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The Anatomy of Prolapse of the Uterus

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Human beings who habitually adopt an upright posture are in constant danger of derangements of the pelvic viscera if these organs are not provided with an adequate support of bone, muscle and fascia. It is a remarkable fact that in many mammals including man the bony constitutents of the pelvis, the muscles that form the pelvic floor and the ligaments which suspend the pelvic organs have remained constant. Thus the innominate bone in the monkey, man or dog is composed of the same three elements ilium, ischium and pubis. However, with a little alteration in an appropriate bone, muscle or ligament, nature brings about subtle changes so that the end result happens to serve best the functional needs of a particular species. These alterations that have taken place during the course of millions of years are referred to as evolutionary changes. I shall first deal with the evolution of the bony pelvis and subsequently the muscles and lastly tell you something about the ligaments, which play such an important role in maintaining the uterus in position.

While we are in complete ignorance as to why the human body has taken the present shape and appearance we do seem to know something about factors which have played a significant role in shaping the human pelvis, its musculature and fascia. The bony pelvis is the result of evolutionary trends which are peculiar to man. These evolutionary processes have resulted in the assumption of an upright posture whereby the mode of locomotion has become almost entirely dependent on the hind limbs. The second factor which has profoundly modified the human pelvis, particularly that of our female species is the necessity to accomodate an increasingly large foetal head during the later stages of pregnancy. Although the human infant is premature at birth, its brain is very large and indeed more than half the size of the brain of an adult gorilla weighing over 600 pounds.

With the change from pronograde to the orthograde posture the articulation of the sacro-iliac joint has become strengthened by the inclusion of more sacral vertebrae at the expense of the antero-posterior articular area so that only the costal portion of the sacrum now partakes in the articulation of the joint in place of the usual costal and transverse portions which normally enter into the articulation of the sacro-iliac joints in lower primates and in quadrupedal mammals. Hand in hand with these alterations the ischiopubic symphysis of lower primates becomes converted into the pubic symphysis of man in whom only the ventral half of the pubic bones are involved in the symphyseal joint. There can be little doubt that these changes are to be correlated with the changed mechanics in the transmission of body weight from the quadrupedal position of mammals to the upright position of man. These changes have also brought about in their wake a large and rounded pelvic cavity in the human female in contrast to the elongated form of pelvis in the quadrapeds. Concomitant with the changes in the shape of the human bony pelvis there follow changes in the disposition of the pelvic viscera and external genitalia.

With reference to the pelvic and perineal musculature, it is perhaps relevant to mention that they are not new innovations but merely a remodelling of material already present in phylogeny. Indeed, the two muscles namely the pubo-caudalis and ilio-caudalis, which are used by ordinary mammals to depress the tail and as a perineal shutter are transformed into the pubic and iliac portions of the levator ani muscle in Man. The sphincter cloacae found in lower mammals such as monotremes has

become differentiated into the sphincter ani externus and perineal musculature of Man. The ischio-coccygeus or the coccygeus muscle is used by animals for wagging their tails and for obvious reasons has become vestigeal in Man. However, the reason as to why the dorsal portion of this muscle has undergone degenerative changes and is represented by an aponeurosis deserves further consideration. The aponeurotic changes have in fact a functional significance, that of providing support for the pelvic outlet with the least expenditure of energy. Similar examples of ligamentous degeneration in muscles are not uncommon in the human body. For instance, we find similar changes in the muscles on the lateral side of the foot where it would have been difficult to maintain the lateral arch of the foot only with the help of muscles.

It is a well known axiom that ligaments form the first line of defence in supporting the arches of the foot while muscles by their unconscious tensing action provide secondary support to the ligaments. Nevertheless, the combined action of both muscle and ligament is essential in maintaining the integrity of the arches. A similar mechanism appears to operate even in the support of the uterus and any impairment or failure in the functional efficiency of either one or both of these components could lead to various degrees of prolapse of the uterus.

