected specimens a superficial vascular plexus was consistently observed in the region corresponding to Woodruff's initial description. This plexus consisted of fragile, superficially placed thin walled vessels. On histological examination a prominent, superficial vascular plexus was identified in all of the sections and in all cases this was a venous network without evidence of arterial or arteriolar structures. An example of the plexus of superficial veins is shown in **Figure 3.4**. This histological analysis confirms that the area known as Woodruff's plexus is, as suspected from endoscopy of live subjects, a plexus of large, superficial veins.

Figure 3.4

Haemotoxylin and Eosin section of mucosa in region of Woodruff's plexus (X38 magnification). **RE**, respiratory epithelium. **G**, glandular epithelium. **V**, large thin walled veins of Woodruff's plexus.



3.4 Which vessels give rise to posterior epistaxis?

If adult epistaxis is not a random event, and there are strong clinical reasons to believe that it is not, it is reasonable to assume that epistaxis will occur from some blood vessels within the nasal cavity more frequently than from others. If this assumption is true then a knowledge of the most frequently involved sites would facilitate bleeding point location for direct haemostasis and could also offer a rational framework for planning arterial ligation procedures.

In attempting to investigate this question numerous authors have recorded the locations of bleeding points in patients with epistaxis and have drawn conclusions on the relative frequency of certain sites of bleeding (Jackson, 1988; O'Leary Stickney et al, 1992; Padgham, 1990; Premchandra, 1991; Shaheen, 1967; Wurman, 1995). In general these studies have been poorly designed with inclusion of heterogeneous groups of patients such as post-traumatic nose bleeds and patients with bleeding disorders. In addition, the studies have used varying and often poorly described examination techniques which may have favoured identification of some bleeding points over others. The findings of these studies are frequently conflicting with some authors concluding that posterior epistaxis originates predominantly from the lateral nasal wall while others maintain that septal blood vessels are mainly responsible (Josephson et al, 1991; Premchandra, 1991).

Table 3.1 shows a summary of the existing work on this subject and it can be seen that the American authors claim posterior epistaxis arises mainly from the lateral nasal wall whilst the authors in the British literature point to the septum as the main site of bleeding.

Table 3.1

Site of bleeding from the literature

Author (year) (USA/UK)	Number of bleeding points studied	% Septal bleeding	% Lateral wall bleeding
Shaheen, 1967 (UK)	36	100	0
Padgham, 1990 (UK)	129	75	10
Premchandra, 1991(UK)	16	100	0
El Simily, 1993 (UK)	27	60	18
Rosnagle, 1973 (USA)	34	9	62
Anderson, 1982 (USA)	10	30	70
Jackson, 1988 (USA)	75	36	64
Wurman, 1988 (USA)	16	0	100
O'Leary, 1992 (USA)	5	20	80

3.5 Aims of study

This study aimed to identify and record the location of bleeding points in patients with posterior epistaxis.

3.6 Patients and methods

During a one year period all adult emergency admissions to Glasgow Royal Infirmary with idiopathic epistaxis were examined by the author with the intention of locating and recording the site of bleeding. Patients were examined in the normal course of management and in patients in whom a bleeding vessel could not be located using standard examination techniques a search for the bleeding point was made using a rod lens nasal endoscope.

Location of bleeding point

The location of the bleeding vessel was recorded using a scheme which divided the nasal cavity posterior to the piriform aperture into septum and lateral nasal wall. Further sub-classification divided the septum above or below the level of the free margin of the middle turbinate. The lateral nasal wall was divided into three regions; above the middle turbinate, below the middle turbinate and the lateral nasal wall below the inferior turbinate (including the inferior meatus and nasal floor). The scheme of recording was designed because it offered a simple unambiguous method of location which would provide sufficient information to allow the causal blood vessel to be identified from knowledge of nasal vascular anatomy e.g. above the middle turbinate is supplied by the sphenopalatine and

ethmoidal arteries, below the middle turbinate by the sphenopalatine artery alone and below the inferior turbinate by the greater palatine and sphenopalatine arteries. More traditional methods of subdividing the nasal cavum and nasal septum include the method described by Cottle but this method was not used as it has no relationship to underlying vascular territories and only subdivides the nasal septum (Hinderer, 1978).

3.7 Results

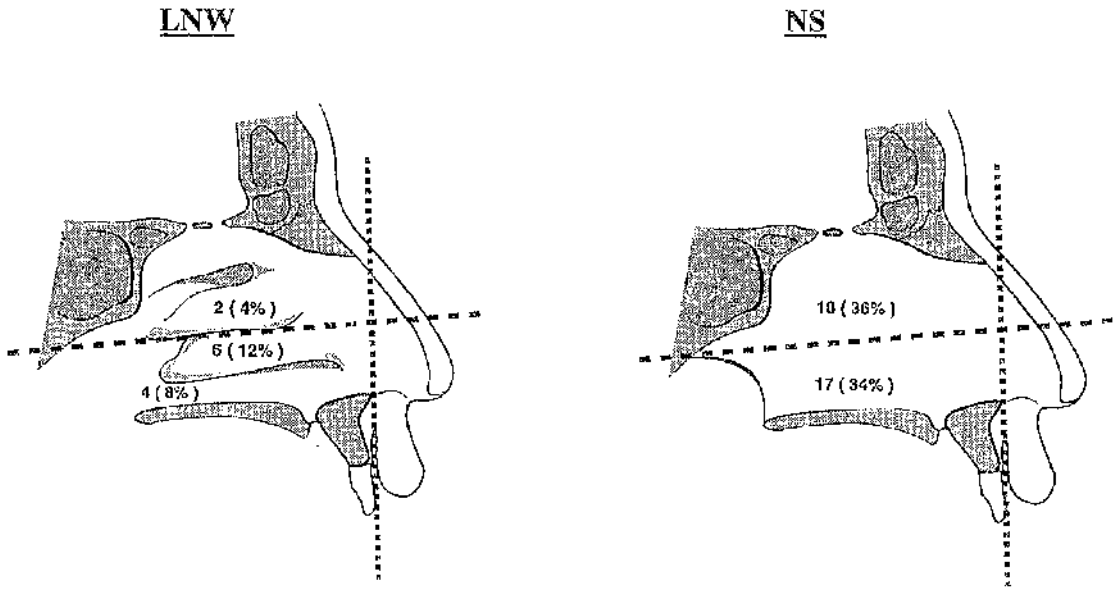
Sixty seven patients were admitted with idiopathic epistaxis during the one year study period and of these 15 (22%) were excluded because bleeding points were located anterior to the piriform aperture and 2 (3%) were excluded because the bleeding point arose from the margin of a septal perforation. The remaining 50 cases of posterior epistaxis constituted the study group.

Posterior epistaxis

The 50 cases of posterior epistaxis included 28 (56%) males and 22 (44%) females with a mean age of 64 years. 25 (50%) of patients were bleeding from the left nostril and 24 (48%) from the right, 1 (2%) patient was bleeding so briskly from both nostrils that the initiating side could not be assessed. Thirty five (70%) patients were bleeding from a septal blood vessel, 12 (24%) were bleeding from the lateral nasal wall and in 3 (6%) cases the site of bleeding could not be identified despite endoscopic examination. Eighteen (36%) septal bleeding points were above the level of the middle turbinate and 17 (34%) were located below the level of the middle turbinate. Lateral nasal wall bleeding points were predominantly below the level of the middle turbinate 10 (20%), although 2 bleeding points (4%) were also found above the level of the middle turbinate. **Figure 3.5** is a diagrammatic representation of the location of the posterior bleeding points and their relative frequencies.

Figure 3.5

Locations of bleeding points on the lateral nasal wall (LNW) and nasal septum (NS).



The apparent excess of bleeding points arising in the nasal septum (70%) compared to the lateral nasal wall or unlocated (30%), seemed unlikely to have occurred by chance. To determine whether this preponderance of septal bleeding points was due to random statistical variation, the results were compared against a null hypothesis that the septum should be involved in 50% of cases (i.e. 25 of 50) using a binomial test of proportions with two tailed significance. The results of this test showed that the proportion of septal bleeding points (35 of 50) differed from the null hypothesis at $p < 0.001$. Thus the predominance of septal bleeding points seems likely to be due to a true effect rather than chance.

3.8 Discussion

The most significant finding of this study is that posterior epistaxis arises predominantly from the nasal septum (70% of cases). This finding contrasts with much of the published literature on the subject but supports the findings of Shaheen (1967). In Shaheen's 1967 study, he personally examined 70 patients with epistaxis and failed to find a single lateral nasal wall bleeding point. Admittedly Shaheen did not have access to rod lens nasal endoscopes but his findings do add further weight to the hypothesis that the nasal septum is the main site of epistaxis in adults. The present data show that septal bleeding points are equally likely to occur on the upper part of the septum as the lower part. This finding is consistent with the anatomical observation that the principal artery of the nasal septum (the posterior septal rami of the sphenopalatine artery) runs an undulating course in the nasal mucoperichondrium, sometimes above the level of the middle turbinate and sometimes below (Shaheen,1967).

On the lateral nasal wall, the majority of bleeding points occurred below the level of the middle turbinate with only 4% being found on the upper lateral wall. Woodruff's plexus which includes the posterior part of the inferior turbinate and adjacent nasal floor, is responsible for only 8% of adult posterior epistaxis, a finding that is in marked contrast to the American literature already cited.

The distribution of bleeding points can perhaps be explained by reference to the calibre of the various branches of the sphenopalatine artery. The largest branch is the posterior septal artery and the second largest branch is the inferior turbinate

artery (Burnham, 1935). These were the two most frequent sites of haemorrhage in this study (70% and 20%). Thus the calibre of the blood vessels alone may in part explain why bleeding from the nasal septum is more frequent than bleeding from the lateral nasal wall and why on the lateral nasal wall, bleeding occurs more often from below the middle turbinate than from above.

This study has identified the sites of bleeding but has not attempted to explain why epistaxis should arise predominantly from the septum. It is possible that the mucosa surrounding arteries of the nasal septum is thinner than that surrounding the lateral nasal wall vessels and may consequently be more susceptible to atrophy caused by inflammation or mucosal drying. It may also be that the bony tunnels in which the lateral nasal wall vessels run for part of their course act to protect them and thus make them less likely to be involved in epistaxis (Burnham, 1935, Shaheen, 1967). The author is currently investigating these hypotheses in collaboration with researchers in the Department of Human Anatomy in the University of Glasgow.

Clinical importance

The finding that the septum is where most bleeding occurs is of value to clinicians managing epistaxis and it has now become the author's practice to first examine the septum in detail when looking for the source of a posterior bleed. This information is also of value when planning more radical surgical intervention such as arterial ligations. There is disagreement at present on whether the anterior ethmoidal artery, the sphenopalatine artery or both vessels should be ligated in intractable epistaxis (Stell, 1977; Poulsen, 1984). From this study it would appear that if a bleeding point cannot be located and haemostasis achieved, then ligation of the internal maxillary artery (sphenopalatine artery) should be carried out in preference to ligation of the anterior ethmoidal vessel. The importance of the septal branch of the sphenopalatine artery in epistaxis may also partly explain the reported success of submucosal resection of the nasal septum as a treatment in refractory posterior epistaxis (Cumberworth et al., 1991). The apparent advantages of performing a submucosal resection of the nasal septum for epistaxis are hard to explain if we accept the hypothesis that posterior epistaxis is a condition of the lateral nasal wall and are far more easily understood when we observe that the septum is the site of haemorrhage in the vast majority of cases.

Conclusion

This study has shown that the nasal septum is the site of predilection in adult posterior epistaxis. This implies that the posterior septal branch of the sphenopalatine artery is the principal vessel involved. What is not clear, however, is why nasal arteries should spontaneously rupture and the following chapters aim to address this question by examining possible aetiological agents which may predispose to epistaxis.

Chapter 4

Idiopathic epistaxis and alcohol

"...the first of whom, in an immoderate haemorrhage, drank such a quantity of beer that blood came from him chiefly watry (sic)."

(Morgagni, 1761)

4.1 Background

It is well known that patients with alcohol induced liver disease can present with severe arterial epistaxis as a result of thrombocytopaenia and hypertension (Ogura & Senturia, 1949). This presentation of epistaxis is a manifestation of the dyscrasia and coagulopathy which is associated with alcoholic liver disease and thus patients with evidence of alcoholism should be regarded separately from those with idiopathic epistaxis (Lepore, 1993). In a study aimed at addressing the underlying causes in adult epistaxis Jackson and Jackson (1988) reported that 30 out of 75 cases showed evidence of heavy ethanol abuse but their paper did not offer definitions for the levels of alcohol intake deserving of the term "heavy abuse". Similarly in another study which implicated alcoholism as an aetiological factor no details of alcohol history, platelet count or coagulation factor activity were given to support the diagnostic label (Poulsen, 1984).

While alcohol induced liver disease is accepted to be important in a small percentage of patients with epistaxis the potential wider effects of lower levels of alcohol intake are unknown. Until the present work the possibility that moderate

alcohol consumption may be associated with an increased risk of epistaxis had not been investigated. Support for the hypothesis that alcohol use may be associated with idiopathic epistaxis can be found in the growing evidence of profound cardiovascular and haemostatic effects which are produced by even moderate alcohol intake (Gronbaek et al., 1994; Hart and Cowan, 1974; Jalleh et al., 1993; Paunio et al., 1996; White, 1996).

4.2 Aims of study

This study aimed to investigate the possibility of an association between idiopathic epistaxis and the use of alcohol. A prospective case-control study was designed to compare the alcohol habits of idiopathic epistaxis patients with those of patients admitted for other otolaryngological conditions.

4.3 Patients and methods

The alcohol habits of 140 consecutive adult emergency admissions to the otolaryngology unit with idiopathic posterior epistaxis (Table 1.2) were compared with those of 113 control patients of similar age and sex. Controls were being treated as in-patients for otolaryngological conditions other than epistaxis. All patients were interviewed by an admitting doctor within 24 hours of admission and a questionnaire was used to record details of alcohol consumption.

Patients and controls were assigned to an alcohol intake category based on the following classification:-

a) **Non-drinkers**: Patients who reported total abstention from alcohol.

b) **Occasional drinkers**: Patients who consumed alcohol with a frequency of less than one occasion each week.

c) **Regular drinkers**: Patients who consumed alcohol on at least one occasion every week.

In addition to the above alcohol intake categories the actual amount of alcohol consumed by the subjects was recorded in units per week. This estimation was based on patient report of consumption for an average week. One unit of alcohol was regarded as the equivalent of one measure of spirits, one glass of wine or one half pint (284 ml) of beer (Dight, 1976). Whether the patient had consumed alcohol during the 24 hour period prior to admission was also recorded.

4.4 Results

Within the 140 epistaxis patients there were 79 (56%) males and 61 (44%) females. The mean age of the patient group was 54.5 years with a range of 23 to 93 years. The controls consisted of 113 patients, 65 (57%) males, 48 (42%) females, with a mean age of 56.4 years and a range from 21 to 92 years. The control in-patients were all suffering from otolaryngological conditions other than epistaxis including a range of otological, laryngological and other conditions such as trauma, neoplasia and infection .

The proportion of non-drinkers in the epistaxis patients was similar to that in the controls, 34% (47/140) *v* 35% (39/113), but the proportion of regular drinkers was significantly higher, 45% (63/140) *v* 30% (34/113), ($p<0.025$, Chi-squared test of proportions).

Epistaxis patients also consumed greater amounts of alcohol with a mean of 33 units per week compared with 7 units per week for controls. Because of the skewed distribution of alcohol consumption (**Table 4.1**) parametric statistical tests could be misleading. The groups were, therefore, compared for the amount of alcohol consumed using the Mann-Whitney U-Test which showed a significant difference $p<0.01$. This difference persisted when the non-drinkers were excluded and was apparent both for men and women, although men drank more units of alcohol than women both in the epistaxis and control groups. These differences in the frequency and amount of alcohol drunk were supported by the finding that epistaxis patients were significantly more likely than controls to have consumed

alcohol in the 24 hours preceding hospital admission ($p<0.01$, Chi-squared test of proportions). The results are summarised in **Table 4.1**.

Table 4.1

Comparison of 140 epistaxis cases and 113 controls by amount and frequency of alcohol consumption. Values are numbers (percentages) of patients and controls unless stated otherwise.

Alcohol consumption	Patients n=140 (%)	Controls n=113 (%)	Sig.
Non-drinkers	47 (34)	39 (35)	Ns
Occasional drinkers	30 (21)	40 (35)	Ns
Regular drinkers	63 (45)	24 (30)	p<0.025
Alcohol drunk within 24h	63 (45)	31 (27)	p<0.01
No.of units of alcohol per week			
Median	10.0	2.0	p<0.01
Interquartile range	0-50	0-10	

4.5 Discussion

This study confirms an association between regular alcohol consumption and adult idiopathic posterior epistaxis. The study was designed to provide a means by which the quantitative (units per week) and qualitative (temporal classification) aspects of alcohol history could be compared between patients and controls. Numerous previous studies of alcohol use have been performed in other branches of medicine but a single standardised method of recording alcohol history has not yet been adopted by all authors (Jalleh et al., 1993; Juvela, 1992; Marmot et al., 1994; Naik and Jones, 1994). The classification used in the present study was similar to that used by the Office of Population and Census Surveys in their study of Scottish population drinking habits (Dight, 1976).

Although it is true that self-reported histories of alcohol consumption may be open to response error it is generally accepted that the reliability of self-reported alcohol consumption is good (Camargo, 1989; Williams et al., 1985). Under reporting, either by error or deliberate concealment, of the amount consumed is a recognised problem in alcohol intake studies but in the present study the similarity (age, sex, admission to an otolaryngology unit) of the patient and control groups means that any inaccuracy is likely to be found in both patients and controls with a consequent reduction in bias (Alanko, 1988).

