ON THE

MUSCULARITY OF THE UTERUS.

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AS midwifery makes no part of my occupations, I intend, in this paper, to confine my attention to the anatomical structure of the womb; or to such points of the pathology as are directly connected with the anatomy. But some facts have been forced upon my observation which have not hitherto been laid distinctly before the public. They have induced me to resume the examination of the muscular structure of the womb; and comparing what I have seen in the dead body, with what I have observed in the living, I shall endeavour to lay a connected account of this subject before the Society.

I have dissected the gravid uterus in all conditions—in women who, in consequence of fever, had died undelivered; in women who had died from flooding; and in women who had died in consequence of distortion of the bones: I have had two opportunities of examining the uterus ruptured by its spontaneous action; and one, in which the uterus had been ruptured by violence; and,

finally, I have examined the state of the uterus after death in consequence of the Cæsarian section*.

In this way I have been led to attend to this subject as an anatomist, rather than as an accoucheur; an explanation which, I fear, will seem very necessary in apology for these observations.

Of the Muscular Structure of the Uterus.

The muscularity of the uterus is proved by direct ocular demonstration of the fibres in dissection; by the thickness of the fibres corresponding with their degree of contraction; by the visible action in the human uterus during life; by the resemblance of the laws of its contraction (as felt and as perceived in its consequences) to those which govern the contraction of the other hollow viscera; and lastly, by the vermicular and intestinal motions of the uterus as seen in experiments upon brutes.

The prevailing notion that the muscular fibres

* I wish that my present subject permitted me also to state what I have found on dissecting the parts after the use of the crotchet, and in particular where the forceps had been used, as I must presume, in a case improper for them. The injury which the seeming harmless instrument the forceps is capable of doing might then be proved, and a wholesome admonition given to the young surgeons.

of the uterus are very confused and scarcely perceptible, has prevented authors from founding the rules of practice on the sure ground of anatomy. And if it be possible to place this matter in a clear light, it may banish, perhaps, a certain vagueness which is much to be regretted in so important a department of practice. The most curious, and obviously useful part of the muscular substance of the uterus, has been overlooked; I mean the outermost layer of fibres which covers the upper segment of the gravid uterus. The fibres arise from the round ligaments: and, regularly diverging, spread over the fundus, until they unite and form the outermost stratum of the muscular substance of the uterus. The round ligaments of the womb have been considered as useful in directing the ascent of the uterus during gestation; so as to throw it before the floating viscera of the abdomen: but, in truth, the uterus could not ascend differently; and on looking to the connection of this cord with the fibres of the uterus, we may be led to consider it as performing rather the office of a tendon, than that of a ligament. It is familiarly known, that the subsiding of the belly in pregnancy, occasioned by part of the womb sinking within the brim of the pelvis, is the least equivocal sign of the approach of labour, and of the pelvis being of due dimensions: and in some measure this is also an assurance of a right presentation of the child. This layer of muscular substance operating on the round ligaments is well calculated to

assist in expelling the foetus; but also in a particular manner it is provided for bringing down the womb in the first stage of labour, and it is well calculated to give the uterus and the head of the child the right position with regard to the axis of the pelvis. From the connection of the lower extremities of the ligaments with the tendinous insertions of the abdominal muscles, we can conceive that this muscle and these ligaments may shift the position of the womb, and carry it off from the support of the ilium; but otherwise we should be at a loss to conceive how the uterus by its own action could adjust the position of the orifice for the delivery of the child.

On the outer surface and lateral part of the womb, the muscular fibres run with an appearance of irregularity among the larger blood-vessels; but they are well calculated to constrict the vessels whenever they shall be excited to contraction.—The substance of the gravid uterus is powerfully and distinctly muscular, but the course of the fibres is here less easily described than might be imagined. This is owing to the intricate interweaving of the fibres with each other; an intertexture, however, which greatly increases the extent of their power, in diminishing the cavity of the uterus. After making sections of the substance of the womb in different directions, I have no hesitation in saying that towards the fundus the circular fibres prevail; that towards the orifice the

longitudinal fibres are most apparent ; and that on the whole, the most general course of the fibres is from the fundus towards the orifice. This prevalence of longitudinal fibres is undoubtedly a provision for diminishing the length of the uterus ; or for drawing the fundus towards the orifice. At the same time these longitudinal fibres must dilate the orifice, and draw the lower part of the womb over the head of the child.

