

Nitrous Oxide Anaesthesia.



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T H E S I S .

for

M. D.-

J. Sim Wallace. B. Sc., M.B., C.M.

NITROUS OXIDE ANAESTHESIA.

Dr. Litch in his work on Anaesthesia and Anaesthetics (p.p.179) makes the following statement:-

"While in common with Prof. Darby and many others, the "writer has frequently heard statements as to the permanently injurious results which in individual instances have followed the inhalation of Nitrous Oxide, it has not been easy to secure satisfactory data concerning such cases".

In consequence of this statement, I made a systematic, and as far as possible complete examination and report of a number of cases in order to secure the data required.

Included in the clinical report was an examination of the urine, which I had the opportunity of making in 60 cases. The results indicate:-

The effect of Nitrous Oxide on the Kidney.

The routine pursued in these cases was as follows:-

I examined the urine before administering the nitrous oxide, and made a few notes as to the general health, pulse, etc.- I then proceeded with the administration of the gas

in the ordinary way, the patient in each case having a tooth -or teeth extracted. When the patient recovered from the operation and the anaesthesia, I made a full report of the case and examined the urine again. A further examination of the urine was made when the patient returned on the following day, and at other intervals.

A synopsis of the results derived from these examinations is as follows:-

In about half of the cases there was no appreciable change in the urine taken after the anaesthesia, from that taken before:-

The post-anaesthetic urine was often of a deeper colour and of a higher specific gravity than that which was taken before the anaesthesia sometimes depositing urates on standing, when the pre-anaesthetic urine did not. Probably this was simply due to concentration. As the quantity of urine obtained shortly after the anaesthesia was necessarily small the specific gravity was taken by means of beads, and as these each differed by .0005 the specific gravity was not very accurately determined.

Sugar was tested for in 30 cases with Fehling's solution -with negative results.

In 15 of the cases the urine taken after the anaesthesia showed a turbidity, decidedly greater than that shewn by the urine taken before the anaesthesia. I examined the turbid urine microscopically, and found numerous cells of various kinds, chiefly small round cells and large nucleated granular principally squamous cells. Of course in the sample which contained blood (to be more fully mentioned below) the blood corpuscles were also observed though not in great number.

In 7 cases phosphates were indicated in quantity (by being precipitated on boiling, but dissolved on the addition of a drop of acetic acid) in the urine taken before the administration of the gas, whereas phosphates were not so indicated after the anaesthesia. In two cases phosphates were thus indicated both before and after the administration. The presence of phosphates might possibly be due to nervous excitement and fear of the operation.

In nine cases the urine, which contained no albumen before the anaesthetic was given, contained albumen after the anaesthesia. In two of these cases the albumen shewed itself after a week's time, in one it was diminished in amount

after 24 hours, and in the remaining cases, after a day it had disappeared from the urine. Three cases were only examined once after the anaesthesia.

one case

In ~~the following~~ the urine taken before the anaesthesia contained a considerable quantity of albumen while that taken after the anaesthesia contained about three times the previous amount. The urine of this case was again examined a week later when the albumen was still present, though not so copiously as on either of the two previous occasions. The microscope showed no evidence of tube casts. Patient stated on being asked, that he had scarlet fever six years ago but had felt perfectly well since.

As the following case is interesting I shall give a few notes of his case.

W.K., age 32, Glass-maker in good health. Had taken food about one and a half hours before the anaesthetic was administered. Took gas, sat during the operation and recovered consciousness quietly. After regaining consciousness felt in a particularly happy frame of mind. Stertor was just brought on, he became slightly livid: and the conjunctival reflex was almost abolished.

The pupil, before the anaesthesia, was very small - on beginning to lose consciousness it dilated very considerably, towards the end of the anaesthesia it again contracted, but not to the degree at which it was at the commencement of the anaesthesia.

The urine immediately before and fifteen minutes after the operation was free from albumen.

