URETERIC TRANSPLANTATION IN CHILDREN

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Ectopia vesicae and epispadias with loss of sphincteric control are the most common conditions calling for ureteric transplantation in children. Many surgeons, commencing with Roux in 1852, have endeavoured to relieve the distress of ectopia vesicae by plastic operations directed at forming a competent urinary bladder. These attempts have almost invariably resulted in failure owing to inability to form an effective vesical sphincter. Hugh Young and more recently Michon, however, claim to have met with some success. The latter author states : ' deviation is not a cure but a palliative, a confession of our impotence to restore a normal urinary tract,' and makes a plea for conservative reconstructive surgery in selected cases. These plastic procedures, however, invariably require multiple operations extending over a prolonged period of time and the efficacy of the final result is always in doubt. This uncertainty, and the generally good results obtained followed diversion of the urine to the bowel by ureteric transplantation have resulted in the almost universal adoption of the latter procedure as the standard treatment for ectopia vesicae.

The views expressed in this article are based on a series of 14 cases of ectopia vesicae treated, during the past three and a half years, by ureteric transplantation and excision of the bladder at the Royal Manchester Children's Hospital.

Type of Operative Treatment

In the series of children under review the ureters have been transplanted singly into the bowel. The aim has been to carry out the two transplantations at approximately two to three week intervals and then, if the child's condition is satisfactory, to excise the bladder a few weeks later. This programme has, however, often had to be modified owing to the onset of various illnesses common to childhood. It is appreciated that in many cases simultaneous transplantation of the ureters might be carried out. The treatment of ectopia vesicae is not, however, one of great urgency, and it is felt that in the young child the risk is minimized by insuring that at least one kidney is working perfectly at the time of each operation. In older children (five years or over)

simultaneous transplantation is probably a reasonably safe procedure.

Many authors advise that there is no need to excise the exstrophic bladder, or that the excision may be deferred until five or six years of age when, in the male, an attempt may also be made to repair the accompanying epispadiac deformity. Although the absence of urine from the abdominal wall leads to a vast improvement in the cleanliness of the exstrophic bladder, the mucosa never dries up completely and the abdominal wall continues to be irritated by a mucoid discharge. Diathermy destruction of the mucosa has been tried but is a rather disappointing and long drawn out procedure. Excision of the bladder is therefore now carried out as soon as possible after the transplantation. Any attempt to repair the epispadiac deformity is postponed until the child is at least five to six years of age.

Optimum Age for Operation

It is commonly recommended that in cases of ectopia vesicae transplantation of the ureters into the rectum or sigmoid colon should be deferred until the child is five or six years of age. But none of those who have to look after such children can fail to be impressed by the misery of the child during this period of waiting. The constant escape of urine saturates the clothes, resulting in a pungent odour of decomposing urine : the skin around the exposed bladder mucosa becomes sodden and excoriated ; multiple septic spots appear ; the bladder mucosa, which is extremely sensitive, tends to be inflamed, to bleed easily and to become ulcerated. Infection of the bladder surface may give rise to an ascending pyelonephritis, and it is claimed that half of these children are dead by the tenth year. Buerger recorded in 1916 that of 74 children born with exstrophy only 23 passed the twentieth year of life. Certainly many untreated children show some dilatation of the ureters, pelves and calices in intravenous urograms.

The sorry plight of these children inclined the author, in 1946, to start transplanting the ureters at an earlier age. The children seemed to stand the operation well and the date of the operation was gradually advanced until, in an otherwise

FIG. 1.—Ectopia vesicae, showing the ureteric orifices and epispadias deformity.

FIG. 2.—Epispadias, with loss of sphincteric control.

healthy child, it is now carried out at the age of a year to a year and a half. Some children, however, when first seen are already past this age. Experiences have been similar in other clinics. Higgins, in 1947, reviewed 41 cases of transplantation of the ureters into the recto-sigmoid for exstrophy of the bladder, and recommended that the operation should be performed preferably during the first year of life.

Malformations Accompanying Ectopia Vesicae

Congenital abnormalities of the renal tract are frequently multiple. Bladder and penile deformities are often associated with faulty development of one or both kidneys. It is therefore important to carry out excretion urography prior to performing any transplantation. Even if the kidneys and ureters prove to be normal, the films are a useful record by which to check the results of operation. In the present small series, apart from slight degrees of dilatation observed in some children, three major deformities were found—one child had a unilateral megaloureter and hydronephrosis, one a unilateral double ureter and one absence of one kidney and ureter.