In making sections of the uterus while it retained its natural muscular contraction, I have been much struck in observing how entirely the blood-vessels were closed and invisible ; and how open and distinct the mouths of the cut blood-vessels became, when the same portions of the substance of the uterus were distended and relaxed. This fact of the natural contraction of the substance of the uterus closing the smallest pore of the vessels, so that no vessels are to be seen, where we nevertheless know that they are large and numerous, demonstrates that a very principal effect of the muscular action of the womb is the constringing of the numerous vessels which supply the placenta, and which must be ruptured when the placenta is separated from the womb.

I have observed further that although in producing contraction and thickening of a portion of

the uterus, by boiling it, or by other artificial means, the fibres are made very evident, and the blood-vessels greatly constricted; yet they are not so effectually closed as in the natural contraction of the muscular fibres of the uterus. Thus we are led to contemplate the uterus as more peculiarly destined for the safe delivery of the secundines, than for the reception and growth of the ovum. Although its system of vessels be admirably adapted for an increase of action, and for rapid growth, yet it is not so peculiar in this respect as in its muscular structure; for we find that where the foetus lodges in the ovarium, it grows, within the term of uterogestation, to the full size: but if the ovum separates from the ovarium, or from the Fallopian tube, in the example of extra-uterine foetus, the woman dies of hæmorrhage, the blood flowing without being restrained by any system of muscular fibres capable of constricting the blood-vessels which are necessarily ruptured*.

The celebrated Ruysch discovered a circular muscle on the inner surface of the fundus of the uterus†. The use of this muscle, as he conceived

* See a case by Dr. Clarke. Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge. Mr. Taunton shewed me the parts where a rupture of the Fallopian tube in a case similar to this of Dr. Clarke, had occasioned a fatal hæmorrhage into the cavity of the abdomen.

† Ruysch, Dec. 2, p. 34.

it, is to draw the surface of the uterus by a gliding motion from the corresponding surface of the placenta; and thus to separate it and cast it off. By some the existence of this muscle of Ruysch is not admitted; and it has been supposed that he was deceived by the appearance of tortuous vessels*. I have nearly an absolute reliance on the observations of Ruysch: and as I have made a section of the uterus, most exactly corresponding with the engraving in Ruysch's work, I must conclude that he was not deceived in what he saw.

In the papers of Dr. Hunter, published by Dr. Baillie, there is the first accurate observation of the concentric fibres which surround the openings of the Fallopian tubes; the description corresponding with the circular strata of fibres which Weitbrecht has seen encircling the mouths of these tubes.

Upon inverting the uterus, and brushing off the decidua, the muscular structure is very distinctly seen. The inner surface of the fundus consists of two sets of fibres, running in concentric circles round the orifices of the Fallopian tubes. These circles at their circumference unite and mingle, making an intricate tissue. Ruysch, I am inclined to be-

* By *Boerhaave* and *Albinus*. See in the *Opuscula of Sandifort* the words of professor *Germ. Azzoguidus*, who has also this idea.

lieve, saw the circular fibres of one side only, and not adverting to the circumstance of the Fallopian tube opening in the center of these fibres, which would have proved their lateral position, he described the muscle as seated in the center of the fundus uteri. This structure of the inner surface of the fundus of the uterus is still adapted to the explanation of Ruysch, which was, that they produced contraction and corrugation of the surface of the uterus, which the placenta not partaking of, the cohesion of the surface was necessarily broken,

Further, I have observed a set of fibres on the inner surface of the uterus which are not described. They commence at the center of the last described muscle, and having a course at first in some degree vortiginous, they descend in a broad irregular band towards the orifice of the uterus. These fibres, co-operating with the external muscle of the uterus, and with the general mass of fibres in the substance of it, must tend to draw down the fundus in the expulsion of the foetus, and to draw the orifice and lower segment of the uterus over the child's head.