Let us first consider the part played by ligaments. The various ligaments connected to the uterus and vagina are the round ligaments, utero-sacral ligaments, vesico-cervical ligaments, lateral cervical or the cardinal ligaments and the lateral vaginal ligaments. These ligaments are described as thickenings of the endopelvic fascia which is found between the peritoneum and the fascia covering the upper surface of the levator ani muscle. The term fascia appears to be used by gynecologists in a much broader sense than Anatomists would perhaps permit. For instance, most of these ligaments contain a large quantity of smooth muscle and ganglia (Fig. 1) which will not fall into the category of fascia according to the anatomical definition. Not only could there be smooth muscles inside these ligaments, some of them may well contain striped muscle fibres as well (Fig 2). Indeed an examination of some of the ligaments of the uterus in the monkey has shown an admixture of both smooth and striped muscle fibres. It would be of interest to examine the type of nerve endings in relation to the striated fibres so as to determine their functional significance. Some of you may think that striped (voluntary) and smooth muscles (involuntary) are so clear-cut in their morphology and function that their coexistance within the same tissue is impossible or imcompatible. This is not true since they are found together in the human levator palpebrae superioris and in the gubernaculum testis. I have noticed their presence in the region of the internal urethral sphincter in one of the lower primates (Fig. 3).

Our next enquiry is to find out which of the various ligaments connected to the uterus and vagina play a vital role in suspending the uterus in position and whose weakness leads to prolapse of the uterus. According to Kennedy (1949) not only the uterus but also the other pelvic structures such as the cervix, vagina, tubes, ovaries, bladder, urethra and levator muscles are all suspended from the white lines and their extensions along the ischiococcygeal ligaments over the coccyx. Dr. Mengert (1936), from an experimental study made in cadavers showed that the utero-sacral and round ligaments played only a negilgible role in the suspension of the uterus. However, when the paravaginal and the paracervical ligaments were severed, the cervix prolapsed through the vagina if forced traction is applied to the cervix. Mengert's conclusions were that "marked descent of the uterus amounting to actual prolapse never occurred so long as any part of the upper two thirds of the paravaginal or lower two thirds of the paracervical tissues were left intact. These conclusions are, in general supported by actual observations by Fothergill during his operative procedure in patients. The paracervical and paravaginal ligaments are composed of identical fibromuscular tissues arising from the side walls of the pelvis along the lines of attachments of the levator ani muscles. It is therefore clear that ligaments and muscles instead of remaining distinct as in the foot have blended together to form the so-called ligaments of the uterus.

While ligaments are of primary importance, the muscles of the pelvic floor play only a minor role in maintaining the uterus in its normal position. In this connection it may be relevant to mention that the pelvic floor is simply the bottom of a bucket for the pelvic canal. Hence

the integrity of the pelvic floor per se cannot prevent the prolapse of the uterus although it may indirectly influence it by supporting the vagina whose integrity in turn may contribute towards the support of the uterus. The most important muscle in the pelvic floor is the levator ani which arises from the back of the body of the pubis and from the inner surface of the ischial spine. In between these two sites the muscles arise from a thickening of the obtruator fascia (white line). While there is unanimity of opinion about the origin of this muscle there is no lack of controversy about its insertion. Shaw (1947) maintains that levator ani muscles decussate between the vagina and the rectum while others say that they fuse behind the vagina. According to Curtis, Anson and McVay (1939), and Curtis, Anson and Ashley (1942) the levator muscles are fused together between the urethra and the vagina as well. Howkins (1960) on the other hand, believes that the inner border of the two levator muscles are bound to the urethra, vagina and rectum by connective tissue elements and at no place do the two muscles come together between the urethra and vagina or between the vagina and rectum, nor do the levator muscles insert into the perineal body. According to the last mentioned author the two levator muscles are joined together between the vagina and the rectum by the prerectal fascia and by the lateral extensions of the external longitudinal layer of the rectum into the triangular ligaments. So when a tear involves the posterior vaginal. wall, it damages the external longitudinal layer of the rectum and the prerectal fascia. As a result the levator muscles have now a greater mobility from side to side and can therefore spread out when the patient strains or when the intra-abdominal pressure increases.

Lastly it is a well known fact that most patients suffering from prolapse of the uterus are multiparae of menopausal age. It therefore remains to be answered as to why only some multiparous women develop prolapse of the uterus and why this condition develops at the time of menopause. It is argued that in those in whom prolapse of the uterus occurs there is an over stretching of the ligaments during pregnancy; if this is so prolapse should develop in these cases before menopause. I consider that the occurence of prolapse in women towards menopausal age as significant since it is at this time that there is a reduction or total abolition of endocrine secretion from the ovaries. It is a well established fact that the action of these hormones on smooth muscles of the uterus is to produce hypertrophy and to maintain the tone of the muscles. So when the action is withdrawn at menopause, the smooth muscles within the ligaments also undergo atrophy, perhaps more so in some women than in others. The second method by which the muscles within the cardinal ligaments might be adversely affected is by the reduction in blood supply to the ligaments brought about by a reduction in the hormonal content in the circulation towards menopause. Here again, one has to postulate that the effect on the vascular supply is unequal in different women, a hypothesis which is not altogether within the realms of fantasy. Once the degeneration of muscles within the ligaments is affected the stretching of the ligaments suspending the uterus is only a matter of time. The collapse of the arches of the foot in polio-myelitis in which the muscles degenerate and whereby the intact ligaments have lost the secondary support from the afflicted muscles gives credence to my suggestions here on the development of the prolapse of the uterus along similar lines.

