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ON UTERINE ACTION.

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IN an able and valuable work by a leading obstetrician of to-day, it is stated that "the principle not to deliver in the absence of uterine contraction is the first point in the prevention of post-partum hæmorrhage. Do not pull away the placenta without waiting for uterine contraction." In traction with the forceps, he says, "pull with the pains, leave off pulling between the pains."

To this principle, so laid down, I must take exception for the following reasons:—Firstly, I know of no clinical data in its support; secondly, it is not in accordance with my own experience and that of others who, when necessity has arisen, have not hesitated to deliberately empty the uterus without waiting for pains, and without thereby inducing hæmorrhage; and, thirdly, the opinion is a logical deduction drawn from an erroneous idea of uterine action.

It is this latter point I would at present discuss *the generally entertained conception of uterine action in its bearing on the management of labour*. The subject has been introduced by the above quotations to indicate the trend of opinion, and to show the practical, as well as scientific, importance of the subject.

The question turns mainly on the nature of uterine retraction and its relation to contraction, but to understand these other properties of the uterus must be considered.

The discussion of the subject in this country dates from the reading of a paper "On Elasticity, Retraction and Polarity of the Uterus," by the late Dr. Matthews Duncan, before the London

Obstetrical Society on May 5th, 1886.* Before that time the term retraction as applied to the uterus was rarely if ever used in obstetric writings.

In the discussion that followed the reading of the paper no difficulty was experienced in realising and acknowledging the difference in meaning between contraction proper and retraction. The term has now come into general use, with the advantage of enabling us to avoid the confusion of ideas ever liable to arise from using the one term in two or more senses, well illustrated by one of the speakers who remarked that "by retraction was meant a persistent contraction of the muscular fibre after contraction has ceased."

All were agreed that retraction is a useful term to designate the condition of the walls of the uterus whereby its capacity is permanently lessened in proportion to the diminution in bulk of the contents. This, however, does not touch the nature of retraction, or how the condition is produced.

Very different was the reception given to what really was the most valuable part of Duncan's paper, where he revived the idea of the early writers on midwifery that, in the words of Baudelocque, "the uterus enjoys two modes of action." Duncan advanced the view that "retraction is a force, which owns as its source the action of muscular fibre, but its action is different and distinct from contraction . . . it is a separate and distinct function—that is, it may go on without contractions."

Such a view of uterine action was not admitted by any of the speakers, nor has it gained acceptance since. When the mind has been accustomed to think of all *shortening* of the uterine muscle as *contraction*, it becomes very difficult to conceive of retraction as separate from contraction, and, though seventeen years have passed since the paper was read, the general obstetric mind has not yet overcome the difficulty. The general opinion then was, and still is, "that retraction was dependent on contraction, and was the permanent shortened condition of the muscle after contraction, when the active contraction had passed off—in other words, that the fibres were not stretched out again to their original length." Under this view there can be no retraction without contractions, in the sense that the term is used in the opening quotations. If this be true it would be unsafe to deliver in the absence of pains. But is it true?

The view just stated has recently been defended by a writer in

* Obstet. Trans., Vol. XXVIII.

this JOURNAL.* He applies to the uterus what may be observed in skeletal muscles, overlooking or not taking into account the marked structural and physiological differences between the two. Such analogies are ever liable to be fallacious. Further, the supporters of the single uterine action have examined the problem under one condition only, where the contents of the uterus have been expelled by contractions, and thereby have in great part begged the question. They have never considered the other condition, what happens when the contents escape in part accidentally, or are entirely removed artificially without contractions.

Before discussing this other side of the subject it is necessary to examine separately the different properties of the uterus and to indicate the exact sense in which the various terms are to be used. This is necessary for clear thinking and right judgment. Without it there is certain to be in the future, as in the past, confusion of ideas and much fruitless argument.

In obstetrics the term UTERINE CONTRACTIONS has a well-known definite meaning, to which its use should be limited. It implies a discharge of muscular energy under a stimulus, recurring at varying intervals. It is the *active* state of the muscle, and lasts but a short time. The force so generated is powerful, and under certain conditions expells the contents. *It is the only uterine expulsive force.* Contraction is always accompanied by shortening of the fibres, producing a change in form and consistence of the organ, diminishing its size, but not necessarily lessening the capacity of the muscular sac. The latter is depended upon how far the contents are expelled. Even when the uterus is empty contractions recur, producing a change in form, it becomes more spherical and therefore less in superficies. It is a mistake therefore to assume, as has been done, that the uterine muscle can contract without shortening, as may be seen in a skeletal muscle. The uterine muscle has no tendinous insertions.

