Various Concepts in the Aetiology of Recurrent Urinary Tract Infections in Girls

PART III

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SUMMARY

It is generally accepted that the majority of urinary tract infections occur by the ascending route. A plea is made that, for the proper evaluation of any case with urinary tract infection, meticulous attention should also be given to any form of vulvovaginal infection, irritation, or local abnormalities. Especially in children, this can often be done only under anaesthesia on the cystoscopic table.

The importance of relative hypospadias and recurrent cysto-urethritis in teenage girls is discussed. Relative hypospadias due to urethrohymenal fusion is rarely immediately evident on cursory examination and should especially be looked and tested for.

It is our impression that there is a definite relationship between recurrent lower urinary tract infection and the use of intravaginal sanitary tampons, especially in teenage girls. Our experiences in this regard are discussed in some detail.

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It has been contended by some authorities that the cure or control of urinary infections depends upon ultimately solving the problem of why pathogenic enteric bacteria become established on the introitus of the female and on the urethra. It is now generally acknowledged that the majority of urinary tract infections occur by the ascending route. Acceptance of this concept implies at least transient involvement of the lower urinary tract in the sequence of events resulting in the urinary infection.[1,2] Recurrent urinary tract infection in females is not always a recrudescence of smouldering infection brought about by persistent or incompletely eradicated bacteria. A new infection can occur each time, brought about by bacteria from outside which gain access to the bladder through the urethra. The pathogens involved are those resident in the vaginal introitus, the pudendum, anus and urethra.[3]

In many cases urological evaluation consists of a short history, cursory physical examination in the consulting rooms, urinalysis, urine culture and sensitivity and perhaps an excretory urogram. The attending physician is then satisfied that any major pathology has been excluded and the patient is started on antimicrobial therapy. Meticulous examination of the extreme distal part of the urinary tract where the offending organisms gain entry, is very often completely ignored. A careful assessment should always be made of any possible vulvovaginal abnormality, chronic infection, or irritation.

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Bubble Cystitis

As long ago as 1955, Simmons[4] reported a series of 116 little girls in whom the regular use of detergents, perfumed soaps and bubble products in the bath water, caused an acute vulvovaginitis and urethritis. In cases of irritative symptoms and infection of the lower urinary tract, it would seem advisable to ascertain whether bubble products or detergents had been added to the bath water. Some urologists advise their patients not to bath but to shower.

Foreign Bodies in the Vagina

Little girls quite often introduce foreign bodies into the vagina. When they present with symptoms of chronic irritation and especially with a history of purulent discharge, a bacteriological culture should be done, and the depth of the vagina should always be inspected with a small speculum. Beads, pieces of wood and small stones have been recovered from the vagina.

Anorectal *Oxyuris* infestation is an important source of chronic irritation, with itching and scratching and resultant trauma to the introitus and external meatus. Pinworms can even gain entrance into the bladder via the urethra; they have been observed cystoscopically, snaking in the bladder.

According to Hendry and associates[5] the infantile uninhibited type of bladder (discussed in Part I of this article) may frequently be associated with spasm and inappropriate contraction of the external urethral sphincter; vulvitis and urinary infection increase the bladder irritability, causing a vicious circle. Urethral dilatation may be helpful in these cases, together with anticholinergic drug therapy if day-wetting is a problem.

Vulvovaginal Abnormalities

In an examination aimed at finding the cause of recurrent infection in little girls, the vulvovaginal struc-

tures should also be carefully inspected for any possible anatomical abnormality that might cause pooling of potentially infected material. Such an abnormality is not always obvious on casual examination and sometimes not found until the patient is thoroughly anaesthetised on a cystoscopic table.

