ACTION ON THE HUMAN UTERUS OF ANAESTHETICS AND OTHER DRUGS COMMONLY USED IN LABOUR.

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We have previously described¹ a simple apparatus for recording graphically the changes in the intrauterine pressure taking place during labour. It consists of a disc-shaped rubber bag attached to the end of a gum-elastic catheter, and connected by a long rubber tube to a mercury manometer. When the bag and the tube are filled with water small changes of pressure exerted on the bag are accurately transmitted to the manometer and recorded on the surface of a slowly moving drum. The bag with attached catheter, carefully sterilized, is inserted with full aseptic precautions through the os uteri so that the bag comes to lie between the membranes and the wall of the uterus in a position well past the head of the foetus. For the insertion it is necessary that the patient has begun labour and that the os is dilated to a diameter of about one inch. By the aid of this apparatus we have previously obtained some evidence¹ about the dose of pituitary extract, measured in units, which may safely be administered before the birth of the child, and have also investigated the action of the alkaloids of ergot, and of the separated principles of pituitary extract, oxytocin, and vasopressin.²

We now describe records showing the effect of the anaesthetics chloroform, ether, nitrous oxide, and stovaine, of morphine, and of atropine, and finally of quinine.

THE ACTION OF ANAESTHETICS.

The value of anaesthetics in labour has been much discussed in recent years, but in none of the discussions has there been any reference to the action of anaesthetics on the behaviour of the uterus itself. It seems elementary that for any final decision on the part which should be played by them in labour there should be a clear mental picture of what this action is.

Chloroform.

Figure 1 is a record showing the effect of administering chloroform on an open mask to a patient in the first stage

FIG. 1.

of labour. In the record the uterine contractions, shown as a rise and fall of the writing point, were proceeding regularly during a period of about twenty-five minutes. Chloroform was administered at the arrow; it is seen that the contraction which began at the first moment of administration was less than the others in height, and that thereafter there were no contractions at all during the remaining twelve minutes of the record. It is evident that chloroform caused complete arrest of the pains. Now to see that so powerful an inhibitory action is not peculiar to the first stage of labour the result in Figure 2 may be

examined. The record shows the characteristic rises of pressure within the uterus which are so different from those of the first stage. Superimposed on the rise due to the uterine contraction itself are further rises due to increased intra-abdominal pressure. Since some teachers state that these "bearing down" pains are voluntary, it may be as well to point out here why this is most unlikely. In our experience of a total of nearly fifty patients, the superimposed rise has only very occasionally been seen during the first stage of labour; it begins sharply with the second stage, and is then seen with every pain until delivery. It is inconceivable that a voluntary effort would be distributed in this way. Cook³ has shown, moreover, that in the fully anaesthetized rabbit at term the entrance of the presenting pole of the foetus into the vagina is accompanied by a very powerful contraction of the diaphragm and abdominal muscles. It seems likely that the superimposed rises of pressure in the human tracings are similarly due to reflex diaphragmatic contractions initiated by the passage of the foetal head down the vagina.

In Figure 2 the administration of chloroform on an open mask during a fully developed second stage at once slowed

FIG. 2.

the frequency of the pains and reduced their height. During the last five of the fifteen minutes' administration there were no contractions at all. At this time the patient was not yet in full surgical anaesthesia, for there was considerable rigidity. Perhaps the most noteworthy feature of the tracing was the rapid commencement of the contractions when the mask was removed; after about two minutes' delay a series of contractions was recorded almost as great in height and rate as at first.

Ether.

There is a belief among some that ether is a stimulant to the uterus. The picture of its action given in Figure 3 shows that the belief has no foundation. The patient was in the first stage of labour, and the administration of ether, like that of chloroform, at once diminished the frequency and force of the contractions; when the anaesthetic was discontinued they rapidly resumed their previous size.

The action of both chloroform and ether is most probably not a direct action on the uterus, for it is too rapid. In

FIG. 3.

our opinion it is due to sympathetic stimulation which, during labour, is inhibitory. As evidence for this we point out that emotion arrests labour, and that, as we have already shown, an intravenous injection of adrenaline causes prompt cessation of the pains.¹

Our evidence shows that the relief given in labour by a few breaths of chloroform or ether is not due only to the anaesthetic action, but at least as much to a diminution in the force of uterine contractions. Chloroform or ether is an ideal agent whenever a temporary brake on too powerful or too painful expulsive forces is required.

Nitrous Oxide and Oxygen.