When comparing the alcohol history of patients and controls it is possible to introduce bias by selecting a control group with an unusually low level of alcohol intake. This potential source of bias was reduced by ensuring that the patients and

controls were similar in age and sex distribution and by interviewing both groups at the same time following hospital admission. Further evidence that the control group did not have an abnormally low level of alcohol consumption can be found in the work of Naik and Jones (1994) who recorded alcohol histories from elderly patients admitted to hospital with acute medical conditions. In their study Naik and Jones (1994) found a similar level of alcohol use to that found in the author's non-epistaxis controls with an almost identical mean consumption of 6.6 units per week. It is likely, therefore, that if the epistaxis cases had been compared with controls derived from acute medical admissions the association would still have been confirmed.

The finding of an association between epistaxis and alcohol does not necessarily imply causation but as already stated there are potential mechanisms which could explain the link. As discussed in the preceding chapters the adult form of epistaxis is a condition typified by sudden arterial rupture followed by continued, often severe, bleeding which may prove difficult to control. Among the many systemic conditions which are known to cause epistaxis, disorders of the haemostatic and cardiovascular systems are frequent (Lepore, 1993). Whilst none of the patients in the present study were suffering from blood dyscrasias or coagulopathy there is growing evidence that even low level use of alcohol may be associated with subclinical but potentially important haemostatic and haemodynamic effects (Gronbaek et al., 1994; Hart & Cowan, 1974; Klatsky et al., 1977; Marmot et al., 1994).

Regular alcohol use reduces platelet aggregation and may prolong the bleeding time, an effect which is believed to be important in the aetiology of haemorrhagic stroke [subarachnoid haemorrhage] (Hart & Cowan, 1974; Hillbom & Kaste, 1982). These haemostatic effects coupled to alcohol induced haemodynamic alterations such as vasodilatation and blood pressure changes may be important in causing some cases of arterial epistaxis (Marmot et al, 1994). The association with alcohol may also in part explain the observed excess of male epistaxis cases, since as a group males exhibit higher and more frequent levels of alcohol intake.

It is apparent that existing knowledge of the anti-haemostatic effects of alcohol could offer a possible explanation for the observed association between alcohol use and adult epistaxis. Evidence for such a mechanism and the potential importance of the anti-haemostatic effect of various levels of alcohol use is the subject of the study reported in Chapter 6.

Conclusion

In summary this case-control study is the first to show an association between regular alcohol use and adult idiopathic posterior epistaxis. Epistaxis patients consumed more alcohol and did so more regularly than controls and were more likely to have consumed alcohol 24 hours before admission. The possible mechanisms of the association may include the haemostatic and haemodynamic alterations produced by alcohol use and this is investigated further in the following chapters. While the cause of idiopathic epistaxis is likely to be multifactorial the importance of alcohol should not be overlooked and a detailed alcohol history should be obtained from every patient.

Chapter 5

Non-steroidal anti-inflammatory drugs in adult epistaxis

"And this you will believe so much the more, of other both internal and external remedies, when you have read, that so many, of both kinds, have been frequently applied by physicians in vain; and in particular by Lentilius, who prudently declares, that the different causes of haemorrhages, in different cases, are to be consider'd."

(Morgagni, 1761)

Section 5. 1 Background

Non-steroidal anti-inflammatory drugs (NSAID) are a group of aspirin-like medications which have wide application in medicine. The various compounds have potent analgesic and anti-inflammatory actions and, although there are minor differences in their pharmacokinetics, they exert their effect by a common mechanism. This common mode of action of NSAIDs is thought to involve the inhibition of prostaglandin synthesis by blocking of the enzyme cyclo-oxygenase (Orme, 1990).

Although widely used and hugely beneficial, NSAIDs have a high incidence of adverse effects (Orme, 1990). These side effects range from major life-threatening effects to more frequent minor adverse reactions. The most frequent major adverse effect is gastrointestinal ulceration which is thought to be due in part to reduction

of mucosal cytoprotective layers in the stomach (Faulkner et al 1988; Henry et al, 1996).

Many of the minor adverse effects of NSAIDs are due to an increased risk of haemorrhage which is a direct result of the effect of these compounds on platelet membrane physiology. NSAID's inhibit platelet aggregation and consequently cause disordered haemostasis which can be exhibited either as minor bruising or more seriously as gastrointestinal haemorrhage (Hardisty & Caen 1987; Watson & Shenoi 1990). Indeed this effect of NSAID on the platelet membrane is the rational basis for the widespread use of aspirin as an anti-thrombotic, cardiovascular prophylactic.

Clinical case reports and anecdote have suggested that the platelet inhibiting effects of non-steroidal anti-inflammatory drugs could possibly be important in the aetiology of adult pattern epistaxis. The proposed mechanism of association is similar to that suggested for alcohol in the preceding chapter. Proof of an association between NSAID's and an increased risk of epistaxis would be important as these drugs are widely used and freely available in many proprietary medications.

Section 5.2 Aims

The aim of the study was to examine the frequency and patterns of NSAID use in patients with adult idiopathic epistaxis and to compare the findings with those in a control group.

Section 5.3 Patients and methods

Using a prospective case-control design, adult idiopathic epistaxis admissions to Glasgow Royal Infirmary were studied and compared with control subjects undergoing treatment for other otolaryngological conditions. The usual exclusion criteria were applied to identify the idiopathic subgroup of posterior epistaxis patients (Table1.2). An administered questionnaire was used to record the history of NSAID use and whether the medication was prescribed by a General Practitioner (GP) or self-administered. The particular medication used and the reported reason for use were also recorded. Controls were subjects who, in addition to undergoing treatment for other otolaryngological conditions, had no previous history of epistaxis.

Section 5.4 Results

Prevalence of NSAID use

126 adult emergency admissions with idiopathic epistaxis were studied (75 (59%) male, 51 (41%) female). The mean age of patients was 60 years with a range from 23-95 years. The control group consisted of 122 patients, 71 (58%) male, 51 (41%) female, with a mean age of 58 years and a range from 22-93 years.

55 (44%) of the epistaxis patients reported use of non-steroidal anti-inflammatory drugs compared to 23 (19%) of the controls. The apparent excess of patients using non-steroidal anti-inflammatory drugs was examined statistically and the difference was found to be significant ($p<0.001$, Chi-squared test of proportions).

Patterns of NSAID use

Of the 55 epistaxis patients who took non-steroidal anti-inflammatory drugs, 34 (62%) were taking these medications on the advice of a general practitioner. The remaining 21 (38%) patients were self-medicating with proprietary aspirin compounds.

In the control group, of the 23 patients who were taking non-steroidal anti-inflammatory drugs, 15 (65%) were taking prescribed medications with 8 (35%) using self-administered proprietary compounds. There was no statistically significant difference in the incidence of use of general practitioner prescribed medications between the patients and controls ($p=0.45$, Chi-squared test of proportions).

Patient reported reasons for use of non-steroidal anti-inflammatory drugs were coded under the following headings:-

Arthritis

Cardiovascular prophylaxis

Upper respiratory tract infection

Self-administered other (including headache, etc.)

Rheumatism

The frequency of non-steroidal use in each of the categories is shown in **Table 5.1**. It can be seen that the reasons for use of the compounds were broadly similar in both patient and control groups.

Table 5.1

Frequency of reasons for NSAID use

Reason	Patients		Controls	
	n	(%)	n	(%)
Arthritis	15	(27)	6	(26)
CVS Prophylaxis	22	(40)	12	(52)
URTI	3	(6)	-	
Self-admin. other	14	(25)	4	(17)
Rheumatism	1	(2)	1	(5)
Totals using NSAID	55	(100)	23	(100)

Overall, GP prescriptions account for 62% of non-steroidal anti-inflammatory drug use in epistaxis patients. The commonest single reason for this is the prescription of aspirin for cardiovascular prophylaxis. Indeed, aspirin was the main NSAID, being used by 73% of the NSAID positive patients and 74% of the NSAID positive controls. The use of non-aspirin NSAIDs was almost identical in both the patient and control group (26% *v* 27%).

NSAID and Alcohol

Use of NSAID and alcohol have each been independently shown to be related to epistaxis. To investigate the possibility that the use of these compounds may co-vary or that one may be a surrogate of the other, NSAID and alcohol data were analysed for 200 epistaxis patients.

One hundred and nineteen (60%) patients were male and 81 (40%) female, the mean age was 60 years (SD 16 years). Patients were classified on the basis of alcohol consumption as drinkers or non-drinkers and on the basis of NSAID history as NSAID users or non-users. One hundred and thirty six (68%) were drinkers and 64 (32%) were non-drinkers. Seventy nine (40%) were NSAID users and 121 (60%) were non-users. The possibility of a relationship between alcohol and NSAID use was investigated using a table of proportions and no significant difference was found between drinkers and non-drinkers in the use of NSAID (Chi-squared =1.034, 1 df, p = 0.309, not significant).

This finding suggests that alcohol and NSAID use are independant variables, an observation which is supported by the absence of any literature to suggest the contrary. The interactions between alcohol and NSAID and the haemostatic mechanisms in epistaxis is discussed in detail in Chapter 6.

Section 5.5 Discussion

This case control study clearly shows a statistically significant excess of NSAID use in patients with epistaxis compared to age and sex matched controls. This finding confirms a previous paper on the subject by Watson and Shenoi (1990) and supports the growing number of published case reports suggesting a link between non-steroidal anti-inflammatory drugs and epistaxis (Akama et al 1990).

The methodology employed in this study aimed to compare the frequency of NSAID use in patients with that of a control group. The observed excess of NSAID use in patients with epistaxis was interpreted in the light of existing knowledge of NSAID action to imply a possible aetiological association. It would, however, have been better to have conducted a prospective study of the incidence of epistaxis in a cohort of NSAID users and compared this to the incidence of epistaxis in a matched cohort of non-users of NSAID. However with an estimated annual incidence of epistaxis of between 25 and 30 per 100,000 per year, in order to detect a clinically significant increase in incidence of epistaxis in NSAID users the study would require the follow-up of clinically impracticable numbers of subjects for a very long period of time .

By analysing the patterns of non-steroidal use in the present study group, we are able to address some of the questions raised by Watson and Shenoi in their 1990 paper on the same subject. In particular, it had been suggested in that paper that since NSAID medications were often taken for arthritis, it was possible that the underlying reason for epistaxis was the arthritis and not the medication itself. As

there is no statistically significant difference in the prevalence of arthritis in patients and controls in the present study, such an explanation for the observed association seems unlikely.

The findings on the Glasgow Royal Infirmary study group point to aspirin as being the main NSAID used by both patients and controls. The aspirin molecule is the basis of most NSAID compounds and it is known to have the most profound effects on platelet membrane physiology. The anti-platelet effects of aspirin are irreversible and the effect on haemostasis is only reduced when sufficient numbers of new platelets have been synthesised (Ten Cate & Jenkins, 1980; Watson & Shenoi, 1990).

Aspirin is a readily available over-the-counter medication and is widely consumed, often unknowingly, as a component of many proprietary medications. Ibuprofen, a propionic acid derived NSAID, has recently become available for over-the-counter sales in pharmacies and has been incorporated into a number of analgesic and "cold" remedies. At present, many of these proprietary medications list gastrointestinal ulceration as a contra-indication to their use but none mention epistaxis. As over a third of all non-steroidal use by patients and controls was in the self-administered category, it may become important to inform the general self-medicating public that the potential haemorrhagic risks associated with taking these compounds could include severe epistaxis.

Chapter 6

Occult haemostatic abnormalities in idiopathic epistaxis

"..the blood on account of its watry or acrid disposition, very easily finds or makes an exit for itself in the nose".

(Morgagni, 1761)

6.1 Background

In the preceding chapters a strong association has been found between idiopathic posterior epistaxis and the antiplatelet agents alcohol and NSAID. The proposed mechanism for this association relies on the critical importance of platelet function in primary haemostasis and the hypothesis that induced platelet dysfunction may lead to conditions which predispose to epistaxis. To date, however, evidence for the existence of previously undiagnosed or ***Occult*** haemostatic abnormalities in idiopathic epistaxis is lacking. Previous authors have attempted to identify haematological abnormalities by recording *in vitro* coagulation factor activity and platelet numbers but they have failed to find abnormalities in adults with idiopathic epistaxis (Jackson & Jackson, 1988; Smith et al, 1988). However such studies of platelet numbers and coagulation factor activity only measure individual components of the haemostatic system and not the overall haemostatic process.

Haemostasis

The process of haemostasis involves a complex series of interactions between blood platelets, the coagulation cascade and the blood vessel wall. Thus abnormalities may be a result of dysfunction in one or more of the component parts of the system (Hoffbrandt & Pettit, 1984). In order, therefore, to test the haemostatic system a more holistic test of overall function is desired. For the purposes of the present study the Simplate® device was chosen as a means of testing haemostatic function (Simplate, Organon Teknika Ltd.).

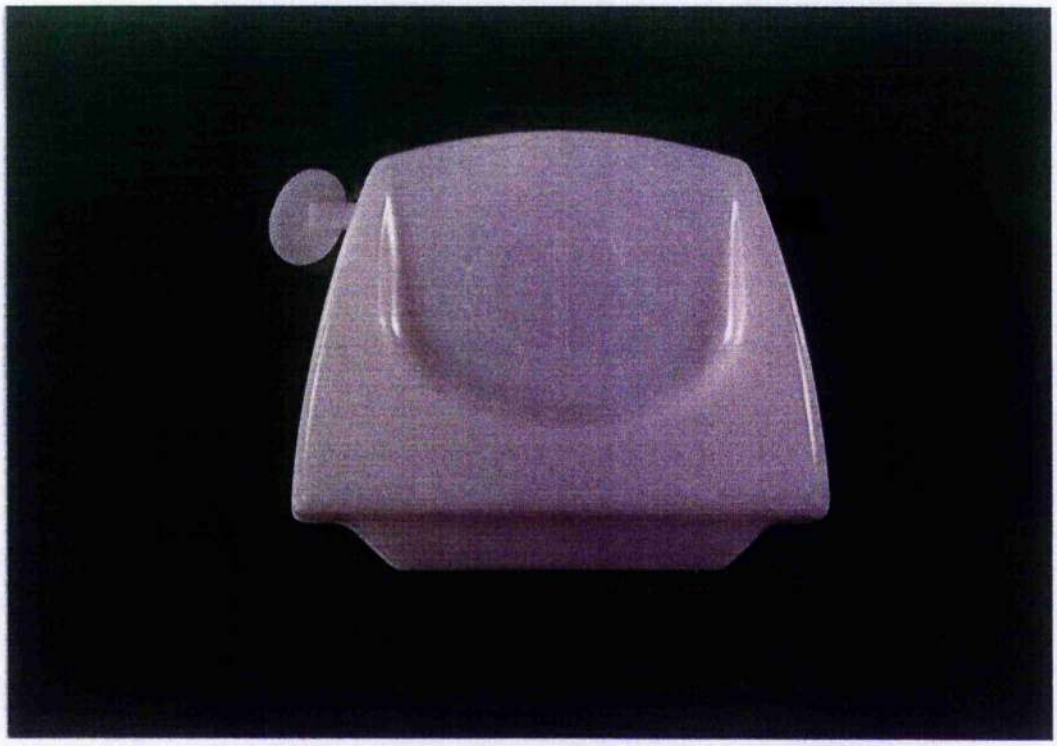
The Simplate bleeding time test

The bleeding time is a sensitive and reliable haemostatic test which relies on the measurement of the time elapsed after infliction of a standardised incision and the cessation of bleeding (Ten Cate & Jenkins, 1980). The Simplate device and test procedure is a standardised modification of the Ivy and Mielke methods of bleeding time estimation which due to its uniformity has greatly improved the level of repeatability and sensitivity of bleeding time testing (Blake et al, 1990; Poller et al, 1984; Ten Cate & Jenkins, 1980). The Simplate is a disposable instrument which when triggered makes a 5mm long, 1mm deep incision on the forearm (**Figure 6.1**). The test measures the time elapsed to haemostasis during a period of venous occlusion produced by a sphygmomanometer cuff inflated to 40 mm Hg.

The expected normal range of bleeding time with the Simplate method is 2.5 to 9.5 minutes. Some laboratories use an upper limit of normal of 7 minutes and others use 10.5 minutes as the threshold for abnormal haemostasis (Poller et al, 1984). The commonest normal upper limit is between 9 and 10 minutes but for the purposes of this study, in order to avoid overestimating the incidence of haemostatic abnormalities, 10.5 minutes was chosen as the upper limit.

Figure 6.1

Photograph of the Simplate device (actual dimensions 30mm x 25mm)



6.2 Aims of study

This study aimed to evaluate haemostatic function in patients with idiopathic posterior epistaxis and to examine possible relationships between alcohol and NSAID use and haemostatic abnormality.

6.3 Patients and methods

50 consecutive adult emergency admissions with idiopathic posterior epistaxis were studied. For each case an administered questionnaire was used to record clinical data and information on the patient's use of known antiplatelet agents such as alcohol and NSAID. Within 24 hours of admission patients were interviewed and a structured alcohol history was obtained, recording the quantitative and temporal details of alcohol use as described in Chapter 4.

In addition to the recording of alcohol history, details of NSAID use were noted including compound used, reason for use and whether prescribed or self-administered as in Chapter 5. Within 36 hours of admission each patient underwent haemostatic testing using the Simplate bleeding time device. As the procedure involved slight discomfort, similar to venepuncture, informed patient consent was obtained and recorded in the case records.

6.4 Results

The study group consisted of 50 patients, 28 (56%) males and 22 (44%) females. The age range was 30 to 93 years with a mean of 64 years. The Simplate bleeding time was less than 10.5 minutes (normal) in 27 (54%) patients and 10.5 minutes or longer (abnormal) in 23 (46%) patients. The mean Simplate time for the group was 10.1 minutes with a standard deviation of 4.1 minutes and a range of 4 to 21.5 minutes. This data conformed well to a normal distribution exhibiting a median of 9.8 minutes and an Interquartile range of 7.4 to 11.5 minutes. This finding of an abnormal bleeding time duration in 46% of patients supports the hypothesis that haemostatic abnormalities are frequent in idiopathic epistaxis.

