admission. The spleen was palpable one inch below the costal margin; haemoglobin was 38 per cent. She was between seven and eight months pregnant, and obviously very ill; she seemed confused. A course of atebirin and plasmoquine was begun on January 17th. At the end of this treatment she was very much improved. Mental symptoms cleared up forty-eight hours after admission. On the fifth day haemoglobin was 45 per cent. The course was repeated on January 26th. In addition she received 1 per cent. arsenical solution—3 minims, rising to 5 minims, three times a day. She is still in hospital awaiting parturition. On February 9th her haemoglobin was 75 per cent. She is walking about and is apparently quite well. Blood findings shown on temperature chart.

CASE VII

A male European, aged 34 years, was admitted on January 17th, 1932, with a history of numerous attacks of malaria. Present illness over a week. Complained of usual symptoms of fever, especially very severe headache. He was slightly jaundiced; the spleen was just palpable; and he had very septic teeth. Blood findings indicated on chart. At the date of writing (March 1st) he is still in hospital awaiting dental attention, but is otherwise well. A course of atebirin and plasmoquine was given, and a second similar course was started on February 27th.

CASE VIII

A male European, aged 28 years, was admitted on February 19th, 1932, with a history of malaria for over a month and of previous attacks. Mentally somewhat dull, verging on coma. Decidedly jaundiced. Pulse bad. Spleen was palpable 2 cm. below costal margin. Complained of very severe headache. Blood examination showed a mixed infection, with practically every blood cell containing a parasite. Many blood cells contained two parasites. Atebrin and plasmoquine were given as above. The results of the blood examination are recorded on the chart. Haemoglobin estimation was done with the Dare haemoglobinometer. A second course was started on February 27th. He is now convalescent.

The last case was of extreme severity, and would be considered as one in which quinine should be given intravenously. One would be justified in regarding this case as being in the pre-haemoglobinuric state. His recovery under atebirin-plasmoquine I regard as a particularly striking demonstration of the efficacy of these drugs.

AVERTIN ANAESTHESIA IN CHILDBIRTH

BY

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The following investigation has been carried out with the purpose of determining to what extent avertin anaesthesia is of value in childbirth. The anaesthetic has been administered to forty-five patients—thirty-two of whom were primiparae and thirteen multiparae. Although the number is very small, some idea has been gained of the value of the method. The whole technique has been made as simple as possible, so that the anaesthetic may be of use in general as well as in hospital practice.

TECHNIQUE

Preparation of Avertin for Use.—All patients have been weighed as far as possible at the end of the eighth month, and the appropriate dosage read off from the Bayer Products Ltd. avertin obstetric dosage table. A 2½ per cent. solution has been used, which corresponds to 0.075 c.cm. per kilogram body weight. A green glass bottle is heated to 40° C. by immersion in hot water, and the measured quantity of Squire's redistilled water run into the bottle. The avertin, measured in minims, is added, and the mixture shaken for several minutes. Occasionally a white deposit appears, but this will dissolve

on continuous shaking. By the use of redistilled water instead of distilled water the solution remains unchanged for as long as one month; thus the drug can be made up and kept ready for use. Before injection of the anaesthetic, the solution is tested by adding to 5 c.cm. of it one drop of 1 in 1,000 Congo red; the red colour should remain unchanged. If the solution is impure, dibromacetaldehyde is liberated, which turns the red to a blue colour. The solution must then be discarded, and a fresh one prepared. This has been necessary three times in the present series.

Administration of Avertin.—It has been found during the course of the investigation that the most advantageous time at which to give avertin is when the os is fully dilated in primiparae, and at three-quarter dilatation in multiparae. On admission to the labour ward, provided that time permits, the patient is bathed, shaved, and given a simple enema. Avertin cannot be administered unless an enema is given and the rectum is empty. The necessary apparatus consists of a glass funnel, to which is attached a No. 6 catheter and a measuring flask, into which the avertin is measured from the bottle. In many of the cases only two-thirds of the calculated dose was used, while in the remainder the total amount was given. At the termination of a pain the patient is placed in the left lateral position, the anus swabbed with biniodide, and the catheter inserted about three inches into the rectum, the funnel and tubing having been previously filled with the solution. The fluid as a rule runs in very easily, but occasionally the catheter has to be manipulated before the flow begins. The injection is made slowly. Should a contraction occur during the administration, the catheter is withdrawn, and the anus closed by pressure on the buttocks, so as to prevent ejection of the avertin.