Partial fusion of the labia minora with a small anterior opening might be responsible for the pooling of urine and infected material in the vagina. Stewart[6] recently reported 6 cases with recurrent urinary tract infection secondary to a partially imperforate hymen. Careful examination revealed a thin membrane covering the vagina and attached laterally to the urethral meatus, with a small opening into the vagina just beneath the urethral meatus. This membrane apparently acts as a shield, diverting part of the urine into the vagina, and in 1 case with sufficient force to reflux through the uterus and tubes into the peritoneal cavity. This membrane of tissue seems to lie deep in the labia minora and yet anteriorly it is distal to where the hymen should be. When the membrane is incised there is no true hymen present and the perineal portion of this tissue seems to be where the real hymen should be. According to Stewart, this entity seems most likely to be a persistent genital portion of the cloacal membrane.

The occurrence of true female hypospadias is very rare and is a curiosity. Most of these cases present with incontinence, dribbling and infection. Stephens states that the failure of explication of the urogenital sinus at the 70-mm stage of the embryo results in the urethral meatus opening into the urogenital sinus in common with the vagina or Müllerian duct remnants.[7] Other urinary tract, Müllerian duct and rectal anomalies are often associated.

In cases of day and night wetting, with otherwise normal bladder function, one should always have a high index of suspicion that it might be due to an urethral or vaginal ectopic ureteric orifice.

Relative Hypospadias and Recurrent Cystourethritis

Although it is not the only underlying factor, the temporal relationship between sexual intercourse and recurrent attacks of lower urinary tract infection has been known for many decades. As emphasised by Steyn,[8] chronic ascending urethritis is a very common disease in women, and it occurs mainly during the sexually active period of life. Steyn found the maximal incidence to be between 20 and 30 years of age. In our experience the peak incidence is at a much earlier age and is gradually and progressively becoming more so.

Since the advent of the pill and with the new morality concept of letting your feelings be your guide, premarital coital activity, even among the very young, has become common practice. This fact has been reported on, and substantiated by, various papers in scientific journals as well as by articles in the lay Press. In a recent article in the supplement to a well-known Sunday newspaper, the secretary of the Transvaal Association for Family Planning stated: 'If I do not give the pill to girls, and I am talking about 13- and 14-year-olds, then one of these days they will present for a pregnancy test.'

It is clear that the old classic adage, 'honeymoon cystitis' coincident with defloration, has lost much of its original meaning and significance. The term 'high-school cystitis' would be much more appropriate.

Urethral-Hymenal Adhesions (Fig. 1)

In 1959, O'Donnell[9] drew attention to what he called urethral-hymenal adhesions. In most females, initial intercourse and defloration tear the virginal hymen radially, with the production of caruncula hymenalis. He suggested that inadequate rupture of the hymenal ring causes relative urethral hypospadias with subsequent contamination of the urethral meatus by vaginal discharge during coital activity. Multiple superficial radial tears could occur which would not extend deeply enough into prevaginal tissues to adequately separate the urethra from the vaginal introitus. In other cases, the hymen is of such tensile strength that it remains intact. Owing to repeated stretching and dilatation during intercourse a perihymenal inflammatory reaction with ensuing fibrosis may follow. Under any of these circumstances, introduction of the penis into the vagina would in effect pull the urethral meatus into the vaginal canal with resultant contamination of the lower urinary tract. It can be assumed that in some cases, especially in the 12- to 14-year-olds, a small vaginal introitus has to accommodate a relatively large penis, with a considerable amount of chafing of the external meatus if it is drawn into the hypospadic position.

Diagnosis and Physical Examination

A relative hypospadias due to urethral-hymenal fusion has been documented and commented on.[10,11] It is emphasised that urethral-hymenal fusion is most often not immediately evident on a cursory examination of the vaginal introitus. As advised by Hirschhorn,[10] the patient should be in the lithotomy position for careful inspection of the vaginal introitus. Normally, the external urethral meatus is located superior to the introitus and separated from it by a broad width of soft tissue. The perihymenal tissues are soft and can easily be stretched. For demonstrating urethral-hymenal fusion the hymenal ring should be stretched with one forefinger on either side at the 3 and 9 o'clock positions. The hymenal ring will feel tense, thick and indurated; the taut hymenal tissue will sweep around and incorporate the urethral meatus. By thrusting the 2 fingers deep into the vagina and depressing the hymenal ring, the urethral meatus will be pulled inwards facing the vagina; it may even evert and pout, i.e. it becomes hypospadic.