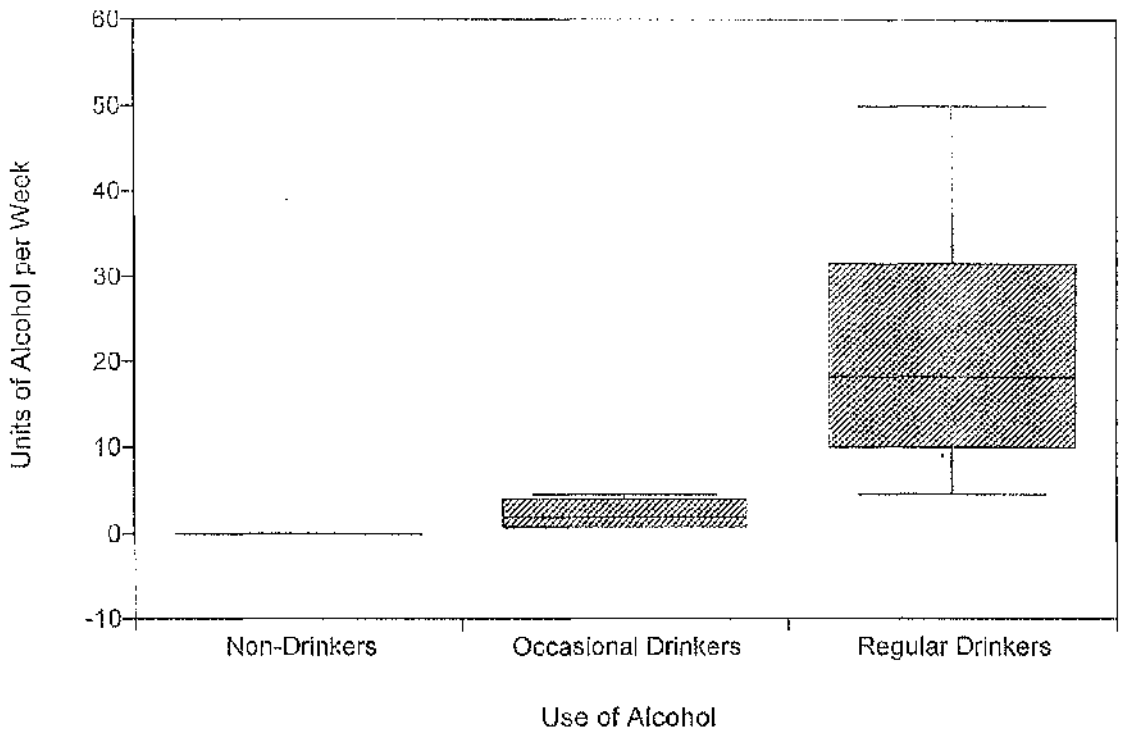
Alcohol history recording revealed that 10 (20%) subjects were non-drinkers, 17 (34%) were occasional drinkers and 23 (46%) were regular drinkers. This is a similar proportion of regular drinkers to that found in Chapter 4. The mean weekly alcohol consumption was 11.3 units with a standard deviation of 13.8 with a range from 0 to 50 units. This distribution of alcohol consumption is not Gaussian and is thus better described in terms of a median of 5 units per week, a 25th percentile of 1 unit and a 75th percentile of 16 units.

The method of alcohol history recording used in the study allowed analysis of both the temporal (alcohol category) and quantitative (units per week) aspects of alcohol use. It is not necessarily the case that the two measures of alcohol use give identical results and thus the relationship between alcohol category and weekly consumption was investigated in more detail. **Figure 6.2** is a box plot showing the

relationship between the two ways of classification and it can be seen that there is a high degree of concordance between the two systems. This agreement between the two classifications provides a measure of the internal consistency of the data. The interactions between the data for alcohol use, NSAID use and Simplate time were examined using a number of univariate and multivariate analysis techniques and the results are discussed below.

Figure 6.2

Plot showing relationship between alcohol category based on pattern of intake (x-axis) and weekly alcohol consumption (y-axis). The median is shown by a solid horizontal line, the shaded box represents the Interquartile range and the 'whiskers' enclose the range.



Effect of alcohol on bleeding time duration

Separate univariate analyses were performed to investigate the effect of alcohol category (non-drinker, occasional drinker, regular drinker) and alcohol consumption in units per week on the Simplate time. **Figure 6.3** is a box plot showing the relationship between bleeding time and alcohol category. The results suggest an increased bleeding time in the occasional drinkers when compared to the non-drinkers and regular drinkers. **Figure 6.4** is a similar plot this time produced by analysing the data in terms of units per week. For this analysis patients were split into the following subgroups;

a) 0 units per week.

b) 1-10 units per week.

c) Greater than 10 units per week.

This method of analysis confirms the prolongation of the bleeding time in the middle (1-10 units per week) group but in addition suggests an elevation of the bleeding time in the greater than 10 units per week group.

Figure 6.3

Plot showing the relationship between use of alcohol (x-axis) and duration of bleeding time in minutes (y-axis). The median is shown by a solid horizontal line, the shaded box represents the Interquartile range and the 'whiskers' enclose the range.

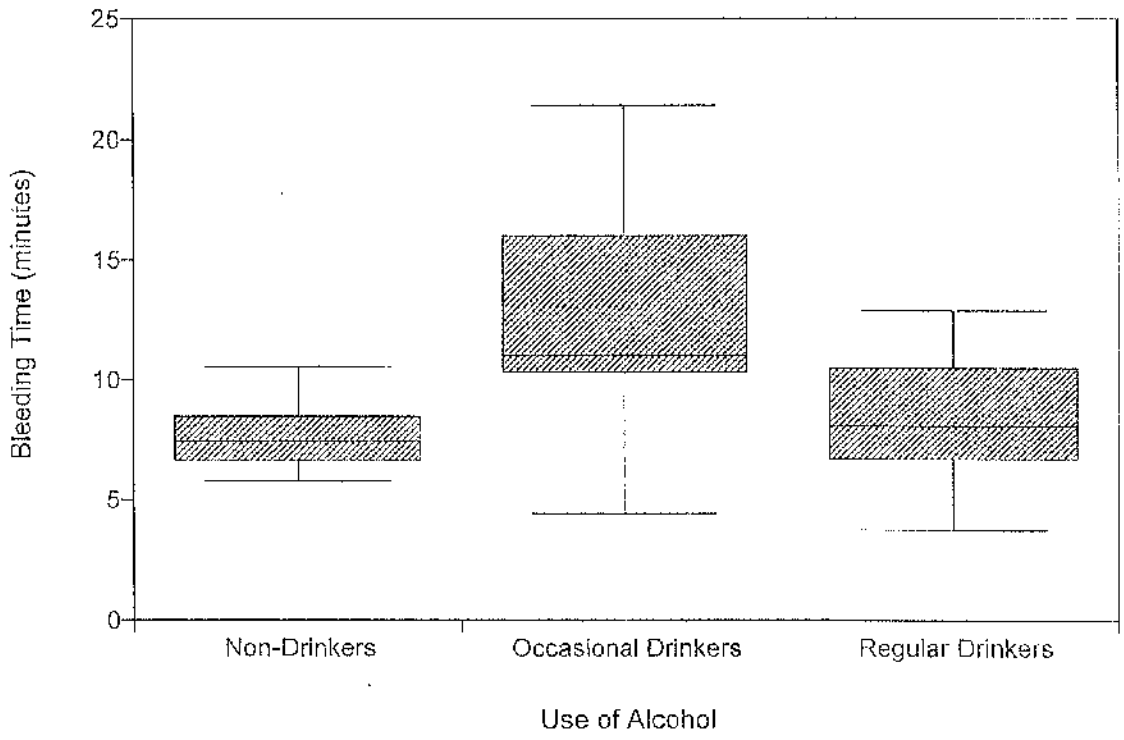
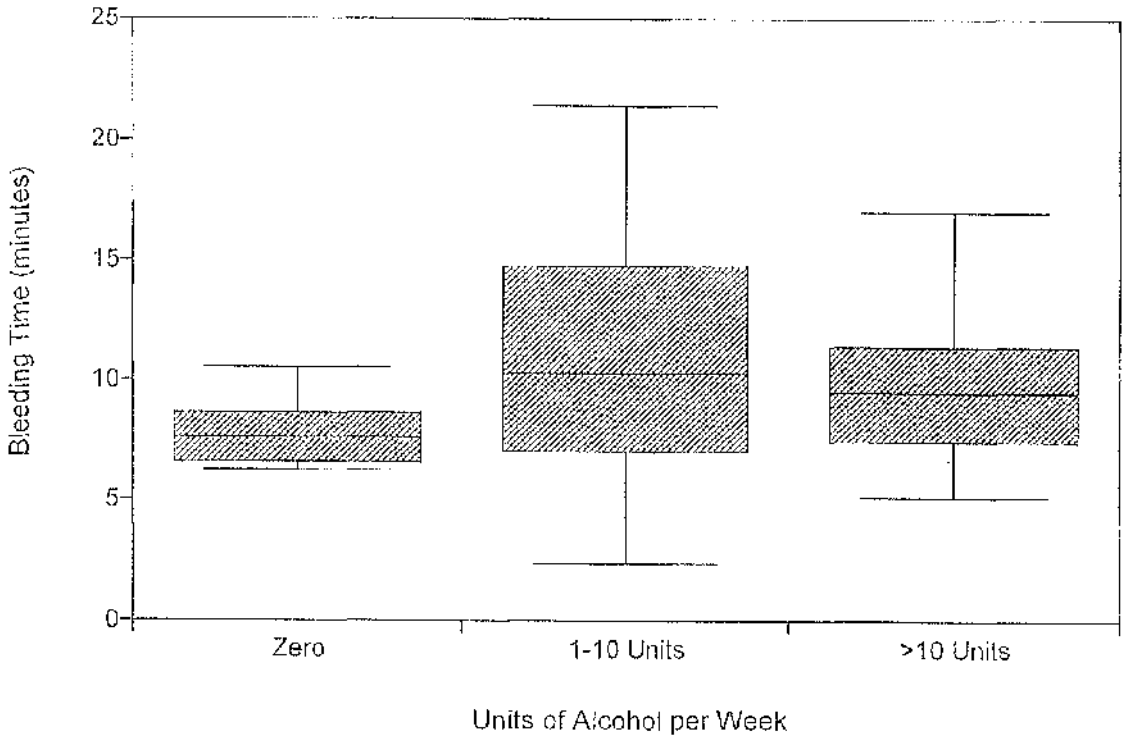


Figure 6.4

Plot showing the relationship between level of alcohol intake in units per week (x-axis) and the duration of bleeding time in minutes (y-axis). The median is shown by a solid horizontal line, the shaded box represents the Interquartile range and the 'whiskers' enclose the range.



Effect of NSAID use on bleeding time

29 (58%) of patients gave no history of NSAID use whilst 21 (42%) were currently using NSAID preparations. This figure of 42% NSAID use is consistent with that found by other authors on this subject (Watson and Shenoi, 1990). The most frequently used medication was aspirin (72%) with other non-steroidals such as Diclofenac and Fluribiprofen accounting for the remainder. Overall 39% of NSAID use was attributed to self-administered medication and this was exclusively aspirin. Patients were classified as users or non-users of NSAID and the Simplate bleeding time was re-examined in a method similar to that used for alcohol category. No significant effect was found in bleeding time duration between the users and non-users of NSAID.

Multivariate data analysis

The data were further investigated using a multivariate analysis of variance with the Simplate time as the dependent variable and alcohol category and NSAID use as factors. For the analysis, alcohol category was set as the reference category and parameter estimates were derived relative to that baseline. The analysis of variance showed a highly significant effect ($p<0.001$) for alcohol category but no significant effect for NSAID use. The parameter estimate for occasional drinkers compared to non-drinkers showed an increase in the Simplate time of 5.3 minutes (95% confidence interval, 2.4 minutes to 8.1 minutes, $T=3.74$, $p<0.001$). When comparing non-drinkers to regular drinkers a parameter estimate of 1.1 minutes was found (confidence intervals 1.6 minutes to 3.84 minutes, not significant). The possible explanations for the greater effect being present in the occasional drinkers are examined in the discussion section.

Another way to examine the data is to classify the Simplate time as either normal (<10.5 minutes) or abnormal (>10.5 minutes). If this binomial method of analysis is used only 10% of the non-drinkers have an abnormal bleeding time whilst 82% of the occasional drinkers and 35% of the regular drinkers exhibit an abnormal bleeding time. Using this approach a logistical regression analysis was performed and this confirmed the highly significant effect of alcohol upon bleeding time duration ($p<0.0001$). The logistical regression revealed an odds ratio of 42 for an abnormal bleeding time in the occasional drinkers compared to the non-drinkers. These findings were confirmed when the analysis was repeated using units per week as the dependent variable.

6.5 Discussion

As discussed earlier, the possibility that abnormalities of haemostasis may be important in idiopathic adult posterior epistaxis has not previously been investigated. Previously authors had investigated various haematological parameters concentrating on the search for unsuspected abnormalities of the coagulation system or undiagnosed thrombocytopaenia (Jackson & Jackson, 1988; Smith et al, 1988). The findings of these studies have suggested that abnormalities only occur in patients in whom such abnormalities would have been suspected on clinical grounds i.e. not those patients within the idiopathic subgroup. Haemostasis is a complex mechanism which relies on the interaction of an adequate number of correctly functioning platelets which in turn will lead to a sequence of events resulting in blood vessel contraction and activation of the coagulation cascade. It is well recognised that haemostatic function may be deranged despite a normal platelet count and normal coagulation factor activity (Blake et al, 1990). The knowledge that individuals with normal platelet counts may have abnormal haemostasis coupled with the growing evidence of an association between antiplatelet agents and idiopathic epistaxis (Chapters 3 and 4) prompted this investigation of in vivo haemostatic function in adults with idiopathic epistaxis.

The single most significant finding of this study is that 46% of adults with idiopathic epistaxis exhibited an abnormality of haemostasis reflected in a prolongation of the Simplate bleeding time. As individuals with thrombocytopaenia were excluded from this study the most likely explanation for

this haemostatic defect is altered platelet function although abnormalities of the blood vessel wall cannot be ruled out by this study design. The evidence for induced platelet function abnormalities would suggest a role for both alcohol and NSAID in the aetiology of these abnormalities (Chapters 3 and 4) (Watson & Shenoi, 1990).

Alcohol in particular exerts profound effects on platelet aggregation mechanisms by reducing the activity of platelet cyclic adenosine monophosphate (cAMP) and decreasing thromboxane synthesis (Hardisty & Caen, 1987). These antiplatelet effects of alcohol are dose related and are present at low levels of consumption (Hart & Cowan, 1974). Ingestion of alcohol reduces platelet aggregation in response to the addition of adenosine diphosphate (ADP) and this effect is thought to be responsible for the reduction in thrombotic cardiovascular mortality which is associated with moderate alcohol consumption (Doll et al, 1994; Renaud & De Lorgeril, 1992).

The anti-thrombotic effects of alcohol are not always beneficial and alcohol-induced platelet dysfunction has been implicated as a risk factor in haemorrhagic stroke and in re-bleeding following aneurysmal subarachnoid haemorrhage (Camargo, 1989; Juvela, 1992). This association between alcohol and subarachnoid haemorrhage is of interest to those studying the aetiology of idiopathic epistaxis as the interaction between haemostatic and haemodynamic factors involved may be similar to those which produce epistaxis. Alcohol is known to produce a rise in blood pressure and it is possible that in some cases of epistaxis this may be the initiating factor that leads to arterial rupture. Once

bleeding has been initiated a background level of alcohol-induced platelet dysfunction may be sufficient to impair the formation of the platelet plug or inhibit the platelet release reaction. This level of haemostatic impairment could in turn allow the bleeding to continue with the result that hospital treatment becomes necessary.

Thus, from our knowledge of the effects of alcohol, it is easy to interpret the observed interaction with bleeding time. It is, however, more difficult to explain the observation that the most significant effects occurred in the occasional drinkers consuming intermediate (1 to 10 units per week) amounts of alcohol. A possible explanation could be that alcohol has an optimal dose range for the production of antiplatelet effects but there is no literature support for such a hypothesis. Indeed the antiplatelet action of alcohol is thought to be dose related and this would, therefore, rule out such an explanation (Renaud & De Lorgeril, 1992). Alcohol may be exerting effects on the other aspects of the haemostatic equation, namely the fibrinogen and fibrinolytic mechanisms and thus it may be that these aspects of alcohol's anti-haemostatic activity are greatest at intermediate dose levels (Renaud & De Lorgeril, 1992).

A more likely explanation for the observed bleeding time findings in the regular, higher intake group could be the so-called ***rebound*** effect (Haselager & Vreeken, 1977; Renaud & De Lorgeril, 1992). This rebound effect describes the increased platelet count and risk of thrombosis which can occur following the withdrawal of alcohol after heavy or binge type drinking (Haselager & Vreeken, 1977). As all the bleeding time estimations were recorded within 36 hours of admission it is

possible that some patients were exhibiting a partial reversal of alcohol's anti-haemostatic effects due to withdrawal. The fact that the rebound only occurs to any significant effect in those consuming large amounts of alcohol or indulging in binge drinking would explain why the bleeding time was less prolonged in the regular and higher level alcohol users.

The failure of this study to identify an anti-haemostatic effect of NSAID use is difficult to explain. The most potent anti-platelet NSAID is aspirin and this was used by 30% of the patients studied. The other NSAID compounds used by the patients are known to have much smaller anti-platelet effects than aspirin and may have offset the distribution of bleeding times in the NSAID group, reducing the overall effect of aspirin in the analysis. It is also possible that patients over-reported the use of NSAID, or were not actually taking their NSAID as required. NSAID may have been used at doses below those required to produce significant haemostatic alterations However, the design of the study did not allow this possible explanation to be investigated (Henry et al, 1996). Further studies of NSAID use and haemostatic function in epistaxis are being designed to specifically address these points, using larger numbers of patients to enable comparisons to be made between the various NSAID compounds and doses, subgrouping patients according to use of alcohol, NSAID compound and dose. The number of patients studied in the present work was too small to allow such sub-analyses to be meaningful.

