ON CERTAIN OBSTETRIC ASPECTS OF THE PELVIC PERITONEUM.

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THE relations of the pelvic peritoneum in the non-gravid state have for long been accurately described, but the changes that occur in these relations during pregnancy have only within recent years attracted attention. The physical properties of the membrane have, moreover, been strangely overlooked. Investigations by means of frozen sections have lately revealed striking differences in behaviour between the serous covering of the uterus and that of the rest of the pelvic peritoneum, and a study of the physical properties thus displayed during pregnancy and labour is calculated to throw light upon various unsettled questions in midwifery.

Dr. W. M. Polk,¹ of America, has drawn attention to the fact that towards the end of pregnancy the level of the peritoneum in the pelvis is considerably raised, that the line of its reflexion on to the pelvic walls, instead of being below, comes to be on a level with the brim, and that the utero-sacral ligaments are attached posteriorly as high as the first sacral vertebra instead of between the third and fourth.

Polk's observations have been confirmed by Dr. Freeland Barbour, of Edinburgh, who has rendered our knowledge more accurate by descriptions of frozen sections. He points out that in the full-time pregnant uterus the peritoneum in front and behind has the same relations as in the non-gravid uterus, that is to say, the reflexion of the peritoneum on to the bladder in front and on to the rectum in the pouch of Douglas behind are undisturbed. In marked contrast with this the peritoneum at the sides has been lifted up by the growing uterus so that the base of the broad ligament is on a level with the brim and at one point considerably above it. The membrane is stripped off the pelvic wall so that "there is a large triangular area at the sides of the uterus uncovered by peritoneum."²

There is in this fact clear evidence that the steadily increasing uterus exerts a pull upon that portion of the peritoneal tissue which forms the ligamentous attachments. The tissue may be stretched, it may be lengthened by growth, but nevertheless there is sufficient stress to result in separation of the peritoneum from a part of the sides and posterior wall of the pelvis.

The same effect has been demonstrated by Dr. Berry Hart, of Edinburgh, in his two cases of pregnancy in the broad ligament, examined and figured by frozen sections. In each the peritoneum exhibited the same resistance to thinning under tension, and accommodation for the growing ovum was for a time obtained by stripping the peritoneum off the neighbouring parts and even off the whole of the posterior surface of the uterus.

Viewing, therefore, the behaviour of the ligamentous portions of the pelvic peritoneum in both normal and abnormal conditions of pregnancy, we may conclude that they offer considerable and permanent resistance to stretching beyond the limits of their elasticity, and that the tension thus thrown upon them is sufficient to undo the attachments to the pelvic walls.

In marked contrast with this behaviour is that of the peritoneum covering the uterus, under the same stimulus of gestation, and a like gradual but persistent action of the steadily-growing ovum during normal pregnancy. Here there is no such borrowing from neighbouring parts, but a gradual yielding, to an unlimited extent, growth supplying the additional material necessary to prevent thinning. That there is no pull or stress on the tissue, as in the former case, is evident, for the reflexions in the utero-vesical pouch in front and in the pouch of Douglas behind are left undisturbed.

It is, therefore, evident that the resistance to expansion by the uterine peritoneum is different in nature from that offered by the rest of the pelvic peritoneum when both are subjected

to the stress of the growing ovum. The latter, stretched to the limits of its elasticity, offers a permanent resistance to extension, and accommodation for the increasing bulk of the ovum is provided by stripping the membrane from its attachments; in the former there is no permanent resistance, but a gradual yielding to an unlimited extent. This difference in the behaviour of the two portions of the same tissue points to a difference in the physical properties which has not hitherto been recognised. In view of this difference, and of others to be presently noticed, it is to be desired that we had more information than at present we possess regarding the histology of the uterine peritoneum, and what changes occur during pregnancy further than the mere increase of material.

Again, in contrast to the unlimited expansion under the gradual increase in bulk of the ovum, is the striking intolerance of the uterine peritoneum to a rapid dilating force. This is well illustrated in the history of the induction of premature labour; the injection into the uterus of only a few ounces of water has led to rupture. In his paper on "Bursting of the Uterus,"³ Dr. Matthews Duncan has shown that the tensile strength of the walls is considerable, and that "experiments show that the peritoneum repeatedly gave way, while the muscular part of the wall remained entire. This shows that this membrane possesses a less degree of extensibility than the muscular layers."