The Urethral Hood

In addition to the appearance of the intact hymenal ring with concurrent downward movement of the urethral meatus, Reed[12] noticed a hood or flap of mucosa arising

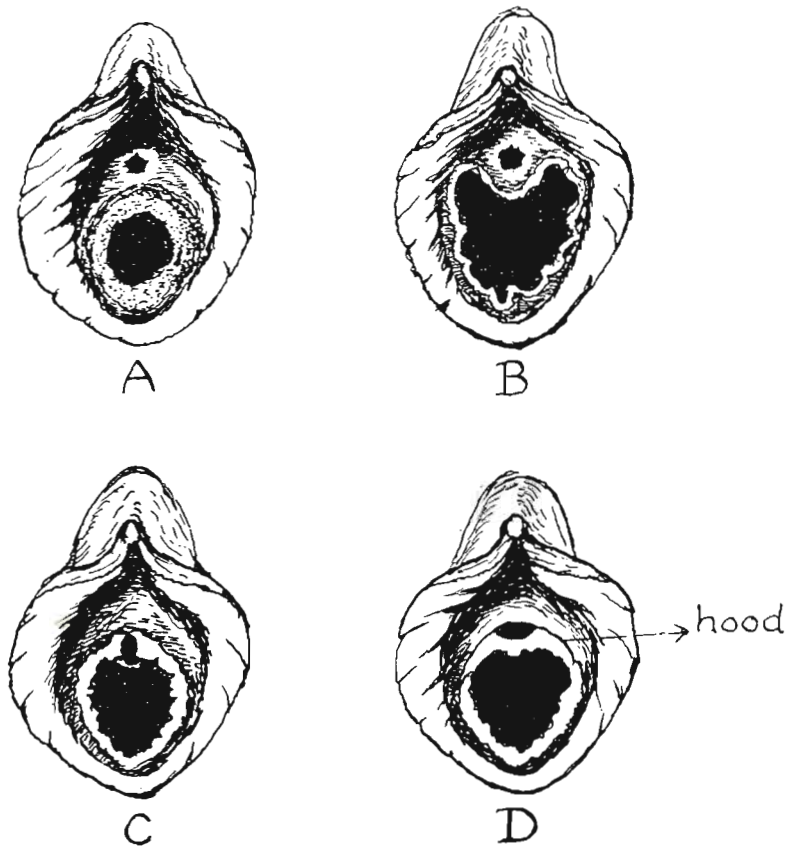


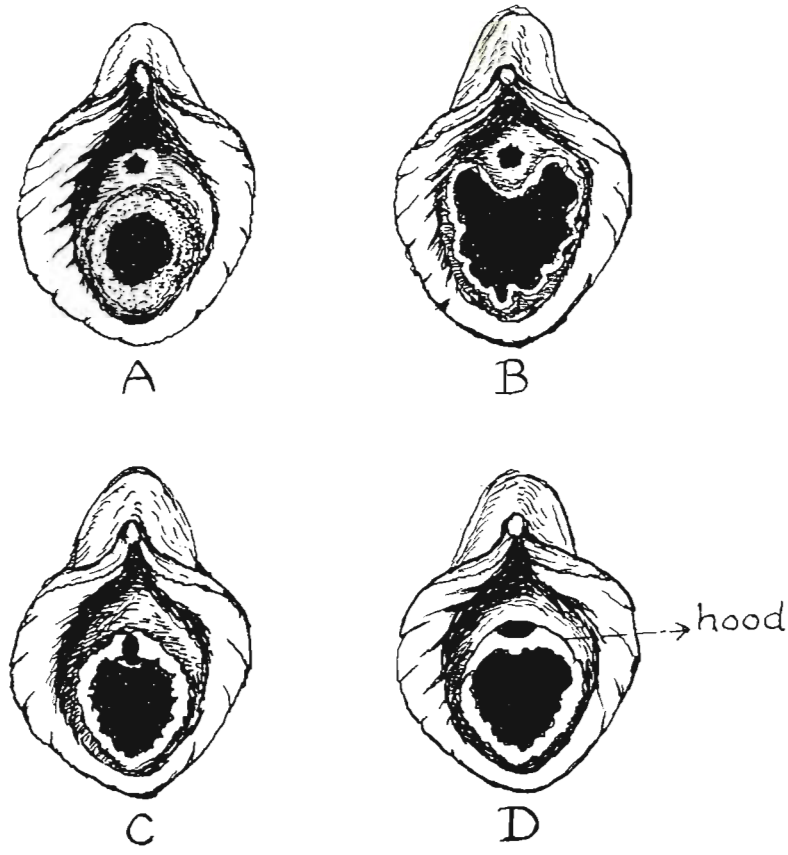
Fig. 1. Various hymenal configurations (modified after Hirschlorn and Reed[10,12]): A—normal virginal hymen. B—normal postcoital hymen. C—relative hypospadias of urethral meatus due to urethral-hymenal fusion. The urethra is incorporated in a fibrotic hymenal ring. D—urethral hood with urethrohymenal fusion.