Conclusion

This study of haemostatic function has found a high frequency of abnormally prolonged bleeding times in patients with idiopathic epistaxis. There were significant associations between the use of alcohol and the presence of a prolonged bleeding time, an effect thought to be due to alcohol-induced platelet dysfunction. The findings support the growing evidence of an important aetiological role for alcohol in adult epistaxis and suggest a need for further areas of study. In particular the effect of alcohol on systemic blood pressure and upon nasal haemodynamics are areas demanding further research, as is the role of alcohol induced activation of the fibrinolytic system.

Clinical implications

From a clinical point of view the Simplate time may prove to be of value in decision-making when managing patients with epistaxis. For example, it is often difficult to decide the optimal time for removal of nasal packing without precipitating re-bleeding. Most authors recommend that nasal packing is left in situ for a minimum period of 48 hours with others favouring 72 hours or longer. Even after such long periods of nasal packing re-bleeding is frequent. Monitoring the Simplate time may help clinicians decide when the patient's haemostatic abilities are sufficiently recovered to allow pack removal. To investigate this possible role for the Simplate test, studies of the relationship between re-bleeding rates following pack removal and the Simplate time immediately prior to removal are necessary.

Chapter 7

Septal abnormalities and epistaxis

"let surgeons take care, lest in examining into, or curing the hidden disorders of the nose, they also believe that to be always from the present disease, which is often owing to another cause, or, perhaps, is so from nature itself; and, in like manner, let them not always expect to find an equal quantity in one cavity of the nose, as in the other; nor be deceived by those, who, not having attended to this variety, absolutely say," the nose is divided into two large equal cavities by a septum lying between".

(Morgagni, 1761)

7.1 Background

Septal abnormalities are frequently implicated as causal factors in epistaxis. It has been suggested that the presence of a deviation of the septum will cause localised mucosal drying and ulceration with subsequent epistaxis (Josephson et al., 1991; Ogura & Senturia, 1949; Lepore, 1993; O'Reilly et al., 1996). The possibility that septal anatomical abnormalities may give rise to ***recurrent venous*** epistaxis in young adults was investigated in the case control study by O'Reilly et al (1996). In that study an association was found between septal deviation and recurrent epistaxis in subjects aged between 16 and 40 years. The findings of that study are, however, not applicable to adult idiopathic epistaxis due to the dissimilarity of the conditions and the population affected. In addition many of the patients studied by O'Reilly et al (1996) had suffered nasal trauma and were thus not idiopathic cases.

The possibility of an aetiological link between septal abnormalities and adult idiopathic epistaxis has not previously been investigated in a case control study.

Prevalence of septal abnormalities

Abnormalities of nasal septum are known to be common in the general population and various authors have estimated the prevalence in normal subjects at between 10% and 85% (Gray, 1978; Haapaniemi et al, 1994; Ishikawa and Amitani, 1994; Lang, 1989; McKenzie, 1884; Sandham & Murray, 1993; Kim et al, 1991). With such a high prevalence of septal deviation in the general population, it could be that the association between epistaxis and septal abnormality is one of coincidence. This was the view by the authors in one paper in which a 16% incidence of septal abnormalities in epistaxis patients was regarded as being unimportant in both the aetiology and management (Jackson & Jackson, 1988).

Definitions and classifications of septal deviation

Many different methods of classifying septal deviations have been used but none are ideal. Ishikikawa & Amitani in their 1994 paper classified septal deviations as absent, slight, moderate or severe; using a scheme which is clearly subjective. Other authors have simply recorded and described the presence of an abnormality using descriptive terms such as 'anterior septal deviation' or 'maxillary spur', without trying to classify it (O'Reilly et al, 1996). Because of the difficulty inherent in producing a repeatable, objective system of scoring and recording of septal deformity the author has adopted the approach used by Haapaniemi et al, (1994) in which any clinically detectable deviation of the septum is recorded and classified according to its direction of maximum convexity. Thus, for the

purposes of this present study, any clinically apparent deviation of the septal cartilage and bone from the midline was taken to represent a septal deviation and was recorded as such. Using this approach the presence or absence of a septal deviation was noted as was its direction. Further sub-classification allowed separate recording of abnormalities consisting of combined sharp angulations of the quadrilateral cartilage and adjacent vomero-palatine crest as ***spurs*** (Haapaniemi et al, 1994).

7.2 Aims of study

The aim of the study was to examine the potential association between septal abnormalities and epistaxis by defining their prevalence in adult epistaxis patients and comparing this with the findings in an age and sex matched control group.

7.3 Patients and methods

Adult patients admitted to Glasgow Royal Infirmary with idiopathic epistaxis were studied (Table 1.2). Control patients were age and sex matched subjects suffering from sensorineural hearing loss who had no history of epistaxis, nasal trauma or nasal surgery. Patients and controls were examined using headlight illumination and nasal speculae. The septal anatomy was recorded as normal or abnormal, noting any deviation from the midline of either the cartilaginous or bony septum. The type and direction of abnormality was recorded. Similarly the presence of septal spur and its direction (to the right or left) was also recorded. Additional information was recorded on the presence or absence of septal perforations.

7.4 Results

There were 123 patients with a mean age of 60 years (range 23 to 93 years, standard deviation 15.7) and 123 controls with a mean age of 58 years (range 22 to 92 years, standard deviation 16.1). Within each group there were 72 (59%) males and 51 (41%) females. There was no significant difference in the sex distribution between patients and controls using a Chi-squared test of proportions. Similarly, the age distributions showed no significant difference on Students's t-test using a pooled estimate of variance.

There was no statistical difference between patients and controls in the prevalence of nasal septal deviation. A septal deviation occurred in 61 (50%) of patients and 64 (52%) of controls (Chi-squared test of proportion, X^2=0.0, p=1.0, not significant.). Further analysis showed that 32 (26%) of patients had a septal deviation with a maximum convexity to the bleeding side and 29 (24%) of patients had a septal deviation with a maximum convexity to the side contralateral to the epistaxis. Comparison of the incidence of deviation to the bleeding and to the contralateral side was found not to be significant under the binomial test (p=0.39, not significant.). As control subjects were not suffering from epistaxis, the maximum convexity of their septal deviation was defined as either to the right or to the left. 27 (19%) of control subjects had a septal deviation to the right and 37 (30%) were maximally convex to the left. Comparison between deviations to the right and to the left in control subjects was undertaken using the binomial test and this was also found not to be significant (p=0.36).

Septal spurs

Analysis of the data relating to septal spurs showed that these occurred in 12 of 123 patients (10%) and 6 of 123 controls (5%) (Chi-squared test of proportions, X^2= 2.15, p=0.14, not significant). Thus spurs were not significantly more frequent in patients. However, further analysis showed that of the 12 patients who had a septal spur, 11 were bleeding from the nostril ipsilateral to the spur and 1 was bleeding from the side contralateral to the spur. Epistaxis is as likely to occur from either nostril (48% right, 50% left, 2% not located) and so this apparent association between septal spur and side of epistaxis was statistically examined using the hypothesis that spurs should be equally distributed between nostrils ipsilateral and contralateral to the epistaxis. Using the binomial test this association between septal spur and side of epistaxis was statistically significant (p=0.006). No such side predominance was observed in controls of whom 2 had septal spurs to the right and 4 had spurs to the left.

Septal perforations

Not all septal abnormalities were deviations or spurs. Information on septal perforations was also recorded. 5 (4%) of patients had a septal perforation compared to 1 (1%) of controls. This excess of perforations in the patients was statistically significant (Chi-squared = 4.22, p<0.05).

7.5 Discussion

In this present work septal deviations were as frequent in asymptomatic control patients as they were in epistaxis patients. This suggests that septal deviations are unlikely to be a major causal factor in epistaxis. That septal deviations are unimportant in the aetiology of epistaxis is further supported by the hypothesis that if they were causal, then one might expect to observe a relationship between the direction of a septal deviation and the side of epistaxis. This study found no relationship between the direction of the septal deviation and the side of epistaxis, with the exception of septal spurs which are discussed below.

The method of recording septal abnormalities used in this study may in part explain the high incidence of septal deviations observed in both the patients (50%) and controls (52%). Alternatively the observed high prevalence of septal deviations may be due to factors such as the age of the study group, as septal deviation is more frequently observed in the elderly (Blaugrund, 1989). This age effect is clearly shown in the 9.5% prevalence in school age children reported by Haapaniemi et al, the 17% incidence in normal subjects with a mean age of 13.1 years reported by Sandham and Murray, a 22% prevalence in a Korean population study, a 31% prevalence in 16-40 year old subjects, and 52% found in this present study whose subjects have a mean age of approximately 60 years (Haapaniemi et al, 1994; Ishikikawa & Amitani, 1994; Sandham & Murray, 1993; O'Reilly et al., 1996).

Septal Perforations

Although only 4% of patients had a septal perforation this was a significantly greater proportion than in the control group. In all epistaxis cases with a septal perforation, the bleeding occurred from the posterior superior margin of the septal perforation. In patients who have epistaxis and a septal perforation, it is the author's clinical experience that the bleeding almost always arises from this region. Therefore the association between septal perforation and the ***site*** of bleeding in adult epistaxis seems to be of clinical importance.

Septal spurs

As we have seen from previous work on the blood vessels involved in epistaxis (Chapter 3), there is an overwhelming importance of the septal vasculature as a source of epistaxis. Despite the importance of the septum as the site of epistaxis, it seems unlikely that the causal mechanism involves septal anatomical abnormalities as they are no more frequent in patients than controls. Septal distortion becomes clinically important, however, when the bleeding point cannot be located because it is situated behind a septal (vomero-palatine) spur. This difficult situation is frequently encountered in clinical practice and results in a high degree of technical difficulty when trying to achieve haemostasis. This may explain why patients were observed to bleed more frequently from the nostril ipsilateral to a spur, since those bleeding from a nostril with no spur are more easily managed, perhaps not even admitted to hospital and consequently excluded from this study, resulting in a degree of selection bias. Thus a spur on the bleeding side may simply make treatment more difficult and hospital admission

more likely rather than being causally associated with the condition. It is possible that this reason has led to the widely held impression that septal deviation is in itself aetiologically related to adult epistaxis.

Conclusion

This case-control study fails to support the hypothesis that septal deviations are implicated in the causation of epistaxis.

SECTION 2:

THE CLINICAL MANAGEMENT OF ADULT IDIOPATHIC EPISTAXIS

Chapter 8

Current practice in the management of epistaxis

"These were, indeed, moisten'd with the juice of nettles, by which only when snuff'd up into the nostrils, I have seen a haemorrhage, sometimes, restrain'd and that mix'd together with the white of an egg, and the soot, which is scraped from the bottom of a brass kettle, rubb'd into the finest powder".

(Morgagni, 1761)

As discussed in Chapter 1, adult epistaxis is a diagnosis which covers a wide range of presentations of nasal bleeding. Whilst it is true that most cases are associated with trivial easily controlled bleeding, a small percentage of patients require hospital admission for severe and life-threatening bleeding. Indeed, it has been estimated that only 6% of all adult epistaxis cases are referred to otolaryngology services (Lepore, 1993). This 6% of cases who reach the otolaryngologist represent the most severe and persistent end of the spectrum and it is the management of this group of patients that is discussed in the following chapters of this thesis.

Any otolaryngologist who has managed adult epistaxis will attest to the difficulties sometimes encountered when trying to achieve haemostasis. The problems associated with treating the condition are emphasised by the vast array of treatment techniques which have been developed and the fact that no single technique is entirely effective (Pearson, 1983). The ideal management strategy for epistaxis consists of a controlled sequence of interventions, starting with simple

measures and progressing to invasive and operative treatments only in cases with refractory or recurrent bleeding (Bone, 1990; Pearson, 1983). In epistaxis, more than in other conditions, it is particularly important that any intervention or treatment should be effective as the dangers of continued bleeding are greatly increased by a high incidence of co-existing cardiovascular disease (Bone, 1990).

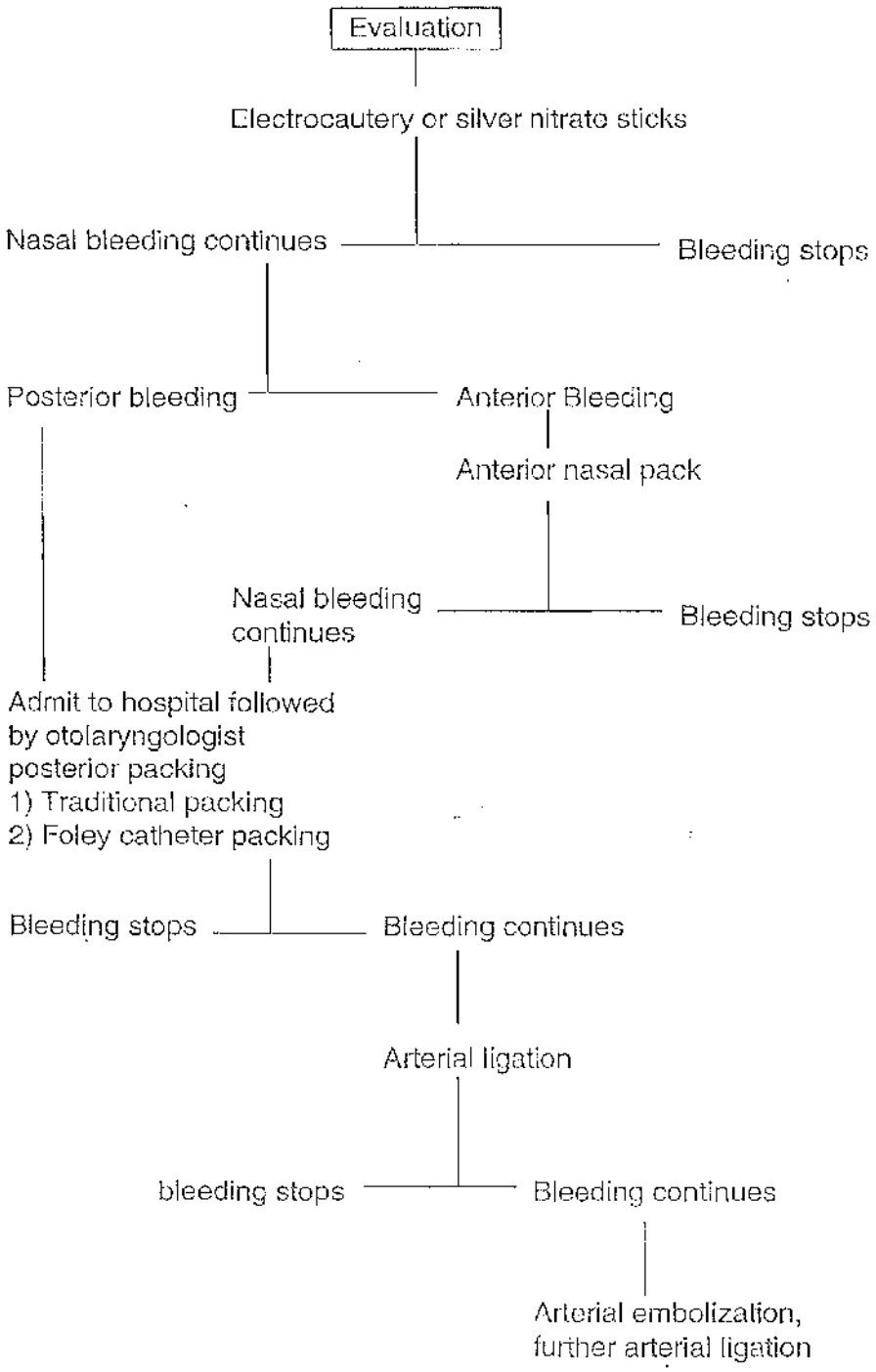
The question of treatment efficacy is at present unresolved as the vast majority of management techniques used for epistaxis have never been formally evaluated. Thus decisions on treatment for epistaxis are made solely by clinical judgement, selecting from a bewildering array of available options in the absence of evidence of comparative efficacy.

Traditional treatments

The traditional approach to epistaxis in adults takes the form of a sequenced plan of action beginning with first aid measures and progressing to nasal tamponade with packing or balloon catheters and ending with progressively more invasive operative therapies such as ligation of arterial feeding vessels, septal surgery or embolisation procedures. No universally accepted treatment algorithm exists but many have been suggested and that by Josephson et al (1991) offers a fair representation of the most commonly used approach **(Figure 8.1).**

Figure 8.1

Management algorithm after Josephson et al (1991).



In addition to a variety of opinions on the sequence of management there is also controversy concerning the actual steps involved. For example some authors recommend septal surgery for patients who have "failed" with packing whilst others regard arterial ligation as the procedure of choice in such patients (Cumberworth et al, 1991; Schaitkin et al, 1987). Even within the group of authors who agree to advocate ligation, there exists significant debate over which vessels should be ligated (Lepore, 1993; Pearson, 1983; Schaitkin et al, 1987; Stell, 1977).

This variation in approach is a direct result of the paucity of prospective research on treatment methods. A lack of evidence-based medicine has led to a situation where treatment protocols are established on a basis of subjective opinion which is obviously open to bias. Evidence of bias is revealed in the contrasting findings in the literature. For example Lepore reported that packing failures occurred in between 4-8% of patients whilst in a prospective study, claiming to compare medical (packing) and surgical (ligation) treatment, Schaitkin et al reported that 52% of patients failed with packing (Lepore, 1993; Schaitkin et al, 1987). Such large differences in the need for arterial ligation (8% *v* 52%) can only be explained by concluding that the nasal packing used in Schaitkin's study was either unusually ineffective or that his study simply measures the enthusiasm of the investigators for performing arterial ligations.

The following section of the thesis attempts to address some of the key areas in the management of adult epistaxis. The areas chosen for study represent problem areas which the author has observed when managing adults with epistaxis.

As the initial stage of management for epistaxis has an important influence on the proportion of cases needing specialist referral, **Chapter 9** investigates levels of awareness of basic first aid management in health care workers dealing with adult epistaxis in an accident and emergency department.

Chapter 10 examines various aspects of the design and mode of action of balloon catheters, which are the most commonly used indirect treatment of epistaxis. The findings are used to recommend design modifications.

Chapter 11 addresses the efficacy and practicability of a new minimally invasive endoscopic technique for direct haemostasis and outlines continuing developments in direct haemostatic therapies.