Figure 4 shows the record of a patient in whom anaesthesia with nitrous oxide and oxygen was induced during twenty minutes. The contractions in this patient were not so regular in height and frequency as they commonly are, but nevertheless the complete absence of any effect of the anaesthetic on the contractions is evident. "Gas and

FIG. 4.

oxygen," therefore, is an anaesthetic which anaesthetizes without interfering with the progress of labour; in this important respect, it stands in complete contrast to chloroform and ether.

Spinal Anaesthesia.

Spinal anaesthesia is not much used in this country, but is greatly used in some parts of the Continent, where very successful results are claimed. In some women it produces a squint, but this is stated to be temporary and never permanent. Whitehouse and Featherstone³ some

FIG. 5.

years ago described the effect of injecting tropacocaine into the spinal canal. They said that "when the lumbar cord is paralysed by the drug the uterus always contracts, and it does not relax until the drug ceases to act." Further, they pointed out that "the lower uterine segment and cervix also appear to be involved in the increased uterine tone." More recently Metzger⁴ has stated that the intraspinal injection of 0.7 c.cm. of a ten per cent. solution of stovaine provokes a hypertonus of the uterus and that very rapid dilatation occurs. On the other hand, Cheval⁵ says that spinal anaesthesia delays labour, for the os will not dilate by itself. We have examined the effect of stovaine in one patient, and the record obtained suggests the explanation of the statements made. The dose injected was 0.05 gram. Figure 5 shows that while the rhythm of the main uterine contractions was not perceptibly altered, there was a maintained rise of pressure in between each contraction. A line has been drawn through the base of the record before the stovaine was administered, and it can be seen that the continuation of this line is appreciably below all points on the line recording the pressure afterwards. In this respect the action of the stovaine resembles that of ergotamine; the normal process, which is contraction followed by complete relaxation, is interfered with, and relaxation is never complete.

Hence our experience agrees with that of Whitehouse and Featherstone, our method of recording the intra-uterine pressure enabling us to analyse the effect more closely. It is clear that if stovaine be injected early in the first stage before dilatation has advanced very far, this contraction of the lower segment will hamper further dilatation, as Cheval has found. On the other hand, if the dilatation is complete, the "hypertonus" described by Metzger will be apparent, and delivery will be hastened.

Morphine.

In Figure 6 is shown a record of a patient to whom an injection of 1/4 grain of morphine was given during the first stage of labour. During the first quarter of an hour after the injection there was no change in the contractions, but thereafter there were two important differences. In the first place, the relaxation of the uterus after each contraction was much slower, and in the second place, the frequency of the contractions was less than before. It is readily understandable that the first of these changes, both of which were observed in a second patient in similar circumstances, may be of considerable value in accelerating the progress of labour, for if the relaxation from each contraction be slower, it follows that the time during which useful work in dilating the os is performed must be considerably increased. Yet the continuous pain to which such a prolongation of the contraction must ordinarily give rise is precisely the type of pain from which morphine gives relief. Hence morphine is an agent which, by prolonging the duration of contractions, may accelerate the progress of labour, and yet not add to the embarrassment of the patient in doing so.

Though we have had the same result in two patients, clinical experience indicates that the action of morphine is not always the same. How far a difference in the action on the central nervous system of different patients is

correlated with a difference in the action on the uterus, we are unable to say.

Atropine.

The view has been expressed that atropine should not be used as a prelude to anaesthesia in parturition, because it may produce an inhibition of the uterus. This opinion would be more reasonable if it had ever been shown that the uterus has a nerve supply by way of the sacral autonomic fibres for the transmission of motor impulses. A paralysis of uterine contraction could then occur from the paralysis of the nerve endings which atropine would produce. No such motor nerve supply has been found; nevertheless it remained a matter of interest to determine whether atropine in ordinary dosage had any action in

FIG. 6.

labour. Figure 7 shows the effect of the administration of 1/100 grain. To our surprise the record showed an increase in the height of the contractions characteristic of the passage from the first to the second stage of labour. It is perhaps unwise to conclude from this single instance that the increased height was really due to the atropine, for the injection may by chance have coincided with a change which would have taken place anyhow. It is, however, quite safe to say that atropine, in the dose given, displayed no trace of an inhibitory action.

Quinine.