from between the urethra and clitoris and covering the urethral meatus on overstretching the vaginal inlet with the fingers, simulating vaginal dilatation by the penis. He also emphasised that hooding was particularly severe and extremely obvious in those patients suffering from recurrent cysto-urethritis related to intercourse. Operative corrective procedures had given complete and permanent relief in 92 cases.

Illustrative cases. In the past 2 years, 5 teenage girls (between the ages of 13 and 15 years) with a history of recurrent severe urethritis and in whom urethral-hymenal fusion had been demonstrated, were investigated. They had had various cycles of antibiotic therapy with temporary improvement. They all admitted regular coital activity and a direct relationship between intercourse and another episode of severe acute urethritis. On close questioning it transpired that none of them really found intercourse a pleasant experience; in fact, they often dreaded another bout of coital activity, but they succumbed to the demands of their boy-friends for fear of losing them. Apparently, according to their way of thinking, it is a worse fate to sit at home on a Saturday or Sunday night and not be entertained by a boy-friend elsewhere, than to sit on the pot on subsequent days in the throes of another attack of acute urethritis. To many of the young ones, a night out is all-important and to be without a date on a Saturday night is to miss a time of never-ending enchantment.

It is beyond the primary aim and scope of this article to discuss the moral, ethical and professional obligations of the attending doctor to the patient, her parents, or other interested parties in such cases.

In all 5 cases the vaginal orifice was relatively small and the hymenal ring was thickened and stenotic, incorporating the external meatus which had polypoid tissue projecting from it. A Hirschhorn type of urethroplasty was done on all cases. A transverse incision about 2,5 cm long and 2 cm deep is made just inside the hymenal ring between the urethra and vagina. The incision is closed vertically, transposing the urethra to a more superior position, away from the vaginal inlet. In addition, a Heineke-Mikulicz type of hymenotomy was carried out in the 10 o'clock and 2 o'clock positions. All 5 cases had excellent results.



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The Periurethral Glands

Moore and Hira,[13] in reviewing 150 cases of chronic urethritis in the female, considered chronic inflammation of the periurethral glands as the basic underlying pathology. Lloyd-Davies and Hinman[14] have also incriminated the periurethral glands. These glands are most numerous at and immediately external to the bladder neck. The paucity of drainage from the glands is a factor in the chronicity of the infective state. Repeated insult to the urethra in one way or another leads to permanent, chronic, inflammatory changes. In severe cases there may be the formation of pseudopolypi. In long-standing cases there is a tendency to fibrosis and stenosis of the urethra.

A chronic infective state of Skene's para-urethral glands may also be responsible for recurrent urethritis. These 2 glands are situated just within the meatus of the female urethra and are regarded as homologues of the seminal vesicles. Although more often documented in older females, we have seen 1 case of chronic abscess and sinus formation of these glands in a 15-year-old girl.