RELAXATION is the *quiescent* or *passive state* to which the musculature returns after a contraction has subsided. The term does not necessarily imply restoration to the previous dimensions, but it does not exclude re-expansion. In a state of simple relaxation the muscle is passive, and offers no resistance to extension, *provided there is an extending force.*

Now the mistake into which so many men have fallen is to say that when the uterus has been emptied by contractions there is no

extension because "there is no extending force in action." They overlook entirely the fact that there is ever present a force tending to expansion—the *blood-pressure*. It refills the blood-vessels emptied by the last contraction, and immediately after delivery, in the quiescent state of the muscle, it is sufficient, as often has been found, to expand the walls to a dangerous extent, unless restrained by another force—and that force is retraction.

To make thoroughly clear the conception of uterine action that we have so far obtained, let us follow the changes that every obstetrician has so often observed. The contraction, which has expelled the placenta and membranes has reduced the uterus to its smallest possible size—often surprisingly small. The cavity and blood-vessels are empty, the organ is hard and well defined. Soon, however, it is felt to be softer—relaxation, and as the fibres relax the blood-vessels fill up, the uterus is getting larger. There has not been time for thrombosis in the sinuses to take place—bleeding more or less, as a rule, occurs into the cavity, and were there no continuous force to counteract the blood-pressure, the uterus may, and often does attain a considerable size, the increase being entirely due to blood in the vessels and the uterine cavity. Another contraction would again empty the vessels and possibly expel the blood clot, if haply it does come; but it is often long delayed, and is of short duration. Retraction, as Duncan said, and retraction alone is the safeguard against the risk of hæmorrhage.

If the view be correct that with simple relaxation the blood-pressure is sufficient to expand the uterine walls and increase more and more the blood area, then the counteracting force of retraction need not be powerful, just slightly greater or even equal to the blood-pressure. Were this all that is implied in the term retraction then the tonicity or tonus of muscle might be sufficient to counteract the blood-pressure. There must, however, be something more than tonicity of muscle, as everyone has experienced who has tried to turn after the liquor amnii has for some time drained away, or who has had to pass his hand through the retraction ring that had closed in front of a retained placenta. The resistance then offered is very considerable. It is not of the nature of contraction, tetanic or otherwise, for if so in the course of time it would pass off, whereas retraction when once established is permanent. It may and does yield, but only slowly, to a steady and persistent force. On the other hand, if the force be suddenly and forcibly applied, there is ever the danger of rupture, as many an incautious attempt at version has proved.

There are thus two properties displayed by the uterus—the one the resistance offered to an extending force, the other the power to recover its original state when the extending force is removed. These two properties combined are characteristics of elasticity. Now if there be one word more than another that should be avoided in discussing uterine action it is elasticity; it leads to numerous misconceptions and erroneous arguments. The old writers used the word to designate what is now called retraction. Contrary to this view, Duncan devoted a part of his paper to prove that the elasticity of all the uterine tissues was slight and quite insufficient to explain the phenomena of retraction. His conclusion is correct, but his statements and argument require revision in the present day. The force of retraction, he says, “owns as its source the action of muscular fibre.” This primary limitation of his view blinded his perception of the possible presence of retracility in other tissues. He refers to the remarkable shrinking of the uterine peritoneum from its extensive superficies at term, to the comparatively small area of the outer wall of the empty organ and this shrinking, he remarks, is so perfect as generally to be without a wrinkle. This he attributes to “the quality of elasticity.” Now his own experiments, elsewhere recorded,* have shown that the uterine peritoneum is even less elastic than the muscular wall—that is, it yields less without laceration to extension forcibly applied.

We nevertheless observe the serous coat undergoing a remarkable amount of expansion under the steady increase in bulk of the ovum; but this is not due to elasticity, for the tension of the membrane does not steadily increase in proportion to the expansion. We observe it also shrinking to a remarkable extent without a fold, when the extending force is removed; nor is this elastic recoil—it is *retraction*. So important is this point to the right understanding of uterine action, that it will be well to consider fully the behaviour of the uterine peritoneum by itself. By so doing the question is simplified by excluding muscular action, and we obtain a key to the nature of retraction.