Quinine is largely used when it is hoped to induce labour, but few obstetricians appear to find it useful. Rübsamen⁶

actually investigated its action by the use of a recording system attached to the abdomen of patients in labour, and concluded that whereas it had little effect before labour had begun, it reinforced the pains afterwards. Our own experience has been more depressing than this, for results obtained on two patients both show very little

FIG. 7.

effect of a kind calculated to hasten delivery. In Figure 8, 10 grains of quinine bihydrochloride were injected into the gluteal muscles of a patient in the first stage. The main effect of the injection appeared to be that the periods of relaxation between pains became shorter, so that contrac-

FIG. 8.

tions were more frequent, but that the height of each contraction was less than before. It was surprising that there was no clear indication of a stimulation of the uterus by the quinine in the same way as there is when a small dose of pituitary extract or a large dose of histamine is injected. It is evident that the powerful action of quinine on isolated portions of smooth muscle when suspended in a bath is little guide to its effect on the uterus in labour, and that its action on the parturient human uterus has been much overstressed.

DISCUSSION.

The importance of a knowledge of the effects of anaesthetics both on the uterine action and on the patient's general state is considerable, especially at present when much attention is being devoted to the problem of alleviating the pain of labour.

We will first recapitulate the advantages and disadvantages which are agreed to attach to chloroform, ether, and gas and oxygen respectively as general anaesthetics. Chloroform produces its effect in the smallest concentration. Attending its use there is a risk of sudden death from cardiac fibrillation, and a more important risk of delayed chloroform poisoning. We understand that in the United States it is now very little used at all. Ether has the disadvantage of inducing infections of the pulmonary tract. Both chloroform and ether cause damage to the circulation by producing a degree of capillary paralysis proportional to the length of time they are administered, as was shown by Dale.⁷ Gas and oxygen has none of these drawbacks, but it is expensive; its administration requires much more skill and attention, and it cannot ordinarily produce a full degree of surgical anaesthesia.

These are the points involved in considering the production of general anaesthesia. In midwifery, however, different varieties of anaesthesia are required. Light anaesthesia is most commonly wanted for the end of the second stage; secondly, prolonged light anaesthesia may be wanted throughout the whole of the second stage; finally, full surgical anaesthesia may be required. For light anaesthesia at the end of the second stage the

arguments given above relating to general anaesthesia do not apply, and we think that chloroform or ether is suitable. The amount of chloroform which needs to be given is very small, and the reduction in the efficiency of the contraction which it causes is often of benefit in avoiding perineal tears. Experience at Queen Charlotte's Hospital since this form of anaesthesia has been used in normal labours shows that there has been no appreciable prolongation of the second stage, nor increased incidence in the forceps rate. In a series of 562 cases there has been no increase in the incidence of post-partum haemorrhage when compared with a previous series of the same number without anaesthetics, and there has been no case of chest complication or delayed chloroform poisoning. The condition of the infants was materially the same whether anaesthetics were used or not.

For prolonged light anaesthesia, throughout the whole of the second stage, the use of chloroform or ether is open to more objection. Boyle⁸ has recently made a strong plea for the use of gas and oxygen in place of chloroform, for he says that patients are far less exhausted and that the pains are not slowed. The question seems to us to depend on the amount of chloroform to be used, and we think that in many circumstances Boyle is right. But in domiciliary practice, at any rate, the weight and expense of the necessary apparatus render gas and oxygen very difficult for routine use.

When full surgical anaesthesia is required, we think that whenever possible ether should be substituted for chloroform, combining the ether with the hypodermic injection of atropine. It is to be remembered, however, that ether is highly inflammable, and the risk of explosion in an ill-ventilated room with an open gas fire may be considerable. But from the point of view of the patient there seems little doubt that the use of chloroform is not in keeping with modern enlightenment.

SUMMARY.

1. Records of intrauterine pressure have been obtained showing the effect of anaesthetics and other drugs on the contractions during labour.
2. The administration of chloroform or ether on an open mask at once arrests the contractions in the first stage, and diminishes their force and frequency in the second stage. The effect comes on rapidly, and passes off rapidly when the administration is discontinued. The action of ether is the same as that of chloroform.
3. The administration of gas and oxygen has no effect on the contractions during labour.
4. The intraspinal injection of stovaine does not inhibit the contractions, but interferes with full relaxation between the pains. This appears to be due to continuous contraction of the lower segment, and if stovaine be given early in the first stage dilatation will be delayed.
5. Morphine lessens the frequency of uterine contractions, but the pains pass off more slowly, so that the work done by the uterus is probably as great as or greater than before, despite the lessened frequency.
6. Atropine appears to stimulate the contractions of the uterus. It certainly has no inhibitory action.
7. The stimulant action of quinine during labour is very small.

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