INTRAVAGINAL SANITARY TAMPONS

About 2½ years ago, we became interested in a possible causal relationship between the use of intravaginal sanitary tampons and ascending urethrocystitis in teenage girls. By coincidence, 3 girls were seen within a relatively short period with the same complaint of repeated episodes of frequency, urgency and dysuria. All of them denied any coital activity or other forms of mechanical sexual stimulation. After careful questioning it transpired that they had never suffered any previous urinary infections until the menarche. Their urinary symptoms usually started within a few days after onset of menstruation. It also became evident that they all made use of intravaginal sanitary tampons; 2 of them used a home-made variety, consisting of a plug of cotton wool wrapped in gauze with a piece of string attached.

Material

During the last 2½ years another 22 girls between the ages of 12 and 16 years were seen in consultation, and they related the same history and symptomatology. In all, acute urinary symptoms commenced during or soon after menstruation; all were using intravaginal sanitary plugs and some occasionally a perineal type of pad during the night.

On further questioning a few girls stated bluntly that the intravaginal plug-type was 'with-it'; the perineal pad was old-fashioned and confined to the older generation 'like their mothers'.

The majority, however, gave a more logical explanation. Modern dress-designing for teenage girls has shifted the emphasis from the bust to the buttocks. The popular and universally-worn stretch pants must be as tight-fitting and revealing as possible around the buttocks, hips and thighs. The result is that the wearing of a perineal pad is too conspicuous and obvious to the eye. The perineal pad also shifts easily out of position and does not always prevent soiling or blood-staining of the external clothes. The pudendal underwear of the mini-dressed girls is also easily exposed to the public eye during bending or a sudden gust of wind.

Methods and Discussion

All cases were subjected to routine urological evaluation including physical examination, excretory urograms, cysto-urethroscopy and urine cultures. On cysto-urethroscopy, 7 cases were found to have some thickening and reddening of the urethral mucous membrane with the so-called 'cobblestone' appearance. One case showed the typical appearance of cystitis cystica over the trigone and bladder base. On *bougie à boule* calibration, 4 cases had a relative urethral stenosis, that is an urethral calibration of less than 20F. All other investigations proved to be normal.

According to our experience from this small series, there is presumptive evidence that a causal relationship exists between recurrent lower urinary tract infection in teenage girls and the use of intravaginal plugs during menstruation.

It is postulated that a combination of 3 aetiological factors is involved. These aetiological factors, expounded by various investigators, have already been discussed in previous sections of this article.

1. It is surmised that in many cases, due to a relatively small vaginal introitus and a narrow, tight, hymenal ring, a vaginal plug is introduced only with some difficulty. We have tested this under anaesthesia on the cystoscopic table. **Some trauma and irritation surely occurs** to the mucous membrane of these structures. We have also demonstrated that, with tight vaginal plugging, and especially if 2 plugs are used, a taut hymenal ring is pushed inwards, the external urethral meatus also is pulled intravaginally to a certain extent and the orifice gapes and becomes everted. This was conspicuously evident in cases in whom the urethral meatus was lower than usual and bordering on the hymenal ring (Fig. 2).

On careful questioning it transpired that many of these young girls do use 2 vaginal plugs, especially during excessive menstrual flow. The upper vaginal plug is inserted to absorb the menstrual blood, while the lower must act as a stopper, occluding the vaginal inlet and fitting tightly within the hymenal ring to prevent soiling of the external clothes.

2. It also emerged that in some cases the vaginal plugs are not changed during the day; after rather tight packing in the morning, they are only removed at night. It seems logical to conclude that very often these plugs become soaked with urine, mixed with the menstrual efflux and form an excellent culture medium for local pathogenic enteric bacteria.