So far this case may be considered normal. The following note however, taken seven days after the operation, shows a remarkable development of the case.

W.K. had headache the day following the anaesthesia, which increased in severity for the next twenty-four hours, when it was very severe. (Headache following nitrous oxide anaesthesia is not uncommon, but I have failed to learn from the literature on the subject what the cause of the headache may be.- In this case it was possibly associated with some kidney trouble). He also complained of pain in the middle of the lumbar region of a peculiar darting character, -it came on twenty-four hours after the anaesthesia, and increased in severity till the following day

when it was most severe, and on one occasion made him fall. He had never had an attack of this kind before. He mentioned that his urine on the third and fourth day after the anaesthesia had been almost as clear as water, but since then it had gradually returned to its usual colour. (It may be remarked that on the two days mentioned it was decidedly colder than the days preceding and succeeding them).

The urine on being examined was deep in colour and showed a trace of albumen.... In the following case, although the urine was normal before the anaesthesia, besides a trace of albumen blood was also detected in the post-anaesthetic urine. This case is rather interesting, so I shall give a few extracts from the report of the case.

J.B. a delicate looking lad of 16 years.- Two teeth were extracted. During the extraction of the second there was muscular rigidity and opisthotonos. The pulse on beginning the inhalations soon became only indistinctly perceptible, but on continuing the anaesthetic became more distinct. The breathing was regular throughout. On discontinuing the anaesthetic the pulse again became very weak and remained in an unsatisfactory state for over a quarter of

an hour. Just after the anaesthesia he felt sick and continued in this state, more or less, for the next twenty minutes. He vomited a little blood which had apparently been swallowed. The treatment he got, was the recumbent posture and ammonia to inhale.

The point, however, of special importance, in connection with this case, over and above the fact of his having albumen and blood in his urine after the anaesthesia, is that he complained of a severe pain in the left lumbar region.

The pain was described as sharp, and lasted about one or two minutes, and did not return.

The fact, that in both the cases in which pain in the lumbar region of this suspicious character was complained of, were associated with albumen and changes in the urine, points rather directly to an unfortunate action on the kidney.

That nitrous oxide has a distinct and probably serious action on that organ in some cases is I think obvious. It is remarkable that most books on the subject do not refer to the kidney, and after-effects when discussed at all are not spoken of in connection with its action on that organ.

The following extracts from the most recently published work on the subject illustrate the current opinion. †

"Kidney complications have no significance in the administration of nitrous oxide" (page 48).

"The after-effects are usually so slight that they are scarcely worth considering". (page 26).

The cause of the action on the kidney is not very obvious, at first I thought that it might simply be ^{due} to a sudden transitory dilation of the renal arteries, but that would not account for the continuance of the albumen in the urine. Besides it is stated (by Mouat and Buxton) that the blood-vessels in the splanchnic area contract while the blood-vessels of the surface of the body dilate, the sphygmographic pulse tracings showing a lowering of blood pressure.

As the administration of nitrous oxide sometimes causes perspiration apparently unaccountable by the slight transitory dilation of the vessels of the surface, it seems as if it may have a direct action on the sudatory glands independent of its indirect action through the circulation.

† (Notes on Anaesthetics in Dental Surgery by Arthur S. Underwood, M.R.C.S., L.D.S. Eng. and C. Carter Braine F.R.C.S. 2nd Edition, 1893.)

Possibly it has also a corresponding action on the kidney, both organs being probably engaged in the elimination of the nitrous oxide. However, this may be, the probability of kidney trouble being accountable for some of the after-effects occasionally complained of is I think clearly indicated.

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What - it may be asked - is the most favorable state of the stomach for the administration of nitrous oxide ?

From a consideration of the belief that some of the ideas with regard to nitrous oxide have been derived from imagining that what was true regarding chloroform and ether would likewise be true concerning nitrous oxide, I have directed my attention to the statement that nitrous oxide should preferably be administered when the stomach is empty.