I am not aware of any observations, pathological or experimental, which would indicate that the uterine peritoneum is capable of *rapid* expansion; all our knowledge is against such an idea. We are now familiar with *rapid* dilatation of the cervix, but the possibility of the operation without injury, in all probability, is due to the fact that the cervix is the portion of the uterus not covered by peritoneum. The internal os, no doubt, is dilated in such operations, with, it may be, a portion of the lower uterine segment; but all have experienced how much more resistant to expansion is the internal os, as compared with the lower portion of the cervix; and we also know now that the peritoneum is more loosely attached to the lower part of the anterior wall than it is elsewhere—a provision, no doubt, to permit of some amount of expansion of the part. Further, I would point out that the peritoneum is not subjected to the rapid stretching and thinning out to which the lower uterine segment and cervix are submitted during the first stage of labour. The relations of the peritoneum above described are evidently a provision to relieve the peritoneum of this stress. Although, in the mesial line, the serous coat extends downwards, behind as far as the vagina, and in front to the reflexion on to the bladder below the level of the brim, yet at the sides, as we have seen, there is a large triangular area, extending up into the iliac fossa, uncovered by peritoneum. This arrangement is equivalent to a slit at each side in the investing membrane, and during the opening up process of labour, must save the peritoneal covering from the severe stress to which it would otherwise be subjected, were it to participate in the stretching which the tissues of the lower uterine segment and cervix undergo.

In thus viewing the behaviour of the serous coat of the uterus during pregnancy, we find it displays very marked peculiarities as regards the character of the resistance it offers to an expanding force. When the action is rapid the resistance is great, and the tissue is liable to rupture. When, on the other hand, the expansion is slow but persistent, it yields to an unlimited extent. The resistance offered by the uterine ligaments to the same force of expansion is different in character; they refuse to yield beyond the limits of their elasticity.

It may be objected to this view that the great increase in superficies in advancing pregnancy is the result of growth—an increase in material; but it is evident that there is expansion as well as hypertrophy. Before labour there is hypertrophy and expansion, immediately after labour the hypertrophy remains, but the expansion has disappeared, because the expanding force has been removed. In extrauterine pregnancy there is hypertrophy of the uterus but no expansion, because no dilating force.

The peculiar property of the uterine peritoneum traced above, indicates a plastic character which belongs to some bodies which may be not only solid, but brittle. A stick of

¹ Observations on the Anatomy of the Female Pelvis, *New York Medical Journal*, vol. xxxvi. See also *The Anatomy of Labour*, by A. H. F. Barbour, M.B. Edinburgh, 1889.

² *Loc. cit.*, p. 15.

³ *Mechanism of Natural and Morbid Parturition*, p. 93.

sealing wax can readily be snapped by a sudden force, and yet will bend without breaking to a small but persistent force, such as that of gravity. So also with the uterine peritoneum, it will rupture under a sudden force, yet yields indefinitely to a slowly acting one, such as the growing ovum. The term plasticity is one with which we are familiar, but it does not accurately denote the true nature of the property we are discussing. The essential idea we are now dealing with is that of resistance to a change of form, great when the velocity of the change is great, but diminishing in amount as the action becomes more and more gradual. Resistance to change of shape depending on the velocity of the change is now termed in physics "viscosity." It is a new term to apply to the uterus, but will be found to play an important part in the explanation of the phenomena of uterine action.

Another characteristic of viscous resistance is that it is not permanent, or in other words there is no limit to the extent of the yielding. In this respect it differs from elastic resistance. The amount of extensibility in an elastic body is limited, and the resistance when that limit is gained is permanent. This enables us at once to discard the idea that the expansion of the membrane is due to the ordinary elasticity of the tissues; a point of importance when we examine the phenomenon of shrinking displayed to so remarkable an extent by the serous coat.

So far as I am aware it has never been suggested that the peritoneum plays an important part in the dynamics of labour. Dr. Matthews Duncan has indicated a possible action. In his paper on "Uterine Shrinking," he remarks: "The peritoneum is not in ordinary circumstances an inelastic membrane. It shrinks by elasticity co-ordinately with the subjacent uterine muscular tissue to which it is attached, and consequently on the recently emptied uterus no rugæ or sulci are in ordinary circumstances observed. This peritoneal elasticity probably furnishes a part of the constant pressure inside the replete uterus."⁴ He does not seem to have pursued this idea further.

The great extent and perfect character of the shrinking of the serous coat is a phenomenon which has not received the attention it deserves. In considering the action of the uterus the muscular walls alone have been studied, to the oversight of the fact that surrounding and firmly attached to them is a well marked membrane, shrinking to a fifth or sixth of its original superficies so perfectly that hardly a fold or wrinkle is to be seen on its surface.