I have not succeeded in discovering circular fibres in the *os tincae*, corresponding in place and office with the sphincter of other hollow viscera, and I am therefore inclined to believe that, in the relaxation and opening of the orifice of the uterus,

the change does not result from a relaxation of muscular fibres surrounding the orifice. Indeed it is not reasonable to conceive that the contents of the uterus are to be retained during the nine months of gestation by the action of a sphincter muscle. The loosening of the orifice, and that softening and relaxation which precedes labour, is quite unlike the yielding of a muscular ring.

Natural Action of the Uterus.

While the uterus retains its whole contents, the action of its fibres is slow and feeble. Its first movement is to shift its position to direct the orifice aright, and to sink down until the lower segment of the womb rests upon the brim of the pelvis: this it does by the operation of the muscular fibres on the round ligaments, and during this shifting of its position are experienced the true dolores præsentientes. When the waters are discharged, the contractions are more powerful, the child's head presses on the orifice, and the fundus and body of the uterus are more powerfully excited. Now the upper and middle part of the uterus contract; but it is evident that the lower part of the uterus must, during this contraction of the upper part, relax and stretch to permit the child's head to pass.—While the child is contained in the uterus, the muscular fibres can not greatly contract nor impede the blood in the

circulating vessels of its substance. But when the child is expelled, then the contraction of the fibres is considerable, and then they take that arrangement which is inconsistent with a free circulation of the blood; the vessels are constricted. By the time that the placenta is expelled by the contraction of the uterus, the vessels of the uterus are closed, and no active hæmorrhage follows.

Action of the Uterus producing Rupture.

I have examined two cases of uterus ruptured by its spontaneous action, and one in which the violent attempts at delivering the child ruptured it. In the two first examples the circumstances of the labour, and the appearances on dissection, had a close resemblance. The labour was going on apparently well, when, after a violent pain, the woman vomited a dark matter; on examination the child's head had receded; on putting the hand on the belly of the woman, the form of the child could be distinctly felt. Such was the description I heard when I came to open the body in the first case. I found the foetus, cord, and placenta lying among the viscera, and the uterus contracted and drawn into the pelvis. The head of the child I found unusually enlarged by hydrocephalus. In the second case, the uterus only was brought to me. In both the uteri were largely

rent transversely, just within the orifice on the fore part; and the margins of the rents were thin and ragged. In the first, the orifice of the uterus was dilated and obliterated: in the second, the lips of the orifice were still distinguishable, being imperfectly dilated and rigid.

In the third case of rupture of the uterus, which I dissected, the circumstances were very different: I went to see a woman, who being remarkably distorted, I thought could not survive her labour. I found a gentleman engaged in assisting her; he had proceeded, I believe, with perfect propriety to deliver the woman with the crotchet, he had evacuated the cranium, and brought away the frontal and parietal bones; he had got the hook into the foramen magnum, and was endeavouring to bring down the base of the cranium laterally, to accommodate it to the flattened pelvis. In this however he could not succeed. On returning next day I found the patient dead: the body was afterwards conveyed to me. On opening the abdomen I found the uterus still containing the body of the child, and the placenta, but an arm and shoulder projected through a rent on the left side and lowest part of the uterus; it was covered with slime and mucus, and the lips or margin of the rent were quite black and sloughy. It required my whole strength, standing on the table, to draw back the remains of the child's head, which were wedged in the distorted pelvis.