Out of the 500 times in which I have administered nitrous oxide, I have had two cases of vomiting. The following notes are extracted from the reports taken of these cases.

W.W. Aet.19. Steel worker in good health. Had last

meal three hours before taking the nitrous oxide. Gas was given twice, the second administration about seven minutes after the first. During the first anaesthesia nothing abnormal was observed. Just before recovering consciousness from the second administration the pulse became hardly perceptible at the wrist; on trying to rise he felt giddy and so was laid on the floor. About seven minutes afterwards he vomited. The vomited matter showed that the food had not been properly masticated and was much like vegetable soup. The food which he had last taken before the operation consisted of fish and bread, but on enquiring I found that he had also had soup three hours before the fish, that is, six hours before the administration of the anaesthetic. He mentioned that soup did not agree with him. Till he was 14 years of age he had been troubled with headache and vomiting, always when his head was sore the vomiting came on. For the last five years he has been free from this complaint.

(This case bears a resemblance, as far as the stomach is concerned to a fatal case which occurred in Edinburgh a few

years ago, in which the stomach was distended with undigested food. The food had been taken early in the morning and the anaesthetic was given at noon.)

My other case in which sickness and vomiting occurred presented the following features as regards the stomach.

J.B. Aet 16. Composer. Has never been confined to the house by illness, but his general appearance, with the presence of boils and pallor, does not indicate good health. Last meal was taken four hours before the anaesthetic was administered and consisted of bread and tea..

Just after the operation he felt sick, the sickness continuing about 20 minutes, during this time the pulse was very weak. He retched and vomited a little blood which he had apparently swallowed.

As this case was interesting in other respects the state of the urine, pain in the lumbar region etc. have been already recorded. (see J.B. page 6)

This case presented the most disagreeable symptoms of any of the cases which I have had. From what is noted above it is most probable that there was no food in the stomach,

and I am inclined to believe that had this patient taken a nourishing meal an hour or two before having the anaesthetic the disagreeable symptoms might have been mitigated.

In one case I discontinued the nitrous oxide before complete anaesthesia was brought on, because of retching. The patient, an anaemic girl, had taken no food for four hours previously.

Judging from these cases, (and I unfortunately can find no others recorded) I think that it is more important, in the case of nitrous oxide anaesthesia, to have the stomach performing its normal functions without undue strain, than necessary to have the stomach empty, as it is likely that faintness or syncope will be induced more readily with an empty stomach than otherwise. It may here be stated that of the fourteen fatal cases which have been recorded due to nitrous oxide, syncope (simple) has been the cause of three deaths. Syncope figured prominently in some of the others but in no fatal case has vomiting or obstruction of the larynx from vomited matter been the cause of death. In the fatal case in Edinburgh, vomiting came on after syncope, during the performance of artificial respiration.

The effect of Nitrous oxide on the eye.

With regard to the general statement that the pupil dilates towards the end of the anaesthesia, I have recorded the following:-

I first observed the size of the pupil after the patient had got seated, generally of course, before a well-lighted window. At this stage I had difficulty in forming an opinion as to what the size of the pupil was, on account of the patient changing the focus. The time I fixed on for determining whether contraction or dilatation had taken place, was when distinct stertor was brought on. The following are the results of these observations recorded in 65 cases and reduced to percentages.

Pupil dilated distinctly in...	13.9	per cent.
" " slightly in....	43.8	" "
Pupil neither contracted nor dilated.....	33.9	" "
Pupil contracted slightly in..	6.16	
" " distinctly in..	3.08	" "

What I think of more value than the state of the pupil in watching the progress of the anaesthesia is the vacant, slow, unconscious appearance the eye assumes, and the gradual blunting of the conjunctival reflex.

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Some points to which I directed my attention, being as far as I see at present, productive of no new information, I have not recorded here (e.g. temperature, pulse, etc.,) I trust, however, that what I have done may further our knowledge on this subject.

James Sim Wallace B.Sc., M.B., C.M.