Chapter 9

Clinical awareness of first aid techniques for epistaxis

"And by this easy kind of remedy, which always answered afterwards, the patient, who had learned to make use of it himself, at length got quite rid of the returns of the haemorrhage, within a few months."

(Morgagni, 1761)

9.1 Background

The majority of patients with epistaxis never reach an otolaryngologist due to spontaneous haemostasis or successful treatment by primary health care physicians. It has been estimated that between 6-10% of epistaxis cases are referred to an otolaryngologist with the remainder being managed successfully in the community (Lepore, 1993). Within the group of patients who are referred to an otolaryngologist there is a significant number of patients who are bleeding from an anteriorly placed septal vessel. These patients often respond to simple measures such as direct pressure over the bleeding point using the Hippocratic method of first aid (Shaheen, 1967).

As with all steps in the management of epistaxis the need for more invasive treatments is often a reflection of the quality of early management (Pearson, 1983). Inadequate or inappropriate first aid management may lead to unnecessarily large proportions of patients being referred for specialist treatment. As the author had observed that large numbers of patients with minor anterior bleeds were being referred to otolaryngology services following inadequate and incorrect first line

management a survey of awareness of the correct first aid manoeuvre was conducted in accident and emergency department staff.

9.2 Aims of study

This study aimed to investigate the awareness of first aid management for epistaxis among staff of an accident and emergency department of a major teaching hospital.

9.3 Subjects and methods

Digital compression of the ala nasi (the Hippocratic method) is the recognised method of first aid management in epistaxis (Browning, 1982; Shaheen, 1987; St John Ambulance et al, 1987; Yates & Redmond, 1985). In this study 115 accident and emergency department staff were asked to demonstrate the method by which they would attempt to control a nose bleed using digital pressure. A correct response was recorded when the ala nasi were compressed. An incorrect response was recorded when the pressure was applied elsewhere. The exact position used by the respondents was recorded in each case. Of the 115 staff surveyed there were - 25 doctors, 60 nurses, 15 paramedics and 15 non-clinical staff. The non-clinical staff were included as an attempt to measure general levels of awareness of the manoeuvre.

9.4 Results

The overall correct response rate was 33%; for trained medical and nursing staff it was 43%. The detailed breakdown of the results is shown in **Table 9.1**. Consultants, senior registrars, registrars and clinical assistants are grouped together as senior doctors for the purposes of this study. The most frequent incorrect site demonstrated was over the lower part of the nasal bones.

Table 9.1

Summary of responses in survey of 115 accident and emergency staff.

Designation	Number	Correct	Incorrect
Sister	10	6(60%)	4
RGN	30	9(30%)	21
SEN	10	2(20%)	8
Student nurse	10	1(10%)	9
Senior doctor	10	8(80%)	2
SHO	15	7(47%)	8
Paramedic	15	3(20%)	12
Non-clinical	15	2(13%)	13
All clinical staff	100	36(36%)	64
All staff	115	38(33%)	77

9.5 Discussion

Epistaxis is the most common otolaryngological condition presenting to an accident and emergency department. The vast majority of nose bleeds (90%) arise from the anterior part of the nasal septum (Raines & Ritchie, 1984). Since the time of Hippocrates it has been known that simple digital compression in the correct place over the ala nasi will achieve haemostasis in most cases (Shaheen, 1987; Morgagni, 1761). Hence compression of this area is described and advocated as primary treatment for epistaxis in standard first aid manuals, accident and emergency medicine texts and basic otolaryngology texts. Despite the high incidence of epistaxis, accident and emergency staff exhibit a surprisingly low level of awareness of the correct first aid manoeuvre. It would appear from the findings of this study that a large proportion (64%) of patients are initially being managed inappropriately by compression of the wrong part of the nose. Although this study only surveyed one hospital's accident and emergency department there is no reason to assume that similar results would not have been found elsewhere. The direct result of this lack of knowledge of appropriate first aid is increased blood loss and eventual unnecessary referral to otolaryngology services.

Appropriate knowledge of the technique seems to be available within the staff of the department as senior doctors (80% correct) and senior nurses (60% correct) exhibit relatively high levels of correct responses. In contrast it is striking that the level of knowledge exhibited by paramedics was almost identical to that of non-clinical staff and that of student nurses (90% incorrect) was not even as good as non-clinical staff!

Despite the existence of a reservoir of knowledge in senior doctors and nurses it would seem that more junior members of staff have either not been taught the technique or have been taught incorrectly. This aspect of incorrect or imprecise teaching of the manoeuvre is underlined by the high proportion of staff who knew of the manoeuvre but erroneously compressed the area of the nasal bones. From this common mistake it seems reasonable to conclude that clinical teachers and textbooks should attempt to be more precise and explicit about the exact site to be compressed. As a result of this study steps have been taken to increase the awareness of this technique among accident and emergency department staff. It is hoped that this training will help reduce the number of patients who receive incorrect initial management and also reduce unnecessary and costly referrals to specialist services.

Chapter 10

Intranasal balloon catheters

"This successful method of treatment, which Valsalva made use of, shews, that tents, or dossils of lint, introduc'd into the nostrils, in order to restrain the haemorrhage, may sometimes be not so much of an advantage, from the virtue of the astringent remedies with which they are moisten'd, as from compression itself."

(Morgagni, 1761)

10.1 Background

In current otolaryngological practice, indirect methods of management remain the most frequently used methods of achieving haemostasis in adult posterior epistaxis. All of the commonly used indirect techniques share the common goal of stopping bleeding by filling the nasal fossae, thus reducing the available space for bleeding and eventually tamponading the bleeding vessel. The most traditional way of achieving this tamponade is the insertion of ribbon gauze nasal packs but over the years a range of devices have been developed in an attempt to improve on this difficult and often unsuccessful technique. Nasal balloon catheters are pneumatic devices which are used to produce nasal tamponade and are thought to be more reliable, more easily inserted and more effective than gauze packing. These balloons would now seem to be the favoured method of nasal tamponade in some otolaryngology and emergency departments and their popularity is

emphasised by the wide range of different types which have been designed (Sasaki et al, 1984; Watson & Shenoi, 1990).

Various designs of nasal balloon catheter have been described and for each claims of a specific mode of action are made (Bayon, 1965; Stevens, 1936). In the manufacturers' explanatory literature the devices are said to fill the nasal cavity, provide firm and even tamponade or to produce choanal occlusion. The description of the mode of action is usually accompanied by an artist's impression or line diagram of the balloon catheter neatly conforming to the internal contours of the nasal cavity. The complexity of nasal internal anatomy and the variable distension and compression characteristics of the cartilaginous, bony and mucosal elements of the nose would seem to cast doubt on modes of action which rely upon even and predictable positioning and expansion of devices within the nasal cavities. Doubts over the feasibility of the proposed mechanisms of action were reinforced when enquiry with the manufacturers revealed that no information existed of how the various designs behaved in the human nose, their manufacture having been based on an entirely theoretical and untested design concept.

10.2 Aims of study

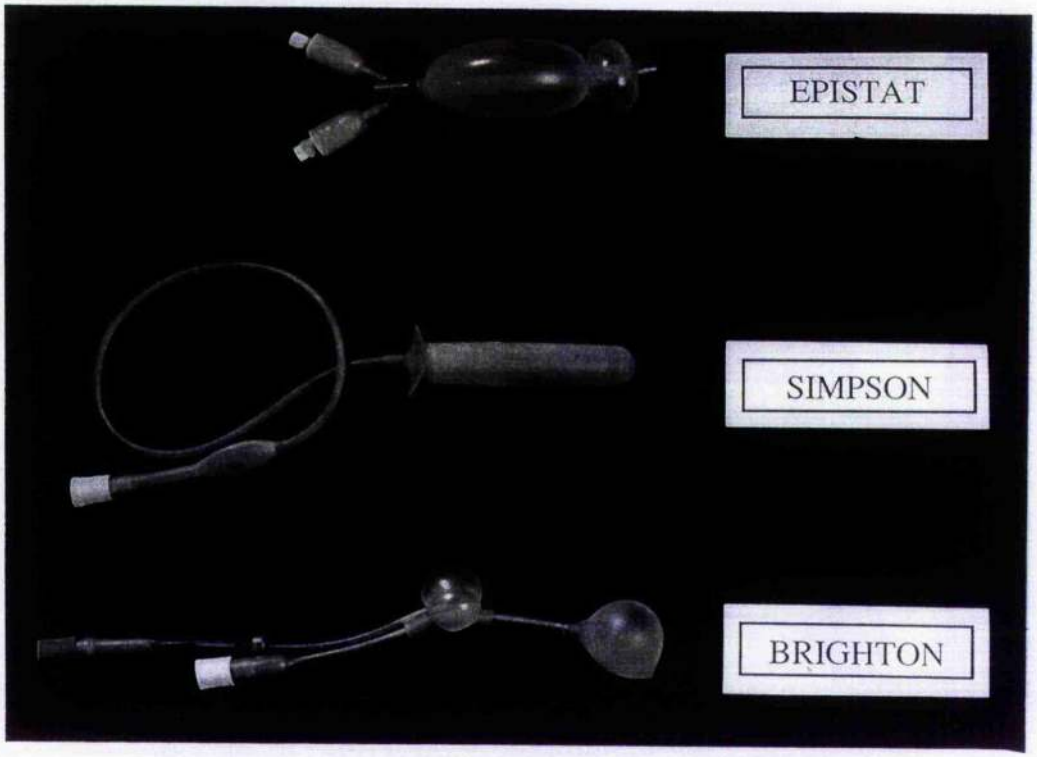
This study aimed to investigate the configuration and distribution of the three most commonly used balloon catheters in the human nose. By relating balloon features to anthropomorphic data and studying the effects of alterations in inflation volume the study sought to identify potential modes of action, explain the observed side effects and make suggestions for rational modifications of existing designs.

10.3 Subjects and methods

The study used radiological techniques and direct observation on cadaveric material to investigate the three most frequently used balloon catheters. The following three devices were studied (**Figure 10.1**):-

Figure 10.1

Balloon catheters studied



Epistat® nasal catheter (Xomed Inc.)

This device consists of a large anterior balloon and a smaller posterior balloon assembled around a central airway tube. The anterior balloon is designed to provide firm and even pressure within the nasal cavity and thus produce haemostasis through tamponade. The smaller posterior balloon is said to position the device accurately in the post nasal space and allow respiration to occur through the central airway tube (Xomed Inc., 1991). The manufacturer recommends an inflation volume of 30 ml for the anterior balloon and 10 ml for the posterior balloon. These volumes are stamped on the respective valve cuffs.

Simpson Plug® (Eschmann Healthcare)

This is a single large balloon with a central plastic rod designed to ease insertion. The balloon is designed to inflate within and fill the nasal cavity and control bleeding by pressing on the bleeding vessel. The manufacturers suggest inflation with 20 ml or more of air (Eschmann Healthcare, 1989).

Brighton balloon® (Eschmann Healthcare)

This has two independent balloons, the anterior balloon is mobile allowing the distance between the balloons to be varied. The mobile anterior balloon is smaller and designed to provide a way of sealing off the anterior nares. The larger posterior balloon is designed to occlude the posterior nares. Haemorrhage is therefore controlled by sealing off the nasal cavity and allowing the accumulating blood to provide a form of self tamponade. It is recommended that the posterior

balloon is inflated with 8-12 ml of air or fluid and that the anterior balloon is filled with 6-8 ml (Wadsworth, 1971).

Length measurements, method

For each of the above devices an assessment was made of the relationship between device dimensions and normal human nasal anatomy. In order to compare the lengths of the intranasal portions of the three balloons it was necessary to know the dimensions of the normal human nasal cavity. At the time of study there was no reliable source of information on the anthropometry of the nasal cavity and therefore it was necessary to investigate this aspect in detail. The principal parameter of interest was the length of the nasal cavity as clinical data had suggested that most nasal balloons seemed too long resulting in prolapse when inflated. In order to investigate this the length of the nasal cavity was determined radiographically using 100 (50 male, 50 female, adults over the age of 25 years) lateral skull X-rays obtained from the accident and emergency department. The length of the nasal cavity was measured from the anterior nasal spine to the most posterior limit of the hard palate. The measurements obtained were adjusted for a 1.2 magnification factor associated with the lateral projection radiographs. All films were taken on the same X-ray machine.

Intra-nasal studies, techniques

In addition to the above measurements each balloon was inserted into the nose of deceased human subject at the time of post-mortem (within 12 hours of death). Cadavers were chosen to avoid the use of multiple, non-diagnostic X-rays on patients or volunteers. Four cadavers (female 5'2", female 5'3", male 5'8", male 6'1") were selected to represent a range of nasal sizes and were not embalmed in order to ensure preservation of normal nasal tissue compliance. Subjects with nasal deformities such as septal deviation and those with a history of nasal surgery were excluded. The mean age at death was 66 years (range 57-73 years).

Control radiographs were taken in the antero-posterior and lateral projections before the balloons were inserted and these were used as a baseline to allow identification and plotting of the anatomical boundaries of the nasal cavity. Balloons were then inserted and inflated to the manufacturers recommended volume and rendered radiopaque by instilling a solution of Urograffin® radiological contrast medium. Antero-posterior and lateral radiographs were taken at manufacturers' recommended inflation volume and then repeated with the devices over and under-inflated by 20%. This gave a total of 8 control films and 72 observations with balloons inflated within the nasal cavity (**Table 10.1**).

Table 10.1

Scheme for observations of nasal balloon catheters

	Epistat		Simpson	Brighton	
Inflation volume	Ant (ml)	Post (ml)	(ml)	Ant (ml)	Post (ml)
-20%	24	8	16	6	9
Recommended	30	10	20	8	12
+20%	36	12	24	10	15

10.4 Results

Length measurements

The mean nasal cavity length in 100 adult lateral skull radiographs was 53 mm (44-63 mm). The mean length in males was 55mm (range 46-63 mm) and in females 51 mm (range 44-60 mm). The length of the intranasal portion of the Epistat is 87 mm and the Simpson device measures 80 mm. It is apparent, therefore that the Epistat and Simpson devices are too long for the average nasal cavity. The design of the Brighton balloon allows the intranasal length to be varied by moving the mobile anterior balloon. Thus the Brighton device can be made to accommodate various nasal cavity sizes without excessive anterior or posterior prolapse of the device.

Intranasal assessment of balloon catheters

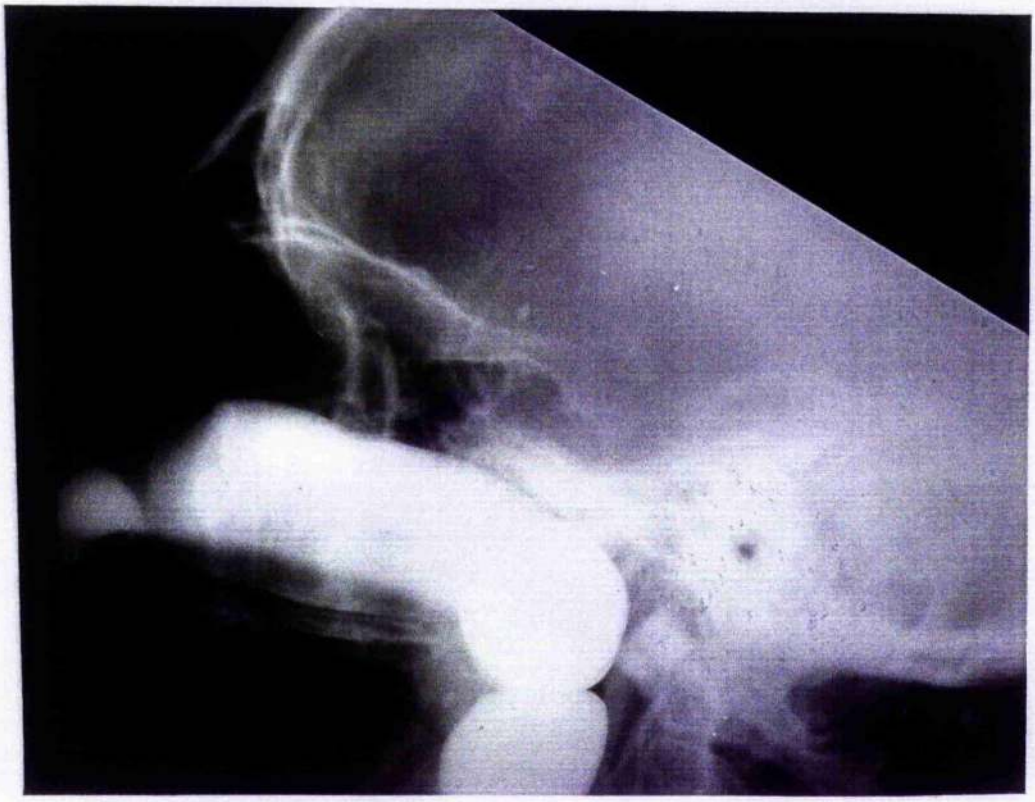
The findings did not vary between the cadavers and thus the results for each balloon were consistent across all 4 subjects.

Epistat

This device does not conform closely to the contours of the nasal cavity but tends to inflate along the inferior part of the nasal cavity. In no subject, at any inflation volume, could this balloon be made to inflate above the level of the middle turbinate. The excessive length of the balloon (87mm) resulted in the device prolapsing posteriorly, pushing down the soft palate and encroaching upon the oropharynx (**Figure 10.2**). The inflation volumes recommended by the manufacturer are excessive. When 30 ml was used to inflate the anterior balloon and 10 ml for the posterior balloon, gross septal displacement occurred. In addition in all cadavers marked alar distension occurred with this device, to a degree which could lead to soft tissue necrosis in patients.

Figure 10.2

Photograph of lateral skull radiograph showing inflated Epistat in nasal cavity. The excessive length has resulted in posterior prolapse and there is no expansion into the upper nasal cavity.