First we recognise the power of the peritoneum to resist a considerable extending force temporarily applied, and if that force be greater than the tensile strength of the tissue rupture takes place. Nevertheless we see the membrane gradually yielding to an almost unlimited extent to the *small but persistent* force of the growing ovum. To prevent undue thinning fresh material is added by

*“Mechanism of Natural and Morbid Parturition,” p. 97.

growth, but the increase in superficies is not all growth—there is expansion, a spreading out of the tissue by relaxation, not by stretching out as against its elasticity. The difference here indicated, *the yielding by plasticity not by elastic stretching*, is important, and must be steadily kept in view. It enables the mind to rid itself of the disturbing ideas associated with elasticity, and accounts for the soft and often flaccid state of the walls in advanced pregnancy. The difference is the same as exists between a soap bubble and an indiarubber balloon when blown up. Both expand, but the one is a spreading out of the material steadily reinforced, the other a stretching of the tissue without addition of new material. In the soap bubble the tension of the film remains the same whatever the size; in the balloon the tension increases and diminishes in proportion to the size.

Now, in physics the property of a body whereby it yields to a small but persistent force, even though it resists or breaks under a strong force suddenly applied, is termed plasticity, a property possessed by many hard and brittle substances. The uterine peritoneum, as we have seen, displays it in a striking manner, but it is not limited to the serous coat alone, all the tissues possess it. It is a characteristic of the uterus, the import of which and the part it plays in uterine action are as yet but imperfectly realised. Plasticity is a property which under different conditions may undergo great and rapid variations in degree. All are familiar with its increase under the term physiological relaxation or dilatability of the tissues—a change which is often explained by inhibition of muscular action, but in view of the closely felted structure of the cervix, rich in connective tissue, such an explanation by itself is insufficient to account for the great and speedy dilatation that occurs. With the increase in plasticity all the tissues yield without rupture to the dilating forces. Presently we shall find an illustration of an opposite change, a diminished plasticity or increased viscosity of the walls in the phenomena of retraction.

To return to the uterine peritoneum, we have yet to consider the shrinking or resilience it displays in so perfect and regular a manner.. The action resembles that of an elastic membrane stretched in all directions, but, as shown above, it is different; the increase in area is not an elastic stretching but a plastic expansion; the diminution of the surface is therefore not an elastic recoil; retraction accurately describes the movement, and implies no theory as to the nature of the force. All that can be said on the latter

point is that the perfect character of the shrinking indicates in the membrane the presence of a considerable amount of internal molecular tension whereby, when freed from external counteracting forces, the tissue tends to assume the smallest possible dimensions.

Such being the property of the serous coat, it is evident, as I have elsewhere pointed out,* that it must play a part in the dynamics of the uterus. It must furnish a part of the persistent pressure inside the pregnant uterus. It is capable of taking a share in the retraction of the walls. Whatever be the state of the muscular fibres of the uterus when labour is over, they are surrounded and supported by a capsule endowed with considerable molecular tension, with which any force tending to expansion must reckon. This idea is strongly supported by the anatomical fact that in the portion of the uterine walls where retraction is manifested the peritoneum is firmly attached, whereas the parts where no active retraction occurs have no peritoneal covering or that membrane is but loosely attached thereto. It is therefore an evident mistake to limit our conception of retraction to the action of muscle alone. The serous coat displays it in a perfect manner. The musculature, however, plays an important part which has now to be considered.

Active contraction is the only expulsive force. Retraction may expel fluid free to move, but it cannot expel even a clot of blood. It gathers the walls around and moulds them to the form of whatever is within the uterus. Contraction by expelling the uterine contents removes the condition which has kept up expansion, and so allows the force of retraction to take effect. So far, *but in this sense only*, retraction in ordinary labour "is dependent upon contraction." It is an error to say that "contraction is the cause of retraction." It is no more so than when we stretch an elastic cord between our hands, the letting go one end is the true cause of the elastic recoil.

We have already seen that in the empty uterus a persistent force is required to resist re-expansion under the blood-pressure. In muscle itself, apart from contraction, there is such a continuous force—the *nerve and nutritive tonus*. We know that the tension of the walls produced by this force varies at times, but is largely increased before active contractions set in. It maintains the uterus in a more tightly strung condition, and is therefore surely capable of taking a great, if not the chief, part in resisting expansion in the empty uterus. It is undoubtedly a factor in retraction, and is independent of contraction. It may be enfeebled in the more or less

* *Brit. Med. Journ.*, March, 1892.

exhausted state of the musculature, but even were it absent there is the other factor—the retractility of the peritoneum, which there is no reason to suppose is affected by the exhaustion of the muscular tissue. These two factors then, with possibly the action of the yellow elastic fibres freely distributed throughout, combine to form the property claimed as the distinct and independent force of retraction. If this holds true, the important practical point is that the force is continuous and not intermittent, and that *its action may be relied upon in the absence of contractions*. It is not a strong force, for such is not required. Its function is not expulsive, but simply to keep the uterine walls in close contact with the contents as they lessen in bulk, and to resist any tendency there may be to re-expansion.