In the male, epispadias is almost invariably present. Higgins has, however, described a patient in whom the penis was normal. The testes may also be incompletely descended. In the female the clitoris is split and the labia minora are separated anteriorly, exposing the vaginal orifice.

Other anomalies, such as spina bifida or deformities of the rectum, may be present. In these instances the advisability of transplantation must be carefully considered, for in the presence of inadequate anal control diversion of the urine to the rectum renders the final state worse than the first.

It is quite common for some degree of rectal prolapse to be present in a baby suffering from ectopia vesicae. The prolapse should be reduced and a finger inserted into the rectum. If tone can be felt in the sphincter when the child strains, then one may be certain that anal control will be adequate.

The presence of the rectal prolapse is curious and may be accompanied by the presence of inguinal herniae. One gets the impression that the child is continually straining. Following transplantation of the ureters, this straining appears to cease and the rectal prolapse disappears almost immediately. This has led me to believe that the straining may be largely due to cystitis of the exposed bladder and is akin to the dysuria, frequency and straining accompanying the systolic bladder of acute cystitis. It is also probable that

the early ureteric and renal dilatation seen in many of these children is due at first to the persistent systole of the exposed bladder and ureteric orifices, and only later to infection. This is, of course, a further argument for carrying out early transplantation.

Preparation of the Patient for Operation

The child's general health should be improved as much as possible. An adequate supply of vitamins should be provided. The condition of the ectopic bladder and the surrounding skin is improved as much as possible by baths, frequent changes of dressing, protection of the vesical mucosa with tulle gras and treatment of the skin with a protective, such as an ointment of zinc and castor oil.

The bowel is prepared by giving a non-residue diet for four or five days. Extra fluids are encouraged. On the day before operation fluids only are given and are continued up to within three hours of operation. A good aperient is given four nights prior to operation. On the two following days a rectal lavage is carried out. No rectal wash-outs are given on the day before, or on the morning of the operation.

Sulphasuxidine is given for five days prior to operation. A course of penicillin (50,000 units intramuscularly eight hourly) is commenced 24 hours prior to operation. The child's blood group is determined.

Operative Technique

As has previously been stated, the author prefers in the infant and young child to transplant the ureters at separate operations. Fine instruments and a gentle technique are essential, as in infants the operative field is small and the tissues delicate. The child is placed in a slight Trendelenburg position; in small children this may be easily attained by placing a sandbag under the buttocks. The ectopic bladder is sealed off and the abdomen opened by a mid-line incision placed at least $\frac{1}{2}$ in. above the margin of vesical mucosa. The rectus muscles are found diverging to their origins on the separated pubic bones, and the lower portion of the linea alba is a sheet of fibrous tissue. The peritoneal cavity is opened and the small intestine gently removed from the pelvis and packed into the upper abdomen. The appendix is usually removed at this point, so that mild attacks of acute appendicitis may not be confused with pyelonephritis. The right ureter is dealt with first and can usually be seen through the peritoneum, running over the common iliac artery. The peritoneum is incised for about 2 in. from the pelvic brim down towards the bladder. The ureter is then gently picked up and separated from

its bed almost to the bladder. This is easily accomplished as the lower ends of the ureters run forward to the ectopic bladder. The ureter is then divided and the lower end ligated. The peritoneal incision is closed from its lower end with a fine catgut suture. A space about $\frac{3}{4}$ in. long through which the ureter emerges, is left at the upper end of the incision.

The lower end of the sigmoid colon and the rectum are then examined, and a point of implantation chosen so that the ureter will run as straight a course as possible into the bowel, and so that the bowel may be fixed to the parietal peritoneum, at the point of emergence of the ureter, without causing kinking. The actual transplantation is carried out by the Coffey 1 technique. This proceeds exactly as in the adult, except that the ureter and colon are smaller and require very careful handling. This is particularly noticeable in making the incision in the bowel wall to form the submucosal bed. Unless great care is taken the mucosa is easily perforated at undesired sites. The lower end of the ureter is finally drawn into the bowel through a small mucosal opening at the lower end of the incision in the bowel wall, and held in position by a fixation stitch. About $\frac{1}{2}$ in. of ureter should be within the bowel. The muscular wall is then brought together over the ureter, which lies in a submucosal bed, by a fine continuous suture of 3/0 chromic catgut, or alternatively, interrupted sutures may be used. This layer must be sutured loosely, so that there is no compression of the ureter. If the sigmoid colon is large a series of Lembert sutures may be used to form a second suture line, and to bury the fixation suture. When the colon is small, and if this second layer of sutures appears likely to cause pressure on the ureter or to constrict the colon, this layer of sutures may be omitted and some fat from the appendices epiploicae is stitched over the first suture line. The bowel is then gently sutured to the parietal peritoneum at the pelvic brim so that the course of the ureter is almost entirely extraperitoneal, and there is no kinking of the colon. The omentum is brought down into the pelvis and the abdomen closed without drainage. A Malecot catheter is inserted into the rectum and held in position by a loose skin stitch.