EFFECTS OF AVERTIN

On the Mother.—The effects of avertin were found to vary considerably. In some patients the result was miraculous. A noisy, unruly patient has immediately become drowsy and lapsed into a deep sleep, while others have shown no sign of drowsiness until as long as twenty-five minutes after the injection. In the present series the average time at which drowsiness occurred was eight and a half minutes after administration. A few patients became absolutely unconscious, only stirring very slightly during the pains, and being quite unaware of the birth of the child. The majority, although asleep between the pains, wakened with each contraction, and were frequently difficult to control owing to arching of the back and movements of the arms and legs. This opisthotonos was more evident than in labours without anaesthesia. In a small proportion of cases, especially in multiparae, the patients did not become drowsy, but admitted that the pains were less severe after the avertin injection.

The time interval between contractions was recorded before and after administration, and it was found that the interval between pains was increased, thus unduly prolonging the second stage. The average duration from the administration of avertin until delivery was two hours thirteen minutes in primiparae. In some of these cases avertin was given at three-quarter dilatation, and in others at full dilatation. The third stage of labour has been concluded normally, no excessive haemorrhage having occurred, with separation of the placenta. Many of the patients have slept peacefully for several hours after delivery. No dangerous symptoms have followed avertin administered in the recommended dosage. In no case has either cyanosis or difficulty in breathing occurred. The respiration rate is sometimes slowed, sometimes quickened, while the depth is diminished. The pulse is slightly increased. The blood pressure falls on an average by about 10 mm. Hg.

On the Child.—Avertin does not affect the child in any way. After delivery it immediately cries lustily and progresses along normal lines. Five of the infants were premature. One of these infants was delivered by Caesarean section, avertin being used as a basal anaesthetic, supplemented by gas, oxygen, and ether. The mother was suffering from confusional insanity of pregnancy, and termination was advisable. The child appeared to be of about thirty weeks' gestation, and survived its birth by ten hours. Great difficulty was experienced in reviving one child where the second stage lasted three hours twenty minutes. Morphine $1/4$ grain, and scopolamine $1/150$ grain, had been given three hours before avertin and six hours before delivery.

There were two stillbirths in the series, but neither could be attributed to avertin. One occurred in a breech presentation, complicated by prolapse of an abnormally long cord, and the other in a primipara who had had no previous ante-natal care or treatment for venereal disease. She was admitted in labour with gonorrhoea and primary syphilitic sores on the vulva. She was an extremely noisy patient, so that it was determined to give avertin early in the first stage and note its effects. The patient lapsed into drowsiness for five hours while the os slowly dilated. During the second stage the foetal heart began to fail, but owing to her venereal condition it was inadvisable to apply forceps, otherwise the child might have been saved.

ILLUSTRATIVE CASES AND COMMENTS

The following ten cases illustrate the chief points of avertin anaesthesia.

is awaited the head may come down so quickly that it may not be possible to administer the avertin.

Two dosages of avertin were used with a view to determining whether or not lesser dosages than those previously advocated were of value. In some cases only two-thirds of the dose, as calculated from the Bayer obstetrical table, was given. There did not appear to be much difference in the results obtained. The temperament of the patient seems to be the chief factor; the placid patient became more profoundly unconscious than the highly excitable, noisy patient when given corresponding doses. In two cases the injection was made by the maternity ward sister, two-thirds of the calculated dose being used, and both were satisfactory. The effective duration of the drug is, on an average, two hours, after which time it passes off.

The first five cases illustrated are normal labours in primiparae, and show the relation between the time of administration of avertin and the dosage used. The sixth case was that of a breech presentation complicated by prolapse of an abnormally long cord. At full dilatation the cord was replaced and avertin given. Unfortunately the frequency of the pains was diminished and the cord again prolapsed. The anaesthesia had passed off by the time of delivery, which had to be assisted by chloroform given by a Junker apparatus. A stillbirth resulted. Judged from further experience with avertin, it would have been better not to have used it in this case. Avertin is unsuitable in labours where the second stage is likely to be prolonged—that is, in disproportions and abnormal presentations—because of the diminished frequency of the pains. The seventh case is an example of where two