Our conception of retraction is, however, not yet complete. It has just been described as a feeble force, and yet when the condition is fully established the walls are found to resist forcible efforts to stretch them. In the retracted portion a change takes place in the condition of the walls, whereby they become markedly resistant to extension—a *change which takes time to produce*. It is well recognised that after the placenta has been expelled the uterus must be watched for some minutes till firmly retracted. The change is a gradual and increasing one. Under ordinary circumstances it does not occur till the uterus is empty, but it may also take place prematurely. It is not due to mere thickening of the walls, for it is at times met with when they are comparatively thin. In cases where the waters have but recently drained away it may be possible to turn the child, for the walls, though in close contact with the fetal body, are still soft and yielding. When, however, some time has elapsed the operation becomes difficult and dangerous, because the grasp is firm and resisting—there is premature retraction rigidity. This change, especially in the latter case, is usually assigned to muscular action alone, but from the views above stated there is good reason for regarding all the tissues as participating therein. Just as in the reverse change in the cervix, inhibition of muscular action of itself was seen to be insufficient to account for the relaxation of all the tissues; so here the opposite change may be best explained by regarding it as one that lessens the plasticity of the walls, a property which, as before stated, may undergo great and rapid variations.

The influence which premature or unequal retraction may have on the course of labour, especially as regards hæmorrhage, cannot be entered on now. One point, however, must be noted. When

labour is incomplete and delay occurs, as from retained placenta, retraction takes place unequally at different parts of the uterine walls,* and should the plastic "setting" have begun in the more retracted portions it may seriously interfere with retraction at the portion where the process is least advanced, and that is always at the placental site. The process of labour, when once begun, should be steadily progressive; the risk in delay in a partially emptied uterus increases with the degree with which the contents have been diminished. Contraction is the only expulsive force, and when that is too feeble or too tardy it is safer to deliver artificially, even in the absence of pains, or not to wait for them. Precipitate action should be avoided, for retraction is often slow and takes time to complete.

Having now discussed the different properties of the uterus, and having got some idea of the nature of the force of retraction as contrasted with contraction, we are in a better position to interpret correctly the clinical evidence regarding the presence and sufficiency of the force upon which we rely to reduce the cavity of the uterus in the absence of pains.

First, let us consider the behaviour of the uterus during the operation of Cæsarean section. The operator does not wait for a pain, but as soon as the membranes are ruptured he must deftly remove the child, otherwise he would find himself hampered by the rapid closing in of the walls, not from contraction but retraction; the walls at once resile when freed from the cause of the expansion. Again, he does not wait for a contraction before removing the placenta, but peels it off, trusting to retraction to restrain the bleeding.

Secondly, for various complications of pregnancy it has at times been deemed advisable to empty the uterus artificially without at first inducing labour. The cervix is dilated and the child removed without waiting for or even desiring contractions. Does the uterine cavity in these cases remain undiminished though empty, and does hæmorrhage occur more frequently than under other circumstances?

Thirdly, take a case of excessive hydramnios, where the patient is suffering much pain, and from difficulty of breathing she cannot lie down. To afford relief one does not wait for labour to set in, but unhesitatingly proceeds to rupture the membranes. Under such circumstances I have invariably found the uterus to steadily retract

* "The Uterus in the Third Stage of Labour," by the author, *Scot. Med. and Surg. Journ.*, January, 1898.

with the lessening bulk of the contents, retaining its spherical form though less tense, and without any evidence of contraction.

Fourthly, in severe hæmorrhage in the third stage with retained placenta, or post-partum where the uterus has melted away from the grasp and the fundus cannot be defined by the left hand externally, I have invariably introduced my right hand into the uterus to separate and remove the placenta where necessary, or, in other cases, to enable the external hand to regain its grasp of the fundus. The placenta can be slipped down or the clots readily be manipulated past without withdrawing the hand. There it is kept till either a contraction occurs, or more generally till, by external kneading and moulding action between the hands, the cavity lessens to allow only room for the fingers, then these are withdrawn, external supervision being kept up for some time after. Here one can observe the difference between the sudden closing in of the cavity by contraction and the more gradual, often slow, but progressive, action of retraction. The latter is by far the most frequent result.

With such evidence and after the above study of the subject, can there be a doubt that, *apart from contraction*, the uterus possesses the power of diminishing its volume and capacity when emptied of a part or of the whole of its contents. Although Duncan said at the time he wrote "that retraction is not dependent on contraction is difficult to prove," now that we possess clearer views of the subject his other statement must be accepted as true, that "retraction is a separate and distinct function—that is, it may go on without contractions."