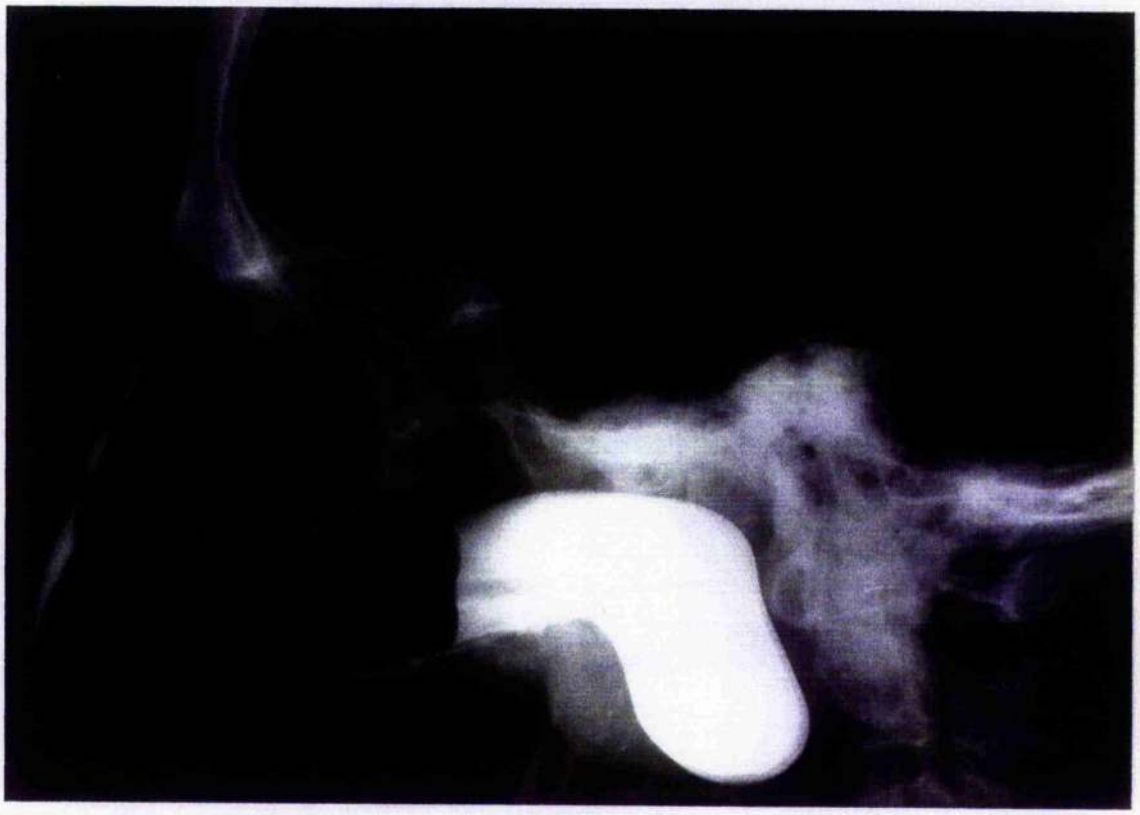


Simpson

In contrast to the claims made by the manufacturer this device did not "fill" the nasal cavity but tended to inflate along the line of the inferior meatus. Additional inflation did not improve contouring and the balloon could not be made to inflate above the level of the middle turbinate. There was a marked tendency for expansion posteriorly into the relative low pressure area of the nasopharynx. This posterior prolapse and expansion resulted in the soft palate being pushed down and at higher inflation volumes the balloon expanded into the oropharynx (**Figure 10.3**)

Figure 10.3

Photograph of lateral skull radiograph showing inflated Simpson Plug in nasal cavity. The device has not contoured to the nasal cavity and is expanding into the nasopharynx and pushing the soft palate down.

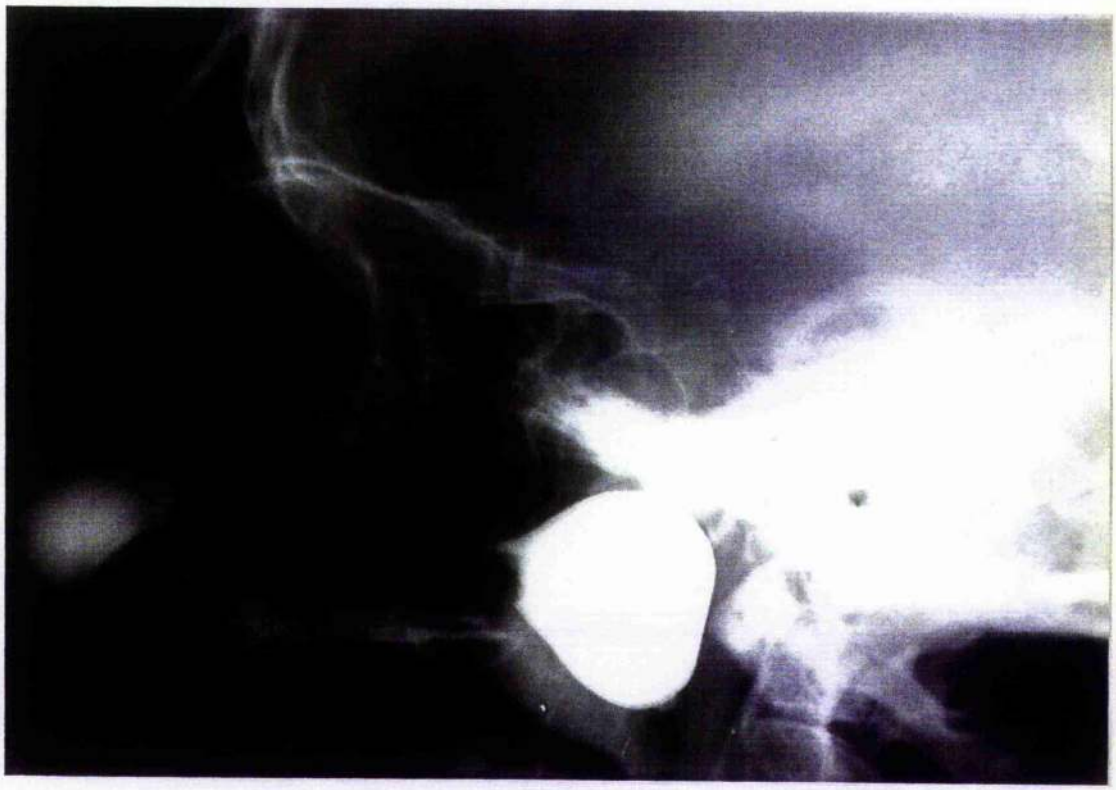


Brighton

This balloon corresponds more closely to the manufacturers' description than the others. The anterior, low volume, balloon achieved the design aim by closing off the anterior nares at the level of the piriform aperture. Although the posterior balloon is designed to occlude the posterior nasal aperture it does so by completely filling the nasopharynx. Thus in place of the manufacturers' description of precise choanal occlusion the device was observed to fill the entire nasopharynx, causing downwards and anterior displacement of the soft palate with resultant narrowing of the oropharyngeal airway. The moulding of the posterior balloon to the contours of the nasopharynx suggested that pressure was being applied to the tissues of the skull base, prevertebral region and Eustachian orifice (**Figure 10.4**).

Figure 10.4

Photograph of lateral skull radiograph showing position of Brighton Balloon. The posterior balloon can be seen to fill the nasopharynx and is pushing the soft palate down.



10.5 Discussion and design modifications

As already discussed intranasal balloon catheters are widely used in the management of epistaxis and in some departments they seem to be the preferred mode of treatment (Watson & Shenoi, 1990). Existing explanations of their mode of action are based on a series of assumptions which this study has shown to be false. It is clear from the results of this research using human subjects that devices which are designed to fill, or contour to the nasal cavity do not achieve this aim. The tendency for the balloons to expand into areas of relatively high volume and low pressure, such as the nasopharynx, leads to compression and displacement of the nasal soft tissues. This tendency to stretch and distort the nasal soft tissues explains the side effects of alar necrosis and septal damage which are frequently observed clinically.

Elwany (1986) drew attention to the problem of Eustachian tube obstruction resulting from the use of pneumatic nasal catheters and the findings in this study clearly show how this can occur (Elwany et al, 1986). Similarly, pressure exerted by a balloon filling the nasopharynx and pressing on the skull base may explain the headache which patients experience with these devices. The particular tendency of the Simpson device to expand posteriorly into the nasopharyngeal and oropharyngeal airways calls for care when using this device in an unconscious patient with an unprotected airway. Indeed the tendency for all of the balloons to push the soft palate down should be borne in mind as they are often used by accident and emergency staff when dealing with patients with multiple trauma (Keen & Moran, 1985; Sasaki et al, 1984).

If these balloons do not do as they are designed, then how do they work? It seems reasonable to propose a mechanism of action which relies on an interaction of different effects. Tamponade, choanal occlusion and direct pressure on the bleeding vessel may all play a varying role in the production of haemostasis. In addition another and perhaps serendipitous mode of action may be important in devices using a posterior balloon (Brighton and Epistat). Balloons which expand posterior to the middle turbinate may press directly upon the vessels of the sphenopalatine foramen and the unprotected parts of the middle and inferior turbinate arteries. These vessels were first described by Burnham (1935) and were further commented upon by Shaheen (1967). These arteries are branches of the sphenopalatine artery in the mucoperiosteum of the nasal cavity, posterior to the posterior end of the middle and inferior turbinates. The vessels have been referred to as the "unprotected turbinate arteries" because they lie in the mucoperiosteum and unlike the anterior segments of these vessels they are not protected by bony coverings. These arteries account for a very significant proportion of the nasal blood flow and it is possible that pressure over these vessels is an important mechanism of action of the posterior part of a balloon catheter.

Design modifications

In the light of the findings of this study a number of areas were identified where the design of nasal balloons could be improved.

The length of the device

It is striking that the lengths of the intranasal parts of both the Epistat and Simpson balloons are so disproportionate with that required to span the nasal cavity. When calculated from 100 adult lateral skull radiographs, the mean nasal cavity length was 55mm in males and 51mm in females (with an overall range of 44-63mm). These measurements correspond closely to those reported by Lang (1989) and suggest that future designs should have a shorter intranasal portion of no longer than 63mm. Adoption of variable distance of balloon separation similar to that used in the Brighton device would allow for accurate chaonal occlusion without excessive posterior prolapse.

The method of action

This study was conducted on subjects without septal deformity. It seems likely therefore that when used clinically the additional effects of septal abnormalities such as deviations and spurs would make it even less likely that accurate predictable contouring could ever be achieved. New designs should therefore aim to produce accurate choanal occlusion and maximise pressure applied by the posterior balloon to the area of the unprotected turbinate arteries. Thus a large balloon designed to fill the nasal cavity may be a less desirable aim than correctly positioned anterior and posterior occluding balloons.

The problem of posterior prolapse and nasopharyngeal expansion

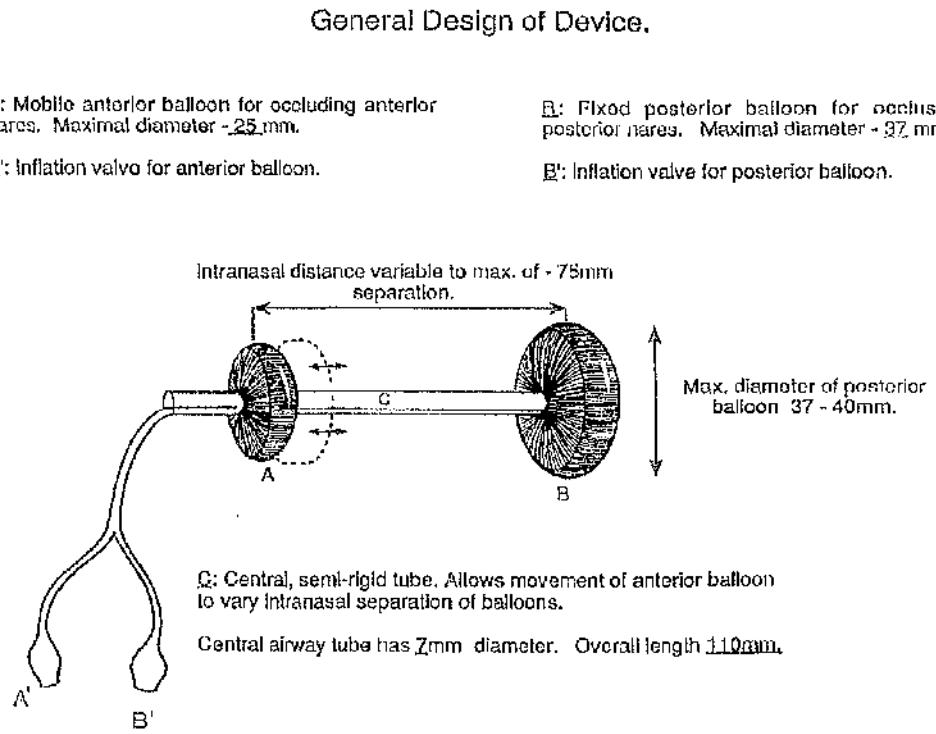
The purpose of the posterior balloon is to close off the posterior nasal aperture and if possible compress the region of the unprotected turbinate arteries. Present designs seem to achieve this by filling the entire nasopharynx. This excessive volume of balloon within the nasopharynx is theoretically unnecessary and is a source of frequent side effects such as headache and middle ear effusion (Elwany et al, 1986). Thus future designs should aim to use a pre-shaped balloon which will not over-expand in craniocaudal and lateral directions.

Proposed new design

Using the above observations it is possible to set out a design of an improved balloon catheter which should offer more predictable placement and reduce the level of side effects observed. **Figure 10.5** shows the general design of such a device and it can be seen that this has similarities with the Brighton balloon. The main differences are in the adoption of dimensions similar to those observed in cadaveric studies, the inclusion of a semi-rigid central airway to allow precise placement and in the use of pre-shaped balloons.

Figure 10.5

Diagram of new device with explanatory notes on the main design features.



Conclusion

In conclusion this, the first anatomical study of nasal balloon catheters, has provided important information on the method of action, causation of side effects and reasons for balloon failure. Such basic anatomical research should prove to be of value in the future in enabling more rational design of nasal balloon catheters.

Chapter 11

The direct approach to treatment

"As the vessels that pour out the blood, are not always situated in those parts of the nose, which can be compressed by the introduction of tents; or, which would be still more certain, if the vessels were at any time in a part of the septum, that might be brought into sight, by an instrument ...."

(Morgagni, 1761)

11.1 Background

Like nasal packing using gauze strips, nasal balloons aim to achieve haemostasis either by tamponade or by choanal occlusion. Packing and balloons are therefore ***indirect*** methods of haemostasis as their mode of action is not directed to a known bleeding point. The development and use of indirect therapies is a consequence of the difficulty associated with examining the posterior nasal cavity during active bleeding. As a result of this indirect approach the majority of bleeding points are never identified during the course of treatment.

If indirect management fails and the patient continues to bleed then further indirect management in the form of arterial ligation may be required. Arterial ligation involves ligature of the feeding vessels to the nasal cavity and as the bleeding point's exact location is unknown, both the internal maxillary and anterior ethmoidal arteries are often tied. If this fails then the management can take yet another step away from the nose to include ligation of the external carotid artery on the side of bleeding!

In 1983, Pearson pointed out the unsatisfactory nature of epistaxis management techniques and called for a move towards more rational, bleeding point specific or ***direct*** forms of management. At the time of Pearson's paper such direct forms of treatment were theoretically possible but required general anaesthesia and operating theatre facilities in order to allow the nasal cavity to be fully examined using speculae to locate the bleeding vessel. A result of this requirement for general anaesthesia was that direct treatments were reserved for those cases who continued to bleed despite repeated indirect treatments. With the advent of rod lens nasal endoscopy and its widespread adoption by otolaryngologists in the late 1980's there became available a means of examining the entire nasal cavity in an awake patient. Thus it was only a matter of time before endoscopes were being used as a direct method of management in adult posterior epistaxis. The use of the endoscope seemed to offer an alternative to indirect methods, avoiding the need for prolonged hospitalisation and reducing the risks of serious side effects associated with nasal packing, such as hypoxia, bacteraemia and even myocardial infarction (Herzon, 1971; Larsen & Juul, 1982).

In 1988, Wurman et al reported a local anaesthetic technique of rod lens endoscopically guided electrocautery for posterior epistaxis. This technique controlled bleeding in 12 out of 18 patients, but like so many epistaxis papers there was no attempt to compare the new technique with the existing indirect treatment methods.

11.2 Aims of study

This study was designed to investigate the clinical effectiveness of endoscopically guided, direct haemostasis in adult, posterior, epistaxis. In addition to evaluating practical aspects of the technique, the study allowed comparison between patients managed by direct (endoscopic) and indirect (packing or balloons) strategies with reference to a number of clinically important outcome variables, including immediate control of bleeding, incidence of re-bleeding, duration of hospital stay and complications.

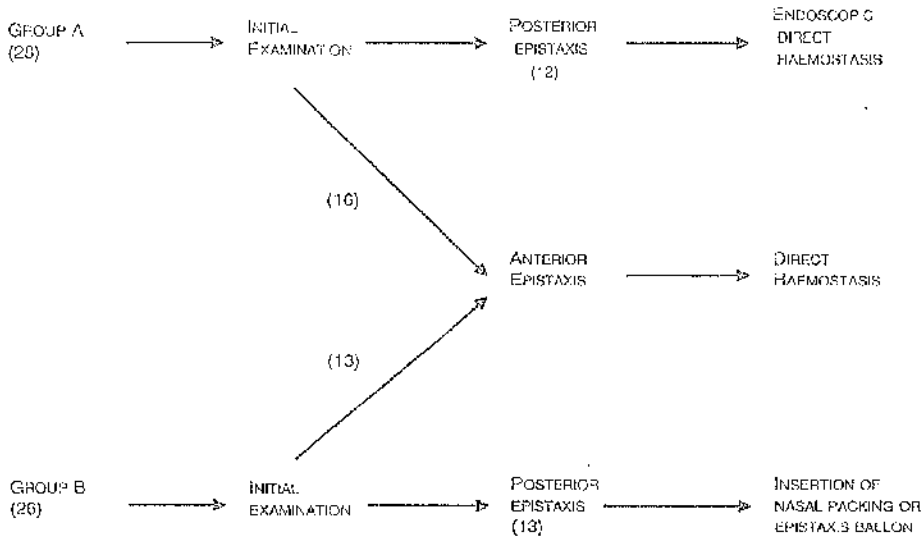
11.3 Patients and methods

The study group consisted of adults with idiopathic epistaxis (Table 1.2), who were admitted to Glasgow Royal Infirmary over a seven month period. Patients were allocated to one of two groups. Those admitted on days when the author was on-call were allocated to Group A and were managed with access to rod lens nasal endoscopy equipment. Those patients admitted on other days were allocated to Group B and were managed by conventional indirect treatments by one of three post-fellowship otolaryngology trainees. The nasal endoscope was not available for use on any of the patients in Group B.