In the first instance, I think the cause of rupture was, that the dilatation of the orifice of the womb was insufficient to admit the preternaturally large head to pass. In the second, the rupture was owing to the rigidity and insufficient dilatation of the orifice of the uterus, while the muscular action of its body was powerful. We know very well, that a muscle during action acquires an additional power of cohesion, and consequently additional strength, but that when relaxed it is comparatively weak. This explains why the rupture takes place at the lower part of the uterus; for there we find, that during the most powerful contractions of the womb, there must be relaxation and dilatation to admit the child's head to pass, and that relaxation is weakness*. In the third case, the remote cause of the rupture was the obstruction to the labour, from the wedging of the child's head; the child being forced by the action of the womb into the pelvis, and by the pulling of the accoucheur in the operation of the crotchet, the uterus was bruised against

* I shall not presume to deny, that the vagina and not the uterus has been sometimes ruptured: yet from the general resemblance in the circumstances of the cases of ruptured uterus, and the appearance of the torn parts, I think the rupture takes place in the uterus, near the orifice. If the orifice of the uterus be relaxed and open, the vagina will not remain rigid, the child's head will descend: if there be no resistance to the contraction of the uterus, the violence of the action cannot be such as to tear the parts. The child and placenta being found in the cavity of the belly, declares the rupture to take place before the full descent of the head into the pelvis, that is, before the final dilatation of the orifice of the uterus.

the linea innominata: hence the appearance, peculiar to this case, of blackness and gangrenous sloughs on the edge of the rent in the uterus*. In this case also, the immediate cause of the rupture was the contraction of the uterus, in the attempt to force down and deliver the infant, the violence of which action falling upon the weakened part of the uterus, near the orifice, tore it: the head of the child being locked in the pelvis, was undoubtedly the cause why the whole child was not thrown into the cavity of the abdomen.

Muscular Action of the Uterus considered in the Case of Cæsarean Section.

While in partnership with my brother, Mr. John Bell, an occasion occurred which made the performing of this formidable operation an absolute duty. As the description of what occurred during that operation, and the appearances which were presented on dissection, may not be without interest to some here; and as they have a direct connection with my subject; I shall take the liberty of stating them.

In proceeding to examine this woman as she lay with her back towards me, I was surprised to find

* The linea innominata was in this case very sharp; the skeleton is in my collection.

a large smooth tumour betwixt the thighs, which I could not readily recognize as the abdominal walls, thus distended and strangely pendulous. In this position of the pregnant uterus, with its fundus hanging down, we discover one consequence of great distortion in the pelvis, and an insuperable difficulty in the way of the operation of embryulcia, since the child's head does not present to the opening of the pelvis, and cannot be felt per vaginam.

My assigned station in this operation was to raise the tumour of the belly; to present the lower part of it; to prevent the intestines from protruding; to compress the belly, and to follow the receding sides of the contracting womb, and to excite the womb towards its ultimate contraction; on which latter circumstance we all agreed the woman's safety in the first period after the operation must chiefly depend. Mr. John Bell, with his characteristic neatness, made the incision. The incision through the walls of the abdomen was made a little towards the right side of the linea alba, and in the space betwixt the umbilicus and pubes: it was of length calculated to admit the child's head to pass, stretching the parts*. When the integu-

* The incision was made as low as possible, to avoid cutting the upper part of the uterus, and in the expectation of avoiding the placenta. In the operation by Mr. Thomson, (Med. Obs. and Enquir. vol. iv. p. 274) the middle of the incision was opposite to the navel. In Dr. Kellie's very interesting case, the incision

ments and muscles were cut through, I moved my hands, which were spread upon the belly of the woman, so as to make the walls of the abdomen glide on the smooth surface of the uterus. The very great distension of the integuments, and their consequent thinness, made this necessary, to inform those who looked on that the abdomen was actually cut into; and indeed the surface, which now presented of a pale rosy hue, was not even what an anatomical student might have expected. It was matter of wonder to me, that no small vessels were perceptible on the living surface of the uterus, and no sinuses tinged with blood, considering that those vessels make so great an exhibition in dissection. But it was more a matter of admiration to me to observe the effect of the first touch of the knife upon the uterus; for instead of the form of a cut remaining for a moment, the fibres were excited to retract what would otherwise have formed the edges of the incision, and instead of a cut being perceptible, there was, in its place, a circular space, with concentric circles of fibres. Another thing remarkable was, that although the integuments and rectus muscle and substance of the womb were cut, yet there was not as yet a drop of blood to flow over the edges of the wound, no large veins were to be seen in the substance of

was made from two inches and a half above the navel to four inches below it. (Edinb. Med. Journ.) The necessity of evacuating the bladder, which lies above the brim of the pelvis, in cases of great distortion, is sufficiently apparent.

the womb; and in this we thought ourselves particularly fortunate.