Case No.	Age	Parity	Degree of Dilatation or Os when Avertin Given	Amount of Avertin Given	Onset of Drowsiness Occurred in—	Time Interval Between Avertin Administration and Delivery	Interval Between Pains		Condition of Child	Notes
							Before	After		
1	26	First	Three-quarters	Two-thirds total dose	min. 10	2 hrs. 25 min.	min. 1	min. 4½	Good	Successful. Very drowsy, but could be roused. Painless delivery
2	21	First	Three-quarters	Two-thirds total dose	23	8½ hrs.	5	8	Good	Unconscious during early part second stage. Delay followed avertin. Effect worn off after 4½ hours. Not satisfactory. Delivery completed without anaesthesia
3	21	First	Full	Two-thirds total dose	10	1 hr. 14 min.	2	3	Good	Completely successful. No delay. Painless delivery
4	17	First	Full Head coming down	Total dose	10	½ hr.	5	4	Good	Very drowsy, but restless. No delay. Satisfactory anaesthesia
5	22	First	Full	Total dose	8	4 hrs. 15 min.	4	7	Good	Unconscious during early part second stage. Some delay. Effect of avertin worn off before delivery
6	17	First	Full	Two-thirds total dose	10	2 hrs. 20 min.	6	6	Stillborn	Breech presentation with prolapse of cord. Delay. Avertin worn off before delivery, which had to be assisted by chloroform in a Junker. Unsatisfactory
7	20	First	Full	Two-thirds total dose	3	1 hr. 25 min.	3	5	Premature. 4 lb. 4 oz. Lived three weeks	Ante-partum haemorrhage due to marginal placenta praevia. Under C ₂ E ₃ anaesthesia membranes ruptured; plugged with flavine gauze. Delivered on following day under satisfactory avertin anaesthesia
8	23	First	Full	Two-thirds total dose	3	27 min.	3	3	Premature. 5 lb. 7½ oz. Survived	Patient had very painful gonococcal arthritis of wrists. No delay. Rapid painless labour
9	23	Second	Three-quarters	Two-thirds total dose	2	1 hr. 13 min.	2	5	Normal	Deep drowsiness produced. Pains weaker and diminished in frequency. Delivery practically painless. Slept for two hours after delivery
10	25	Second	Full	Total dose	5	½ hr.	2	2	Normal	Avertin was given too late, but drowsiness was produced and delivery was effected without much discomfort

It will be seen that the effect of avertin varies, like all other factors in labour. During the investigation the drug has been given to primiparae either at three-quarter dilatation or full dilatation of the os. Although some cases have been successful when the drug has been injected at three-quarter dilatation, it has, on the whole, been found more satisfactory to give it at full dilatation. If given too soon delay follows, because the uterine contractions become less frequent and weaker, and the effects of the drug pass off before delivery is completed. It can, however, be supplemented by chloroform in a Junker apparatus. In multiparae it is essential to give the injection at three-quarter dilatation, otherwise if full dilatation

anaesthetics have been necessary on two successive days. There was an ante-partum haemorrhage due to marginal placenta praevia. Under general anaesthesia (C₂E₃) the membranes were ruptured and the vagina packed with flavine gauze. On removal of the gauze twenty-two hours later the os was fully dilated, avertin given, and the patient experienced a comfortable and painless labour. This illustrates the advantage of avertin when a second anaesthetic is required, since it is well known that occasional deaths occur from delayed chloroform poisoning when this drug has been repeated during the same confinement. The eighth case is that of a patient suffering from painful gonococcal arthritis of both wrists. Her labour

was made more tolerable by avertin. The last two cases in the series illustrate the use of the drug in multiparae. It must be given when the os is three-quarters dilated. Several multiparae, intended for inclusion in the series, were on examination found to be too far advanced to admit of administration of the drug, since the head was on the perineum.

CONCLUSIONS

1. Avertin is of value in normal labours provided that it is given at full dilatation of the os in primiparae, and at three-quarter dilatation in multiparae.

2. It is of special value where a previous chloroform anaesthesia has been necessary in the same confinement.

3. It is contraindicated in disproportions and abnormal presentations, because of the diminution in frequency of the pains.

4. It is not dangerous, and can be administered by a competent trained midwife, provided that suitable precautions are taken to ensure the solution being tested before injection.

5. It is uncertain in its action. Given in doses according to weight it affects some patients more than others. Labour is sometimes delayed owing to diminution in the strength and frequency of the uterine contractions.

6. It is extremely pleasant for the patient. It allays mental anxiety, mitigates pain, rests the patient while the labour progresses, and sometimes gives a painless delivery. Many patients sleep for several hours after delivery, and there are no unpleasant after-effects.