Patients in both groups underwent a standard nasal examination using headlight illumination, nasal speculae, suction and cocainization as appropriate. If a bleeding point was identified on this initial examination the bleeding was classified as anterior (relating to an anterior source in the nasal cavity) (Pearson, 1983). Anterior bleeding points in both groups were managed by cautery directly applied to the bleeding point and these patients were not studied further. Those patients in whom an anterior bleeding point could not be found were by definition suffering from posterior epistaxis (Pearson, 1983). Patients in Group A with posterior epistaxis proceeded to nasal endoscopy in an attempt to locate and directly treat the bleeding point. Patients in Group B with posterior bleeding were managed by insertion of nasal packing or epistaxis balloon catheters. **Figure 11.1** details the steps in management.

Figure 11.1

Flow diagram showing steps in management with patient numbers shown in brackets.



All patients were admitted to hospital and managed with intravenous crystalloids, bed rest and observation. In Group A patients were deemed fit for discharge if there had been no further bleeding for a full 24 hours after endoscopic treatment or in the case of Group B patients if there had been no bleeding in the 24 hours following removal of the balloon or packing. All patient information was recorded on a separate proforma and patients were invited to attend a follow-up visit at one month. At follow-up a history of re-bleeding and re-admission was taken and patients underwent nasal examination and endoscopy by the author.

Description of endoscopic technique

All patients in Group A with posterior epistaxis underwent nasal endoscopy. A 2.7mm, 25 degree rod lens nasal endoscope (Richard Wolf Endoscopes Ltd.) was used to search for the source of the bleeding. A 2.7 mm endoscope was used in preference to a 4mm endoscope because its narrower diameter allowed septal deviations and septal spurs to be bypassed without undue discomfort to the patient. In addition a slim nasal endoscope is advantageous when simultaneously manipulating a suction cannula or cautery probe under direct vision in the narrow confines of the nasal cavity. In order to maintain a clear view of the endoscopic field, continual use of the suction cannula is required. As suction apparatus regularly becomes blocked with clot it is important to have several cannulae available from the outset of the examination.

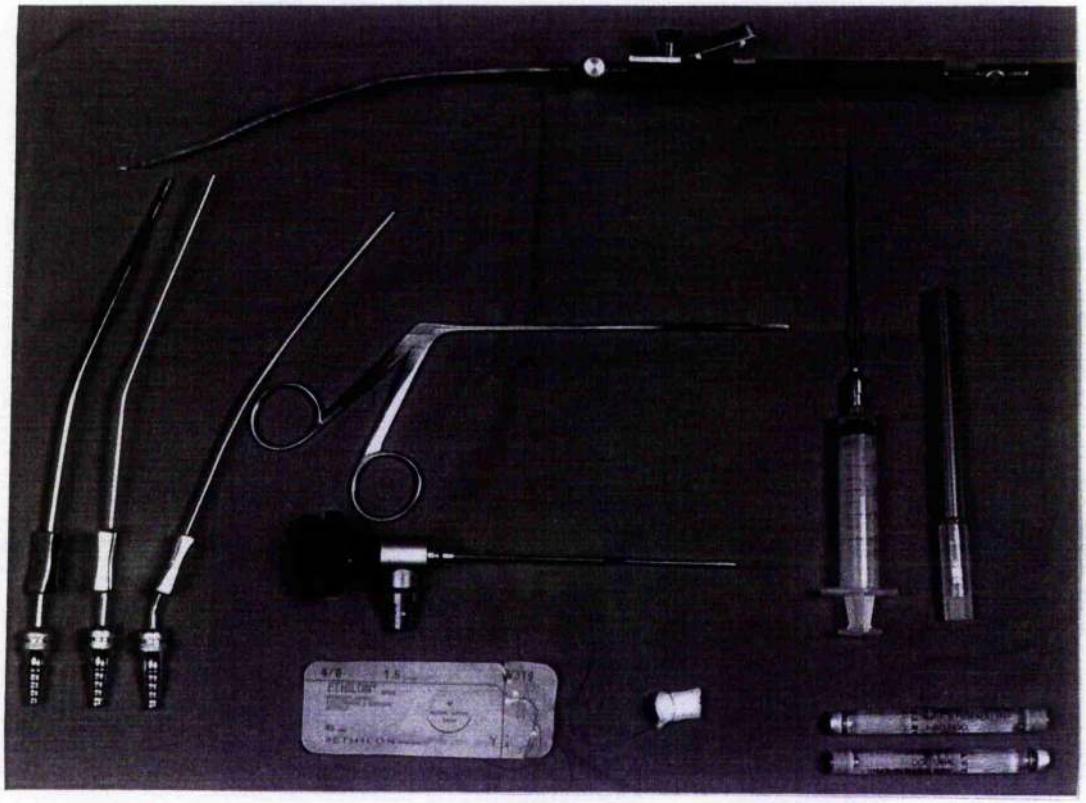
Prior to inserting the endoscope, the rate of bleeding can usually be reduced by inserting a strip of cotton wool soaked in 1.5 ml of 10% cocaine solution into the nasal cavity on the bleeding side. Xylometazoline® (Ciba Pharmaceuticals Ltd.) is an equally effective alternative vasoconstrictor which unlike cocaine is free from cardiovascular side effects. However as cocaine solution represents standard clinical practice it was used in both groups in preference to the safer Xylometazoline. The vasoconstrictor/decongestant wool pledget is removed prior to inserting the endoscope. The endoscopic search for the bleeding point should follow a systematic pattern beginning with the nasal septum, then the inferior meatus and inferior turbinate, floor of the nose, middle meatus and middle turbinate, nasal vault (including the superior turbinate and sphenoethmoidal recess), and post nasal space. Once located the area of the bleeding point can be

anaesthetised by local infiltration with 0.5ml of a solution of 1% lignocaine with 1:80,000 adrenaline. Infiltration is performed under direct endoscopic vision using a 22 gauge spinal needle on a 2ml syringe. The injection of the area around the bleeding point proved to be remarkably easy to perform and usually had the effect of reducing the bleeding to little more than a trickle, with resultant improvement of the visual field for the next stage in treatment.

Endoscopic haemostasis can be produced either by using an insulated electrocautery or by inserting small wool pledgets directly over the bleeding vessel. Whilst electrocautery is the ideal method of producing haemostasis these small pledgets provide useful backup in situations when electrocautery is not available. During the course of this study the electrocautery malfunctioned on two occasions and haemostasis was then achieved using these miniature packs. The miniature packs can consist of purpose made merocel sponges cut to size or fragments of dental roll cut to a 5mm diameter and transfixed with a nylon suture. The nylon suture allows the pack to be removed with ease. These miniature packs conform to the ideals of direct management as they are placed directly on top of the bleeding vessel to produce haemostasis by direct pressure. **Figure 11.2** shows the equipment required for the endoscopic technique.

Figure 11.2

Photograph showing materials required for the endoscopic technique. These include: 2.7 mm 25 degree nasal endoscope, long crocodile forceps, suction cannulae (three different diameters), insulated electrocautery unit, 22 gauge spinal needle mounted on a syringe for injection of local anaesthetic solution and a pledget of dental roll transfixed with nylon suture to facilitate its retrieval.



11.4 Results

During the study period there were 54 admissions that satisfied the entry criteria. There were 32 men and 22 women with a mean age of 60 years. Twenty eight patients entered Group A and 26 patients entered Group B.

Group A

Of the 28 patients in this group 16 (57%) were found to be bleeding from an anterior source and were therefore managed by silver nitrate cautery as out-patients and not studied further. The remaining 12 patients (7 male, 5 female, mean age 57 years, range 35-84 years) were suffering from posterior epistaxis (Pearson, 1983). These 12 patients underwent nasal endoscopy using the described technique and in all 12 patients the source of the posterior epistaxis was located. The site of the bleeding is shown in **Table 11.1**. Immediate haemostasis was achieved in 10 patients by local anaesthetic endoscopic electrocautery and in 2 patients by endoscopic insertion of miniature pressure packs as described above. One patient bled again within 2 hours of endoscopy and this was controlled by the insertion of a Brighton epistaxis balloon (Eschmann Health Care Ltd., 1989).

The mean duration of hospital stay for patients in Group A was 2.7 days (range 1-6 days, standard deviation 2 days). Eleven patients (92%) attended the follow-up clinic at one month. At the time of follow-up no patient had been re-admitted to hospital and no local complications were identified.

Group B

Of the 26 patients in this group, 13 (50%) had an identifiable, anterior source of bleeding. The remaining 13 patients with posterior epistaxis consisted of 8 males and 5 females with a mean age of 56 years (29-77 years). Six of these patients were managed by the insertion of Vaseline impregnated ribbon gauze nasal packs to the nasal cavity on the bleeding side and the remaining seven were managed by insertion of an epistaxis balloon catheter. Brighton balloons were used in 4 patients and the Epistat was used in 3.

Immediate control of the bleeding was achieved in all 13 patients, but 3 patients re-bled within the first 24 hours. These 3 patients required surgical procedures under general anaesthesia to obtain control of the bleeding. One patient underwent septal surgery and insertion of nasal packing, another was managed by the insertion of a nasopharyngeal gauze pack and the third patient had removal of a previously unrecognised nasal polyp followed by re-packing of the nose. The author was not involved in the decision to operate on any of these patients. One patient, a 54 year old man, collapsed and suffered an acute myocardial infarction at the time of insertion of an Epistat balloon. He was admitted to the coronary care unit where he made an uneventful recovery.

The mean duration of hospital stay in this group was 4.5 days with a range of 2 to 7 days and a standard deviation of 2 days.

Ten (77%) of the initial 13 patients attended follow-up at one month. Two complications were recorded. One patient had developed a 1 cm perforation of the cartilaginous part of the septum and another had developed a synechia between the septum and the medial border of the inferior turbinate. Neither of these abnormalities had been present prior to treatment and both of these patients had been managed by insertion of an Epistat balloon.

In-patient stay

When the mean duration of in-patient stay in the groups was compared it was apparent that the endoscopic technique allowed a shortened period of hospital stay. (2.7 days (sd 2) *v* 4.5 days (sd 2), $p<0.05$, Students t-test).

A summary of the results in group A and group B is presented in **Table 11.2.**

Table 11.1

Sites of bleeding in group A

Number of patients	Anatomical location of bleeding point
8	Posterior part of nasal septum
2	Middle meatus
1	Inferior meatus
1	Nasal floor
Total 12	

Table 11.2

Comparison of results in Groups A and B

	Group A	Group B
Total number of patients	28	26
Number with posterior epistaxis	12	13
Mean age of patients with posterior epistaxis	57	56
Initial haemostasis achieved	12	13
Re-bleeding	1	3
General anaesthesia required	0	3
Re-admission within 1 month	0	0
Procedure related complications	0	3

11.5 Discussion

This is the first study to compare the endoscopic approach to epistaxis with a simultaneous cohort of patients undergoing treatment with indirect methods. The design of the study was aimed at investigating the clinical feasibility of the endoscopic technique and to allow comparisons to be made with respect to a number of important clinical variables. Although the allocation of patients to each of the treatment groups was not via an ideal method of randomisation, the method used was not open to bias as it was entirely based on the date of presentation. In fact the comparability of the two treatment groups appears to be good and they seem well matched for age and sex. In addition the observation that comparable numbers of anterior (exclusions) and posterior bleeding points were found in both groups points to the initial overall similarity of Groups A and B.

The principal finding in this study was that the endoscopic technique allowed identification of the bleeding point in all of the patients in Group A. This finding suggests that endoscopically guided, direct, treatment is a therapeutic option in most, if not all, cases as opposed to only anterior bleeds (Pearson, 1983). It is interesting that bleeding from the lateral nasal wall accounted for only 25% of posterior bleeding points in this group of patients as this is consistent with the observations made in the separate patient group who were studied in Chapter 3.

As a result of allowing identification of the bleeding point, the endoscopic technique enabled haemostasis to be achieved in 11 out of 12 cases without recourse to nasal packing. This success rate seems on clinical grounds to be as good as, if not better than, existing treatment strategies. In addition to the apparent efficacy, the potential for reducing the duration of in-patient stay makes the endoscopic technique a very attractive means of improving the quality of patient care and simultaneously reducing the costs associated with prolonged hospitalisation. As experience with the technique grows it should eventually become possible to manage the majority of posterior epistaxis cases on an out-patient basis. All otolaryngologists should possess the ability to perform nasal endoscopy, and epistaxis provides a good opportunity for the clinician to perfect his endoscopic skills. If this technique was widely adopted in preference to the blind insertion of indirect methods such as packing or nasal balloons then it is likely that the morbidity associated with the commonest otolaryngological emergency would be significantly reduced.

Procedure related pain and discomfort

It is widely accepted that the insertion of nasal packing and to a lesser extent balloon catheters is an extremely painful procedure. Pain and discomfort continues whilst the packing is in situ and even the process of removing the packing is associated with pain (Laing & Clarke, 1990). Attempts to measure and compare the pain associated with packing and the endoscopic technique were piloted during this study. Sequential end-referenced linear analogue pain scores were recorded from patients undergoing both treatments. The results suggested that the endoscopic technique was associated with a much shorter period of discomfort. This finding is, however, clinically obvious as the endoscopic treatment takes a matter of minutes then ceases, while packing and balloons remain in situ for a minimum of 48 hours. Thus the pain rating for the endoscopic technique at 24 and 48 hours was consistently zero, compared to a spread of results for the 24 and 48 hour post-packing measurements. The numbers of patients involved in this study and the spread of results of pain scoring were such that meaningful statistical analysis was not possible.

In the author's opinion, more detailed attempts to compare the pain and discomfort associated with packing and endoscopy are likely to fail because of the numerous difficulties associated with comparison of dissimilar techniques across two different patient groups (Jensen & Karoly, 1986; Revill et al., 1976). For example a patient may score the direct technique highly on an ascending pain scale but as that patient has never experienced the pain of indirect techniques an intra-patient comparison of techniques cannot be made. Thus, the eventual comparison is inter-

patient, rather than a comparison of the techniques themselves. Despite the lack of statistical evidence, there was a strong clinical impression that endoscopy and local anaesthetic cautery was well tolerated with Group A patients suffering less discomfort than their counterparts in Group B. This observation, that endoscopy was well tolerated and relatively pain free, is supported by the fact that it is now a standard routine technique of nasal examination in out-patient clinics.

Ongoing research

A major difficulty of the direct approach is that its use demands a higher level of skill than that required to insert a nasal balloon catheter. As epistaxis is frequently managed, at least initially, by junior and inexperienced otolaryngology trainees it is likely that the efficacy of the direct technique may not reach its full potential. The practicalities of adoption of the endoscopic direct technique by all members of staff of a general otolaryngology department are currently being investigated by the author in a prospective study. In this study all members of staff (senior house officers, registrars, senior registrars and consultants) are encouraged to manage epistaxis cases by the direct technique, using endoscopy as required and defaulting to indirect methods only when the direct approach has failed.

The study which is currently recruiting patients uses outcome measures such as: ability to locate a bleeding point, immediate haemostasis and prevention of re-bleeding. The frequency and reasons for resorting to indirect strategies are also recorded.

In an attempt to minimise the technical difficulties and increase the "user friendliness" of the endoscopic technique a number of new instruments have been developed. One such refinement in the technology of the direct technique is the aspirating, electrodiathermy endoscope designed by Wolf Endoscopes Ltd. This device which is shown in **Figure 11.3** enables manipulation of the endoscope, suction and diathermy with one hand in a purpose designed housing. The author in conjunction with Wolf Endoscopes has in addition designed a special bipolar electrodiathermy probe which when used with the endoscope assembly allows local anaesthetic out-patient electrodiathermy of bleeding points (**Figures 11.3 and 11.4**).

Initial results confirm that adoption of the direct technique enables a higher percentage of bleeding points to be identified and controlled and greatly reduces the frequency of packing and nasal balloon use, irrespective of the grade of operator. Thus while staff are learning to use the direct approach re-bleeding rates and length of hospital stay appear to be already improving. This work is continuing and is likely to take another two years before completion.

Figure 11.3

Photograph of the Wolf epistaxis endoscope showing the bipolar diathermy generator.