In marked contrast with this is the effect upon the membranes lining the interior of the uterus. These are found to be thrown into innumerable small folds.⁵

The uterine peritoneum thus behaves like a stretched elastic membrane, such as an inflated india-rubber balloon, and hence we may speak of its elasticity. But in using the term we must clearly realise the true nature of the phenomenon; and be careful not to introduce wrong notions and false reasoning from ideas associated with ordinary manifestations of elasticity. This error runs through obstetric writings and discussions, and has led to much confusion of ideas.

Tension of some kind there must be in the membrane to produce so great and perfect a shrinking, but it is evident that it is not the tension of ordinary elasticity. If we dilate an india-rubber balloon the tension increases with the amount of expansion; in the case of the uterus there is no evidence or reason to suppose that the tension of the walls is greater at the ninth than at the seventh month. But we have already seen that the resistance to expansion is not that of elasticity.

Whatever, then, be the nature of the tension which produces so perfect a shrinking, it is not ordinary elasticity, and we must seek some other illustration than that of an ordinary elastic membrane to help us to form an idea regarding this property.

For a true analogy we may go to a soap bubble. When we blow it up it grows, like the uterine peritoneum, by the addition of new material, more than by the stretching and thinning of the soap film. If the tube by which it was blown up be left open, the bubble retracts and expels the contained air. This is due to the molecular tension of the film. In like manner, when the contents of the uterus are diminished in

bulk, the serous coat shrinks or retracts. The analogy, however, must not be carried too far; all that is intended is to illustrate how tension sufficient to produce the phenomenon may exist and differ from the force of ordinary elasticity. In either case the film or the membrane, by its molecular forces, "tends to take the smallest superficies consistent with the conditions." The analogy, moreover, helps us to other important conclusions. The molecular tension is dependent upon the temperature and composition of the tissues, and is independent of the size of the uterus; the unit of tension remains the same however large the organ may be, and the tendency to shrink is as great however small its surface may have become.

Under this tension we see, as in the case of the soap bubble, the replete uterus varying its form under the action of gravity, becoming moulded to the shape of the hard structures it is in contact with, and again regaining its own natural form when freed from pressure. It is plastic because of its viscosity; it regains its form and assumes the smallest superficies compatible with the conditions, because of the molecular tension, and the molecular forces which produce this tension are free to act, because the tissue is viscous in its nature. This mode of viewing the subject sweeps aside all the difficulties based upon the idea of ordinary elasticity, and explains the seeming inconsistency of the pliable and lax state of the replete uterus, with a persistent internal pressure and a precise and perfect property of shrinking.

It may be objected that the energy displayed is vital and not purely physical, but it must be remembered that there is no vital action outside of the purely physical. Vitality is concerned only in the generation of the force—the building up of the molecules. What we are now concerned with is the mode of action of the forces, and that is a purely physical problem. The energy of the serous coat is vital, just as the contractility of muscle is vital. But there is this difference between the two. The potential energy of the muscle is rendered kinetic by a stimulus, and is temporary; that of the membrane is always in action, producing a persistent tension upon the contents of the uterus, and visibly displayed whenever the bulk of the contents is diminished.

Such being the properties of the serous coat, it is evident that it must play a part in the dynamics of the uterus. It furnishes a part of the persistent pressure inside the organ. It is also capable of taking a share in the retraction of the uterus. Whatever be the state of the muscular fibres when labour is over, they are surrounded and supported by an elastic capsule, with which any force tending to produce dilatation has to 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 either no peritoneal covering or that membrane is but loosely attached thereto.

Retraction, however, is a subject so important that it merits a separate investigation; but we have obtained these new ideas, that the phenomenon of retraction is not peculiar to muscular tissue, but is displayed in a striking manner in the serous coat; and that wherever retraction is actively manifested a "firm attachment" exists between peritoneum and muscular fibre. How far this may help us to a true realisation of the nature of retraction must be dealt with in my next paper.

THE Rangoon Hospital can boast of a Royal Princess among its lady medical students. A Myingoonline princess, granddaughter of the late Mindoon Min, King Theebaw's predecessor, is qualifying herself to practise medicine among her fellow countrywomen, the Burmese. She, with other members of King Mindoon Min's family, was rescued from captivity by the British occupation of Burmah in 1885.

POISONING BY BARIUM CHLORIDE.—At an inquest held by Mr. Braxton Hicks this week on a girl in the service of Mr. William Johnston, public analyst, it was shown that a dose of barium chloride was administered to the girl by the lady of the house in mistake for Carlsbad salts. She had taken about 150 grains. The evidence showed that vomiting commenced in twenty minutes, and death ensued four hours and a-half after taking the dose.

⁴ *Mechanism of Parturition*, p. 125.

⁵ *Vide* Barbour, *op. cit.*, p. 102.