7. It is harmless to the infant.

8. Avertin is worthy of trial in general and hospital practice, but cannot be regarded as sufficiently efficacious to enable the use of chloroform to be avoided during the delivery of the head in all cases.

9. More experience of its use is required to decide the merits of avertin compared with such drugs as paraldehyde.

The results of this investigation are very similar to those described by Connell¹ in his paper.

My sincere thanks are due to Mr. F. Neon Reynolds for his help and advice during the course of the investigation.

REFERENCE

- ¹ Connell, J. S. M.: *Lancet*, 1930, ii, 184.

INJECTION TREATMENT OF INGUINAL HERNIA

BY

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Ten years ago, in spite of the fact that experiments had been made off and on for the previous seventy years, the idea of curing varicose veins by causing a chemical thrombosis would have been regarded by most people as the vapourings of a disordered imagination. The idea of curing hernia by means of subcutaneous injections seems still more impossible, and, until the rationale is understood, can only give rise to incredulity. When I first heard of it I was frankly sceptical, but on reading the literature it became obvious that the idea was by no means absurd, and the rationale suggested was not beyond the bounds of possibility, but was even highly credible. As the result of experiments during the past two years I am convinced that in the injection treatment for hernia we have a valuable addition to our surgical armamentarium, and this paper is brought forward in the hope that others will be stimulated to investigate further a line of non-operative surgery which offers a prospect of cure to many sufferers.

The number of people afflicted with hernia is enormous, and many are frankly afraid of the surgeon's knife. We cannot assure them that the operation is free from risk, nor is it a painless procedure; and if unsuccessful the last state of the man is worse than the first. Quite apart from risk and pain, the operation requires a stay of three weeks to a month in hospital or nursing home, and a rest from strenuous work for two to three months afterwards. In contrast to this, the injection treatment carried out in properly selected cases is free from risk, involves no anaesthetic or operation, causes little pain, does not interfere with the patient's employment or social engagements, and, if not successful, leaves him no worse off than before.

MECHANICS OF HERNIA

To follow the argument one must understand how a truss keeps back a hernia. In addition to the existence of a sac, preformed or acquired, it is necessary, if the sac contents are to "come down," for the external oblique to be separable from the internal oblique and transversalis. If by any mechanical means this separation is prevented the hernia cannot descend. It is well known that ruptured persons hold themselves when they cough or sneeze to prevent their rupture coming down. A satisfactory truss likewise prevents the descent of the hernia by exerting enough pressure on the tissues directly superficial to the neck of the sac to prevent the external oblique being separated from the subjacent muscles. When ruptured subjects cough the abdominal musculature is strongly contracted; the conjoined tendon is thus drawn backwards, but the inelastic aponeurosis of the external oblique, although drawn taut, is at a mechanical disadvantage. The neck of the sac may thus be allowed to open and, once contents enter, their semifluid character enables them to exert a dilating influence comparable in every way to the dilation of the birth canal by the unbroken "bag of waters." When the patient is not straining the conjoined tendon is slack, maintained by intra-abdominal pressure flush against the external oblique, and the hernia does not come down.

This suggests that if we could prevent the external oblique from separating from the subjacent muscular layers, the hernia would never "come down," in spite of the existence of a sac. This is what is attained in the injection treatment first devised by Dr. George Heaton¹ of Boston, Mass., exactly a hundred years ago and perfected by Dr. Ignatz Mayer² of Detroit, whose technique is here advocated.

By means of a suitable sclerosing fluid, a mass of tissue—microscopically, a foreign-body granuloma—is formed in the inguinal canal between the layers of the lower abdominal muscles and surrounding the sac and spermatic cord. The layers of muscle are firmly united together by the subsequent dense scar tissue by which it is replaced so that they cannot be separated, while the contraction of the scar tissue also constricts the sac, and the hernia is cured.

Although many thousand cases of hernia have been treated by the injection method by various surgeons in other countries, there has been reported no case of injury, whether temporary or permanent, to the testis or cord. Sections cut from experimental animals show that the cord passes undamaged through areas of artificial induration³ and remains uninjured by the subsequent contraction of scar tissue. It is essential that a well-fitting truss should be worn from the commencement of treatment, and never removed day or night until several weeks after the final injection. The surgeon must see that the pad accurately covers the internal ring, and that even when the patient is lying down it is still exerting pressure. It must be of the spring pattern; the elastic truss is, in my experience, useless. For the treatment to be successful the hernia