The transplantation of the second ureter is usually carried out three weeks later (in older children a double transplantation may be performed at the first operation). The wound is reopened, the left ureter exposed and separated. The transplantation into the bowel is placed at the most convenient site, which is often 2 to 3 in. above the right ureteric transplantation. If the ureter is short or if the sigmoid colon does not lie satisfactorily, the left ureter may be passed behind

the mesosigmoid and brought through a small opening in the peritoneum above and to the right of the sigmoid colon; the transplantation is then made into the right side of the sigmoid colon.

The transplantation of a double ureter does not involve special difficulties. The two ureters are held together by a fascial sheath and may be transplanted into the bowel through one incision, using two fixation sutures.

The excision of the exstrophic bladder is carried out as soon as the child is fully recovered from the ureteric transplantations. The operation is inclined to be a troublesome one and accompanied by considerable bleeding.

The skin is incised around the bladder mucosa and across the urethra at the level of the bladder neck. The bladder is then dissected up and carefully separated from the peritoneum. Many vesical vessels will require ligation, others may be sealed with diathermy. The fibrous band uniting the two separated pubic bones must not be divided. When the separation is complete, a large cavity is left between the diverging rectus muscles, with a thin layer of parietal peritoneum forming the floor, and the skin edges are widely separated. In some cases it may be possible to form a fascial covering to the peritoneum by turning down a flap from each rectus muscle; in others this is impossible and no special covering can be made. The skin margins are then extensively undercut and almost invariably may be sufficiently mobilized to bring them together. A small drain is left in the vesical space. The repair of the abdominal wall always appears rather inadequate, but healing is usually good, and there is seldom more than slight separation of the lower $\frac{1}{2}$ in. of skin margin. This area gradually contracts down and heals. The amount of subsequent herniation is amazingly slight.

Post-Operative Treatment

Following the operation of ureteric transplantation, the child is encouraged to take fluid by mouth from the moment of regaining consciousness. The amount is only restricted if post-anaesthetic vomiting occurs, when small but frequent drinks are given. For the first three days the fluid is limited to glucose and water flavoured with fruit juices. On the fourth day milk or milk foods may be added to the diet. From the fifth day milk puddings, custard, jelly, junket, etc., are given and the diet gradually increased to normal. Intravenous fluids are only used if the child is vomiting persistently and becoming dehydrated. A transfusion for shock or blood loss is seldom required.

The drainage from the rectal tube is carefully watched. In the most satisfactory cases it com-

mences soon after operation, indicating that the child is getting sufficient fluid and that the anastomosis is not too tight. The drainage is at first frequently blood stained. By the fourth or fifth day faecal matter may be draining away, and occasionally a stool may be passed around the tube. The tube is removed on the sixth or seventh day. From this time training in rectal micturition commences. Most children rapidly gain control and quickly become accustomed to the new condition.

Results

Of 14 children submitted to ureteric transplantation, one died directly as the result of the operation. One month after transplantation of the right ureter a sub-acute intestinal obstruction developed and the child subsequently died; the obstruction appeared to be due to constriction and kinking of the sigmoid colon at the point of anastomosis. One other young child developed intestinal obstruction four weeks after transplantation of a single ureter; the transplantation

was satisfactory but a piece of small bowel had become adherent to the abdominal scar and was strangulated. The remaining 12 children have made complete recoveries. No cases of peritonitis have been encountered.

Urinary control is perfectly satisfactory in ten cases. Of the remaining two one had full control whilst in hospital, but following returning home to rather unsatisfactory parental control periods of incontinence have occurred. The remaining child suffered from a slight deformity of the rectum and has sufficient leakage to necessitate the wearing of a pad.

Acute or chronic pyelo-nephritis has not been troublesome. Intravenous pyelograms, however, show in some cases a moderate degree of renal pelvic and caliceal dilatation. This condition seems to stabilize itself and not to interfere with the enjoyment of life, but there is no doubt that the reserve of renal tissue must be diminished. It seems probable that renal dilatation following ureteric transplantation is largely due to compression of the ureter at the site of the anastomosis.