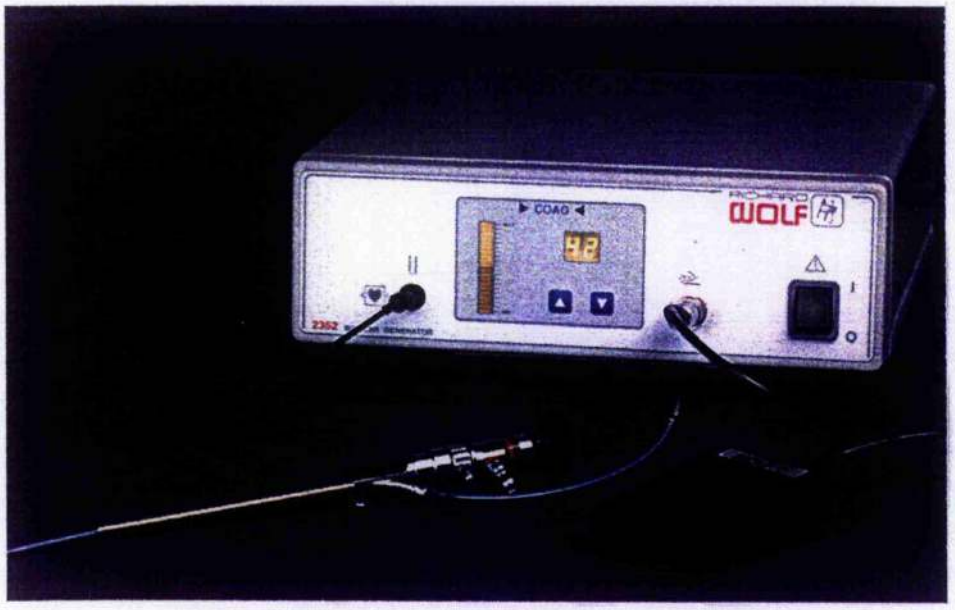
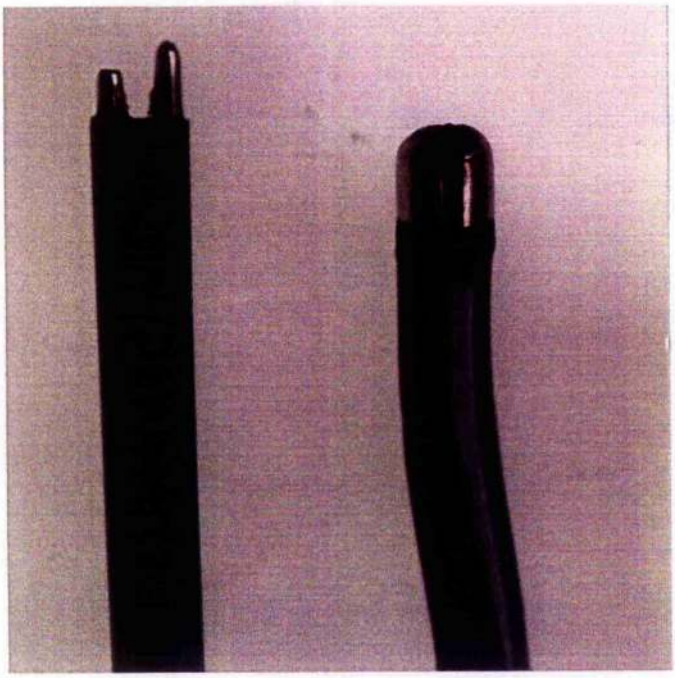


Figure 11.4

Close up photograph (x3.5 magnification) of the new bipolar diathermy electrodes for use with the Wolf endoscope. The electrode on the left has two separate needle electrodes. The electrode on the right has two semicircular electrodes separated by an insulating layer.



Chapter 12

Conclusions, clinical relevance and future research

12.1 Overview of findings

This thesis differs from the existing literature on epistaxis because of its use of prospective data collection, case control study design, and a hypothesis-based approach to test specific questions in epistaxis aetiology and management. In addition, the work was carried out on a clearly and consistently defined clinical subgroup of patients, namely adults with idiopathic epistaxis. As a result the findings should be interpreted as being applicable only to the idiopathic subgroup of patients and not to the many and varied presentations of epistaxis.

The areas chosen for study were clinically important subjects which were of particular interest to the author. There are many other areas of uncertainty in the aetiology and management of epistaxis which merit research but obviously one has to start somewhere! The following is a summary of the principal findings from both the aetiology and management sections of the thesis with a discussion of their clinical relevance.

Aetiology studies

Sites of bleeding

The finding that most cases of posterior epistaxis arise from the nasal septum is of importance to clinicians who manage adult epistaxis. This work has identified the posterior septal rami of the sphenopalatine artery as the principal vessel involved in the condition. Thus attempts at direct haemostatic manoeuvres should initially be directed to the region of the nasal septum. Operative intervention for failed haemostasis from an unknown source should also be directed towards the septum and sphenopalatine artery territory.

Much of the existing literature suggests that Woodruff's plexus is of importance in adult posterior epistaxis. This thesis has shown Woodruff's plexus to be a superficial venous plexus whose anatomical location accounted for only 8% of posterior bleeds. Although the septum has been identified as the main site of epistaxis the reasons for this remain obscure. It is possible that features of the septal mucous membrane may in some way predispose to vascular rupture. The author is currently involved in collaborative anatomical research, using cadaveric material and vascular injection techniques to investigate this area.

Alcohol and NSAID

As with any idiopathic condition, a large number of potential aetiological candidates are likely to exist. This thesis has identified statistically significant associations between idiopathic epistaxis, alcohol and NSAID. These strong associations between alcohol and NSAID and idiopathic epistaxis are of interest as they tend to suggest a possible systemic haematological causation for epistaxis rather than an isolated local nasal cause. Using the Simplate haemostatic test the mechanism of the association between alcohol and NSAID and epistaxis was investigated. A strong relationship was confirmed between the use of alcohol and idiopathic epistaxis. The possibility that this relationship was due to haemostatic abnormality was supported by the finding of a prolonged bleeding time in 46% of patients and a strong statistical correlation between the duration of bleeding time and the quantity and frequency of alcohol use. However, despite strong associations between the use of NSAID and adult epistaxis, no such effect on the bleeding time was identified for use of NSAID. This finding may be a result of a deficiency in study design or it may signify that the association between NSAID and epistaxis has its basis in a non-haemostatic mechanism.

Septal abnormalities

Nasal septal abnormalities have long been regarded as causal factors in epistaxis. While septal deviations may be related to recurrent venous epistaxis in young people there would appear to be no such relationship between septal deviations and adult epistaxis. The frequently cited association between septal deviations and adult epistaxis may simply be a result of coincidence as a result of the high prevalence of septal deviations in the normal population. Septal spurs, however,

occur significantly more often on the same side as epistaxis. In the author's opinion, the relationship between the side of epistaxis and a septal spur is likely to be due to the fact that when epistaxis occurs a co-existing spur increases the likelihood of the patient being admitted for hospital management. As the study reported in this thesis was performed on patients who had been admitted for treatment, and specifically excluded those who were treated as outpatients, there could be bias towards more difficult cases. Thus, the presence of a septal spur may simply be an indicator of difficulty in treatment and need for hospitalisation rather than a truly causal association.

Management Studies

First aid

The management of epistaxis is difficult and many techniques have been employed in the attempt to achieve haemostasis. This thesis has shown that the first-aid treatment of nasal bleeding is poorly understood, even by hospital staff. Indeed, the majority of accident and emergency staff were unaware of the correct application of the Hippocratic method of achieving haemostasis. The result of this deficiency could be increased blood loss and the inappropriate referral to specialist services of individuals who may have responded favourably to first-aid. Thus, the training of accident and emergency staff in the correct application of the Hippocratic technique needs to be improved.

Balloon catheters

Epistaxis balloon catheters are commonly used to achieve haemostasis in epistaxis. Their use is particularly appealing as they do not require specialist supervision. This thesis has shown that the design of the three most frequently used balloons is flawed. In particular, the devices are too long for the nasal cavity and those which aim to produce haemostasis by tamponade fail to do this. Using radiological and anatomical data, it has been shown that nasal balloon catheters should be shorter and incorporate a variable intra-nasal length similar to that used in the Brighton balloon. Attempts at tamponade using existing devices are likely to be unsuccessful and therefore new designs should aim to occlude the anterior and posterior nasal apertures. In producing choanal occlusion, the shape of the posterior balloon is important as excessive expansion in the nasopharynx may be

responsible for the pain and headache which results from pressure on the skull base. With these design modifications in mind, the author has designed a new intra-nasal balloon.

Direct haemostasis

The theoretical ideal in epistaxis is to achieve haemostasis without the need for nasal packing or balloons. Ideally this should be achieved without the need for operative intervention and with a low incidence of procedure-related side effects and rebleeding. The trial of direct management in posterior epistaxis involved the development and application of endoscopic techniques for haemostasis. The study confirmed that the endoscopic technique was both clinically feasible and efficacious. In addition to producing haemostasis and complication rates which were comparable to existing indirect methods, the endoscopic technique allowed a shorter in-patient stay. Research continues in this area, in particular examining the general applicability of the endoscopic technique and the effects of new endoscopically guided technologies.

12.2 Future Research

Inevitably, the work of this thesis has given rise to many other questions. Brief details of current and planned future research in the aetiology and management of epistaxis are discussed below.

Aetiology Studies

Associations between idiopathic epistaxis, alcohol, haemostatic abnormality and non-steroidal anti-inflammatory drugs are likely to explain only a proportion of patients with idiopathic epistaxis. The underlying aetiological factors in the other patients remain to be explored. Whilst alcohol, non-steroidal anti-inflammatory drugs and haemostatic defects may all be related to the aetiology of adult epistaxis, the **initiating** factors remain obscure. It is possible that, in addition to haemostatic effects, alcohol may exert haemo-dynamic effects on nasal blood flow and blood pressure which may in some way initiate epistaxis. The development of sensitive methods for recording nasal blood flow (laser Doppler interferometry) has made detailed, in vivo, studies of the vascular effects of potential aetiological agents feasible.

Management studies

The author is currently active in the development and assessment of new techniques for direct management of epistaxis. This includes the design of bipolar electrodiathermy equipment which can be used in conjunction with the nasal endoscope to produce direct haemostasis in posterior epistaxis. The direct and endoscopic therapies developed in this thesis are now the mainstay of management

in the author's own department and their use is gaining widespread acceptance throughout otolaryngology (Elwany & Abdel Fattah, 1996; Wurman, 1996). The impact of this change towards direct treatment is the subject of an audit study being carried out by the author. Initial findings show a marked reduction in hospital stay, re-bleeding rates and need for general anaesthetic procedures in comparison to two years ago in the same department.

It is likely that in time more of the aetiological factors in epistaxis will be identified and the number of idiopathic patients will become significantly smaller. Awareness of possible aetiological factors may lead to ways of reducing the frequency of the condition and also help to prevent recurrences. The development and refinement of direct haemostatic techniques will ultimately make adult posterior epistaxis treatable on an outpatient basis in the vast majority of cases. This aim, of out-patient therapy for the most frequent otolaryngological emergency, is already being realised and its effects on health care resource management are being demonstrated.

Appendix 1

EPISTAXIS AETIOLOGY

Hosp. No	.....	Name
D.O.B	...\...\...	Address
Date of Adm.	...\...\...	
Date of Disch.	...\...\...	
Sex	.....	1 Male 2 Female
Social Class	.....	1 Manual 2 Non manual

Medical Hx

TREATED BY METHOD	.....	A B C

ALCOHOL		
Status	.....	1 Non Drinker 2 Occasional Drinker 3 Regular Drinker
Alcohol < 24 Hr	.....	0 No 1 Yes
Alcohol Units/Wk	.....	

DRUG HX

List current drugs:

NSaid	.....	0 No 1 Yes
Name NSaid.....		
Prescribed by G.P.	.....	0 No 1 Yes
Reason	.....	1 Arthritis 2 CVS Prophylaxis 3 Rheumatism 4 URTI 1
If answer No 5 please specify		5 Self Adm. Other

URTI

Recent URTI	.....	0 No 1 Yes
If Yes:		
Date of onset of symptoms	...\...\...	
Medication for symptoms.....		

HYPERTENSION

On medication for HBP	.....	0 No 1 Yes
If Yes:		
Drug.....		

INVESTIGATION

Septal Anatomy	.....	0 Normal 1 Deviated to bleeding side 2 Deviated away from bleeding side 3 Spur on bleeding side 4 Spur on other side 5 Perforation 6 Adhesion 7 Polyps 8 Other
If other please specify.....		

BLEEDING TIME

Time of estimation	.....	
Date of estimation	...\...\...	
Simplate Time	.....	seconds
Simplate Time	.....	seconds

If simplate time is abnormal attach copy of coagulant screen.

FBC

DATE	..../..../....	..../..../....
HB		
PLATS		
WCC		
MCV		

BIOCHEMISTRY

DATE	..../..../....	..../..../....
&GT		
CRP		

EPISTAXIS MANAGEMENT STUDY: DATA SHEET

Hospital No..... Name

Date of birth ...\...\... Address

Doctors initials.....

Date of admission ...\...\...

Time of admission :....:....: Use 24 hour clock notation

Date of onset of bleed ...\...\...

Time of onset :....:....: Use 24 hour clock notation

Side of bleeding ..... 1 Right
2 Left
3 Both
4 Uncertain

INITIAL SURVEY

1. Is the bleeding from Little's area? ..... 1 Yes 2 No
2. Has the bleeding stopped? .....
3. Is there a history of recent nasal surgery? .....
4. Is the bleed duration less less than 1 hour? .....
5. Has the bleed followed nasal trauma? .....
6. Is the patients on anti-cogulants? .....
7. Has the nose already been packed? .....

IF THE ANSWER TO ANY QUESTION BETWEEN 1 AND 7 IS YES THE PATIENT HAS FAILED THE ENTRY CRITERIA FOR THIS STUDY AND SHOULD NOT UNDERGO RANDOMISATION. ALL OTHER PATIENTS SHOULD NOW BE RANDOMISED TO A TREATMENT GROUP.

Treatment limb allocated	.....	A B C

FROM NOW ON COMPLETE ONLY THAT PART OF THE FORM WHICH REFERS TO THE TREATMENT LIMB ALLOCATED TO THE PATIENT.

Treatment A Complete Questions 8 to 18

Treatment B Complete Questions 19 to 26

Treatment C Complete Questions 27 to 34

TREATMENT LIMB A.

Search for the bleeding vessel, using endoscopy if required, and direct control of the bleeding point.

8. Has the bleeding point been located?	.....	1 Yes 2 No
9. How was the bleeding point located?	.....	1 Standard examination 2 Nasal endoscopy 3 Combination of both 9 Not located
10. Where is the bleeding point?	.....	1 Septum anterior to piriform aperture above level of m.turbinate 2 Septum anterior to piriform aperture below level of m.turbinate 3 Septum posterior to piriform aperture above level of m.turbinate 4 Septum posterior to piriform aperture below level of m.turbinate 5 Lat.nasal wall above level of m.turbinate 6 Lat.nasal wall below level of m.turbinate 7 Nasal floor 8 Other (specify in space below Question 10) 9 Unknown
11. How has the bleed been managed?	.....	1 Endoscope cautery 2 Non-endoscope cautery 3 Endoscope other 4 Non-endoscope other 5 General anaesthetic 6 Brighton Balloon 9 Unknown
If answer is 3,4 or 5 please specify...		
12. Has the bleeding stopped?	.....	1 Yes 2 No
13. If answer to Q.12 is 2(No) what action is being taken?	.....	1 None required 2 Brighton Balloon 3 General anaesthetic 4 Other
If answer is 3 or 4 please specify.....		

14. What is the patients immediate post procedure linear analoque score?	0 - 25

OUTCOME

Date of discharge ...\...\...	
Time of discharge :....:....:	Use 24 hour clock notation

15. Has there been any further bleeding during this admission?	1 Yes 2 No
16. If the answer to Q.15 is yes(1) what further action was taken?	1 None required 2 Brighton Balloon 3 General anaesthetic 4 Other
If answer 3 or 4 please specify.....	
17. What is the patients linear analogue score at 24 hours post admission?	0 - 25

FOLLOW UP AT CLINIC AT ONE MONTH

18. Has the patient required readmisssion with epistaxis?	1 Yes 2 No 3 Don't Know
19. Does the patient have any complication of the treatment?.....	1 No 2 Yes septal perforation 3 Yes nasal adhesions 4 Yes sinisitus
If answer is 5 specify.....	5 Other

COMMENTS

TREATMENT LIMB B

Insertion of a Brighton epistaxis balloon into side of bleeding.

20. Is the bleeding controlled by the balloon?	.....	1 Yes 2 No
21. If the answer to 20 is no(2) what action was taken?	.....	1 Nasal pack 2 General anaesthetic 3 Other
If answer is 3 please specify.....		
22. What is the patients immediate post procedure linear analogue score?	.....	0 - 25

OUTCOME

23. Did the patient rebleed during admission?	.....	1 No 2 Yes with balloon insitu 3 Yes after balloon removal 4 Both before and after balloon removal.
24. If the patient did rebleed what action was taken?	.....	1 Re-insert the balloon 2 General anaesthetic 3 Other 4 Examination and cautery 5 Nil
Date of discharge	...\...\...	
Time of discharge	:....:....:	Use 24 hour clock notation
25. What was the patients linear analogue score at 24 hours?	.....	Enter 0 - 25
48 hours?	.....	

FOLLOW UP VISIT IN ONE MONTH

26. Has the patient required readmission with epistaxis?	.....	1 Yes 2 No 3 Don't know
27. Are there any complications of the treatment?	.....	1 No 2 Yes septal perforations 3 Yes nasal adhesions 4 Yes sinusitis
If answer is 5 please specify.....		5 Other

COMMENTS

TREATMENT LIMB C

Nasal packing to side of bleeding using B.I.P.P. guaze.

28. Is the bleed controlled with packing?	1 Yes 2 No
29. If answer to Q.28 is no(2) what action have you taken?	1 Brighton balloon 2 Re-insert pack 3 Post foley 4 Two and three 5 Examination and cautery 6 General anaesthetic 7 Endoscopic examination 8 Other 9 Nil
If answer is 6 or 8 please specify.....	
30. What was the immediate post-packing linear analogue score?	0 -25
31. Was there further bleeding during admission?	1 Yes 2 No
32. If the answer to Q.31 is yes(1) what action have you taken?	1 Brighton Balloon 2 Re-insert the balloon 3 Post foley 4 Two and three 5 Examination and cautery 6 General anaesthetic 7 Endoscopic examination 8 Other 9 Nil
If answer is 6 or 8 please specify....	
Date of discharge ...\...\...	
Time of discharge :....:....:	Use 24 hour clock notation
33. What was the patients linear analogue score at 24 hours	0 - 25
48 hours	

FOLLOW UP VISIT IN ONE MONTH

34. Has the patient been readmitted with epistaxis?	1 Yes 2 No 3 Don't know
35. Are there any complications of the treatment?	1 No 2 Yes septal perforations 3 Yes nasal adhesions 4 Yes sinusitis
If answer is 5 please specify.....	5 Other

COMMENTS

Appendix 2

Published articles

Reprints of published articles originating from the work of this thesis are held in an envelope attached to the back board of the thesis.

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