3. The concept of normal urethral laminar flow versus turbulent flow in cases of distal outflow obstruction, as proposed by Halverstadt and Leadbetter,[15] has been discussed in Part I of this article. Turbulent flow may cause the reintroduction of bacteria into the bladder, especially in the presence of residual urine. According to

these investigators, a careful review of voiding cine cysto-urethrographic studies demonstrated some residual urine in almost all their cases of urethral obstruction.

Ward *et al.*[16] have called attention to the so-called pseudo-bladderneck syndrome in female patients, arising from extrinsic pressure in the region of the bladderneck

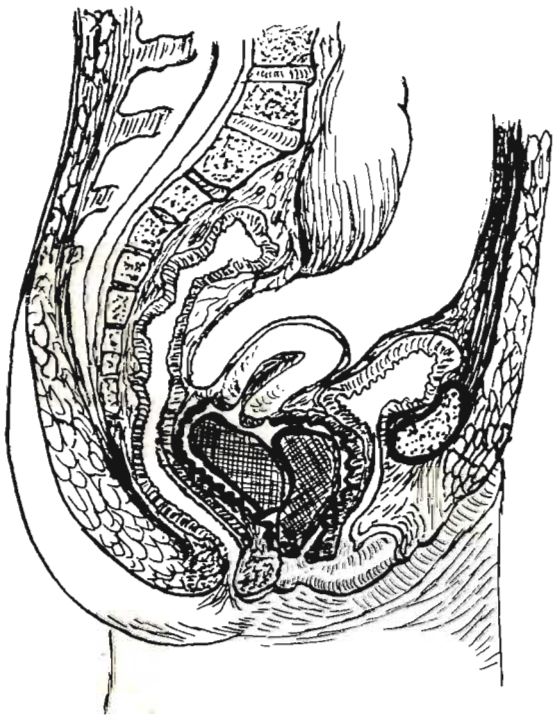

Fig. 2. Diagrammatic representation of 2 intravaginal sanitary tampons in position. The rectum is pushed backwards, and the bladder neck and urethra forward against the symphysis pubis, with pseudo-obstruction of the bladder neck and urethra.

and urethra. They stressed the importance of pelvic examination to exclude pelvic tumours.

It is also logical to conclude that these intravaginal sanitary plugs can cause a certain amount of urethral outflow obstruction with turbulent flow, from extrinsic pressure on the urethral lumen.

Ten of the 22 girls questioned admitted that on tight vaginal plugging, normal micturition is adversely affected, with a feeling of incomplete bladder-emptying. Two girls who regularly used a home-made variety, stated that on several occasions they could not void at all after insertion of the tampons.

Eight girls were subjected to urethroscopic and cysto-urethrographic examination after insertion of 1, 2 and if possible, 3 plugs, of a popular commercial brand. The introduction of 1 plug, deep into the vagina, usually did not make much difference, but 2 plugs, in most instances, definitely caused a forward elevation of the trigone, bladder neck and urethra, pushing these structures against the symphysis pubis and causing an abnormal configuration with partial obstruction of the bladder neck and urethral lumen.

CONCLUSION

In conclusion it can be said that in the absence of serious anatomical abnormalities, the general prognosis for children and young girls with urinary tract infections is basically good, provided one is prepared to make a meticulous search for every possible offending aetiological agent which is often simple to remedy, and provided the patient and her parents are prepared to subject her to intensive and prolonged treatment, which is incumbent in some cases.

However, one does face a small 'hard core' of patients with persistent problem infections; for instance, the presence of cystitis cystica identifies patients who are likely to have infections that constitute difficult therapeutic problems. The endoscopic appearance of cystitis cystica, mostly seen over the trigone and lateral walls, is usually quite characteristic. Basically it consists of epithelial-lined cysts which harbour and perpetuate the microbial infection. It always indicates a poor prognosis in terms of short-term cure. Long-term medical therapy, even for many years, is sometimes required for eradication of this chronic form of non-specific cystitis. Kaplan and King[17] documented cases among female children with cystitis cystica, who eventually underwent transurethral resection of the bladder neck and fulguration of the cystic lesions. Despite 5 years of continuous medical therapy, the patients were still infected.

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