In nulliparous women who develop a prolapse of the uterus it is not unusual to find that they belong to the menopausal or post-menopausal age group. In these cases it may be argued that the same endocrinal factors as those in women who have had children are in operation. On the other hand in those nulliparous women who suffer from prolapse of the uterus before menopausal age, I would venture to suggest that there is a congenital reduction in the amount of smooth muscle within the supporting ligaments of the uterus. Indeed, in many of these cases it was revealed after an X-ray examination that they were suffering from spina bifida, which might well be associated with a deficiency of the smooth muscles within the ligaments.

Summary

The human pelvis is the outcome of bipedal mode of progression and the evolution of a large brain which entails the presence of a large foetal head. (2) The uterus is supported chiefly by the lateral cervical and the lateral vaginal ligaments which contain an admixture of muscle

and fascia. (3) Secondary support to the uterus is mainly provided by the levator ani muscle. (4) It is suggested that atrophy of the muscles within the ligaments as a result of hormonal deficiency is the chief factor concerned in the aetiology of prolapse. (5) A tentative suggestion is also made that the atrophy within the ligaments may be the direct result of hormonal insufficiency or secondary to a vascular reduction following the withdrawl of hormones from the circulation as occurring at menopause. (6) In nulliparous women with prolapse, there may be congenital reduction in the smooth muscluature within the ligaments.

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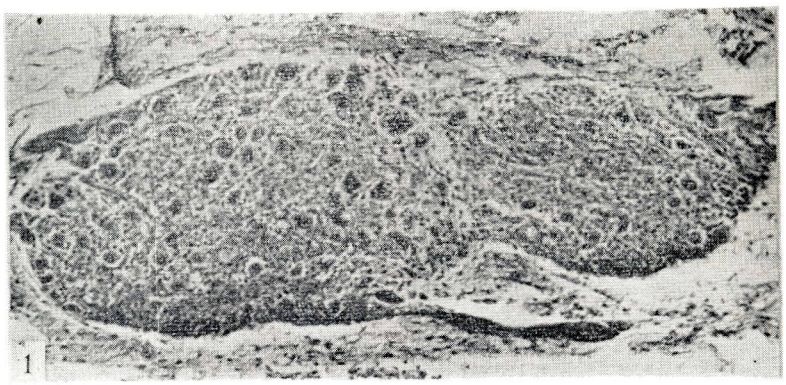
Explanation of Plates

Fig. 1 — A paracervical ganglion within the cardinal ligaments of money X 72.

Fig. 2 — Striated muscle fibres within the cardinal ligaments of monkey X 500.

Fig. 3 — Smooth and striated muscle fibres in the urethral sphincter in Galago X 750.

FIG. 1

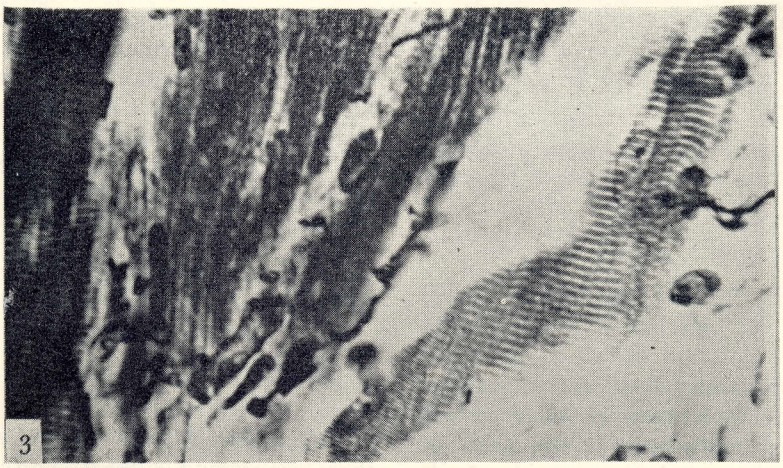


X 72

FIG. 2

X 500

FIG. 3



X 750