But presently it appeared how much we had been deceived; for the substance of the womb being cut through, the lobes of the placenta rolled out. The placenta was unfortunately attached to the fore and lower part of the womb, and now, notwithstanding that no blood jetted from the womb, I was convinced that the incision must be through the larger blood-vessels, and I already despaired of the woman's recovery.

Mr. Renton, Surgeon of Pennycuik (who had, in a manner deserving the highest praise, delivered the woman on former occasions with the crotchet, in very difficult circumstances,) was prepared to break the membranes; to pass his naked arm into the uterus; to seize the child by the feet; and deliver it. This was done rapidly and dextrously by Mr. Renton passing his hand in a conical form below the lower edge of the placenta: the child was delivered safely, and is now alive. After the delivery of the child, the placenta was thrown out by the action of the uterus*.

The instant the operation was performed, the

* We did not see a portion of the intestines, owing to due pressure sustaining the lips of the wound; it has occurred in performing this operation, that they have come down into the surgeon's hands upon the rapid subsiding of the uterus.

mother was seized with violent vomiting ; and now it required all my strength to compress the abdomen, and retain the parts against the operation of the diaphragm and abdominal muscles. For twenty minutes I continued pressing the belly, and compressing the uterus betwixt my hands. The wound of the integuments was dressed ; stitches were introduced, and the intervals strengthened by adhesive straps ; compresses were put on the abdomen, and the belly swathed. But that happened which I foresaw would be the consequence of ceasing to compress the uterus : the woman became more faint, and at last insensible ; she lived only to the gratification of her wish, to become, at all hazards, the mother of a living child.

Dissection.

It was fully three weeks before I could procure the body for dissection, yet as this was during a severe winter, the demonstration of the cause of death, and of the state of the uterine contraction, was perfect. On opening the belly, I saw the uterus lying contracted ; but the wound of it was gaping, the lips everted, and it now appeared as if the uterus had been cut from the fundus to the neck. This singular appearance and deception I attributed to the contraction of the body of the uterus, while the edges of the incision remained

paralysed and uncontracted *. The thickness of the womb was increased to four times the diameter it presented during the operation : but what most deserved attention was the appearance of the large vessels, now with open mouths, which during the operation were not apparent. From the mouths of those vessels the streaming blood had been coagulated, and now formed strings, reaching from the mouths of the vessels to the great cakes of coagulated blood which lay on each side of the abdominal cavity. Besides the coagulated blood which lay in the cavity of the abdomen, a large clot was in the cavity of the uterus †.

From this case we see, that when the substance of the uterus is cut, either the muscular fibres do not fully contract, or in their contraction in consequence of being cut across, they do not constrict the blood-vessels. The misfortune in the case was, that the placenta was attached to the lower and fore part of the uterus ; and this, with the defect of action in the muscular fibres, was

* Precisely the same appearance presented in the case communicated by *Dr. Hunter, Med. Obs. and Enq. v. 4.* Mr. Thomson's incision was six inches in length of the gravid uterus: on dissection the uterus was found contracted to the size of a common melon; and the wound appeared nearly the whole length of its body.

† This corresponds with the dissection in the case communicated by *Dr. Hunter.*

the occasion of the death of the woman by hæmorrhage.

The circumstances of this case suggest very material improvements in the manner of performing the operation. Instead of cutting into the womb, as was done in the preceding case, I would recommend that a very small incision should be made, such only as would enable a finger to be introduced; by boring, aided by the disposition which the uterus has to dilate, another finger might be passed, and then a third, and at length the whole hand, in a conical form, might be forced into the womb. I further venture to suggest, that this should be done as far down upon the lower part of the uterus as the urinary bladder and the reflection of the peritoneum will permit; for at the lower part the uterus is least vascular, and most disposed to dilate. In the further prosecution of the operation, the child should not be suddenly extracted, but the feet being brought out by the opening, the body should be slowly delivered by the spontaneous action of the womb; and the whole operation performed as much as possible in imitation of the gradual progress of a natural labour: the only apology for hurry in the operation would be the separation of the placenta, or the compression of the cord in the narrow wound*, but the placenta could

* In the operation by Mr. Hunter, Med. Obs. and Enq. V. V, p. 227, the womb strongly contracted round the neck of the child,

not possibly be detached in the method now proposed, and it would be possible to guard against the compression of the cord.

The muscular structure of the womb becomes a subject of very great interest in connection with that of *flooding*; it has been proved by the sections of the uterus, made in different states of its contraction, that the order of the muscular fibres is calculated so as to close the vessels; that where nature has provided for the attachment of the placenta, there the broken vessels are guarded by the provision of the surrounding muscular texture; but we know also, that during this contraction of the superior part of the womb, the lower part dilates and relaxes. Now if the contraction of the womb be essential to the safety of the mother, what will be the effect of the attachment of the placenta to a part of the womb which must relax during the labour! Every one knows the peculiar danger of the case of *placenta previa*, that each labour pain, as it returns, increases the violence of the flooding, instead of checking it. In common

child, so as to retard the delivery of the head and press the funis; it is added, that Mr. Hunter soon overcame this stricture sufficiently to let the head be extracted.—By passing the fore and middle fingers into the womb, so that a finger might lie on each side of the cord, the pulsation of the cord would be free, however powerful the contraction of the uterus. But in truth there is no disposition in the wound to contract.

cases, breaking the membranes and accelerating the labour, checks the flooding, and secures the safety of the patient; but when the placenta is attached to the orifice of the uterus, the reverse of this takes place.

From attention to the muscular structure of the uterus I have been led to conclude, that in common cases of flooding, during labour, the hæmorrhage is not accidental, in any other meaning of the term, than as it proceeds from the place of the uterus to which the placenta is accidentally attached; that the placenta cannot be partially separated if it be attached in a regular circle to the fundus of the uterus; and that flooding on the commencement and during the progress of labour, is owing to an irregularity in the shape and attachment of the placenta.

When the placenta is attached in a regular circle to the fundus uteri, it cannot be partially separated, and cannot be separated bodily, until the uterus is permitted to have a great degree of contraction by the delivery of the child; the circular muscles of the fundus being agents in a double capacity, that is, both expelling the child, and in constricting the uterine vessels; by the time that the child is expelled, the vessels of the fundus are greatly diminished in diameter. Further, the place and strength of these muscles being perfectly regular and uniform, their action must have the

effect of equally drawing the surface of the uterus, which is in correspondence with the margin of the placenta, towards the center of the fundus, and consequently of separating the surface of the uterus from the placenta; but no one part of it will be separated until the general restriction is nearly completed. This will not be the case when the margin of the placenta extends irregularly, or when the placenta is attached to the side of the uterus. After the delivery of the child in cases of flooding, it is not uncommon to find a portion of the placenta low down in the uterus, and separated, while the greater portion remains attached to the fundus. In examining the inner surface of the uterus by dissection, I have seen the part corresponding with the placenta irregular in its form, and extending towards the side and neck of the uterus. In such circumstances of the attachment of the placenta, the retraction on the lower part of the womb being to a greater extent than the fundus, will account for the too early separation of that margin of the placenta which stretches towards the orifice, and also for the hæmorrhage, which is a consequence of this partial separation; but in progress of the labour, and after the discharge of the waters, the more powerful efforts of the uterus draw the muscular fibres more closely around the blood-vessels, and then the flooding ceases.

The flooding which attends the torpor of the uterus in any circumstances, when the connection

with the placenta is broken, will be very easily accounted for on recurring to the details of the anatomy given in the first part of this paper *.

* Some of the appearances described in this communication are illustrated in the figures of Plate III.