

South African Medical Journal Suid-Afrikaanse Tydskrif vir Geneeskunde

P.O. Box 643, Cape Town

Posbus 643, Kaapstad

Cape Town, 4 June 1955
Weekly 2s. 6d.

Vol. 29 No. 23

Kaapstad, 4 Junie 1955
Weekliks 2s. 6d.

SUBSTITUTE BLADDER

A REVIEW AND SHORT REPORT

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During recent years much discussion has arisen on the question of transplanting the ureters into the colon and the complications of this operation. In general, dissatisfaction is expressed and alternative methods, using a variety of techniques have been described. The Lancet¹ states 'there is clear need for further investigation, both clinical and experimental, of alternative procedures.' Pyrah² says, 'The operation of uretero-colic anastomosis is not a procedure like an appendicectomy for gangrenous appendicitis or cholecystectomy for gall-stones, which finally removes from the patient a diseased organ which may be threatening life; it is rather a procedure which, by producing a fundamental change in the excretory arrangements of the body, often confers great benefits on the patient, but also carries risks of renal infection and derangement of the blood electrolytes that are sometimes inimical to health and occasionally dangerous to life. It is reasonable, therefore, that... attempts should be made to relieve the pathological process for which it is performed by some alternative procedure.'

Many years ago Coffey³ and Stiles⁴ described their methods of transplanting the ureters into the bowel. In both methods the free end of the ureter was drawn into the bowel and held by a suture; but whereas Coffey buried the ureter in a tunnel formed by bowel wall, Stiles buried the ureter in the manner of a Witzel gastrostomy. The usual late complication of these methods was a hydronephrosis due to stenosis at the anastomotic site. At post mortem, 25.8% of indirect implants showed narrowing or occlusion against 17.6% of direct cases (Jacobs).⁵ Smith⁶ was the first surgeon to report a direct mucosa-to-mucosa anastomosis; his case developed a faecal and urinary fistula which persisted for 14 months. Following the transplantation of the second ureter, the patient died. Necropsy revealed destruction of the first kidney due to infection. Nesbit⁷ and Cordonnier⁸ revived the direct anastomosis, using slightly different techniques. The incidence of stenosis fell but

ascending infection continued. It would appear that its incidence may even have increased. Using the pneumopyelogram as a test Jacobs⁵ demonstrated reflux in 20 out of 43 direct implants against 4 out of 45 indirect implants. The true figure is probably much higher if the excessive build-up of pressure in the colon during defaecation is borne in mind. Leadbetter,⁹ in an effort to overcome reflux in the direct technique, buried the lower ureter in a tunnel formed by bowel wall. Pyrah² reports that with this operation his early results have been satisfactory. The immediate post-operative mortality rate for the different methods according to Jacobs⁵ averages about 18-20%. This includes all causes; if cancer is excluded, the rate drops to 10%. The immediate morbidity rate is 40%.

It is well known that patients suffering from a variety of renal conditions, e.g. congenital hydronephrosis, congenital cystic kidney, chronic pyelonephritis and chronic nephritis, may continue in good general health for many years. They finally come under the care of the clinician and require hospital admission for severe exacerbations of infection or renal failure. In cases of transplant another factor, which is not clearly understood, comes into the picture. This condition is hyperchloraemic acidosis. It is generally agreed that selective absorption of chlorides occurs from the urine in the bowel. This hyperchloraemia is associated with a lowered alkali reserve and usually with a raised blood urea, and these changes appear to be progressive. The levels of sodium and potassium in the blood, although showing early changes, tend to approach normal after 6 months. Sodium shows a slightly raised level in 9.4% of cases whereas potassium is slightly depleted in 31%. The incidence of acidosis at 6 months is 81.7% as shown by a lowered alkali reserve; whereas 48.6% of cases suffer from a hyperchloraemia. Of these 71.6% have raised non-protein nitrogen. The reader is referred to Jacobs and Stirling's paper⁵ in the B.A.U.S. series for further

particulars. These figures in general agree with other writers.

The majority of authorities agree that the healthy kidney can deal with the absorption of chlorides from the bowel and keep the acid-alkali imbalance under control. However, in the presence of hydronephrosis or pyelonephritis the mechanism breaks down and demonstrable and clinical acidosis appears. Kekwick *et al.*,¹⁰ Lapidès¹¹ and Creevy,¹² as well as many speakers discussing the B.A.U.S. series, all consider renal damage as essential to the development of the condition. It would therefore appear that hyperchloraemic acidosis is not a separate disease but a manifestation of renal damage. This damage would appear to be in the distal tubules since evidence is available that in disease of these tubules imbalance can occur even when the ureters have not been transplanted. Its clinical incidence may be used as evidence of renal dysfunction, which may not be demonstrable by means at our disposal for investigation of the living subject.

In the B.A.U.S. series the highest cause of death following sigmoid implantation was renal. This amounted to 301 out of a total of 1,029 deaths, or 18% of all cases operated upon. Cancer was the second highest, amounting to 298 or 17.8% of all cases. Thereafter the figure drops to 5.6% for pulmonary and 5.4% for 'other' causes. In the great majority the cause of the renal damage must be attributed to the operation. Jewitt¹³ in a smaller series has a similar mortality of 18% due to renal causes.

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From these few figures one must agree that it is desirable to find an alternative procedure. With the introduction of more radical pelvic surgery, the need for some other means of draining away urine in place of sigmoid implants becomes imperative. Few patients will tolerate a wet colostomy. Cutaneous ureterostomy would need (in addition to the colostomy) two other skin stomata which require continuous drainage into collecting bags and, even with the recent attempts to form 'spouts', are seldom if ever dry on the surface.

The concept of using an isolated segment of bowel as a bladder has gained recognition and various methods have been tried with a measure of success. In 1908 Veerhogen¹⁴ described a substitute bladder made from ileum, but the patient died shortly afterwards. Previous experimental work had been carried out by Tizzoni and Foggi¹⁵ in 1888. Higgins¹⁶ experimented with the lower rectosigmoid in dogs but found that after 2 years it contracted down to such an extent that its capacity was virtually *nil*. Other animal experiments are described where an isolated loop of bowel is anastomosed to the urethra (Thompson,¹⁷ Rubin¹⁸), but the practical application of this operation to man is doubtful. Two main approaches have been used in man. In the first a loop of ileum, into which the ureters are transplanted, is isolated. One end is closed and the other brought to the surface as an ileostomy. Here the ileum acts merely as a conduit and the wearing of a Rutzen or similar bag is essential. This method is reported by several surgeons,¹⁹⁻²² making a total of 113 cases.

In the second method an effort is made to construct a container within the abdomen which can be emptied intermittently by catheter. Gilchrist *et al.*²³ reported initially on this operation. The caecum and part of the ascending colon is mobilized and used as a bladder substitute. A short length of ileum is left attached and its cut end is brought out to the skin to act as a urethra. I have traced 52 such cases.²⁴⁻³²

In Bricker's series¹⁹ of 106 cases of ileal conduits, 5 operative deaths are attributed to the ureteric part of the operation although all these cases were associated with pelvic exenteration. In 25 cases where no other procedure was performed, there were no deaths. Two deaths are reported after re-operation for unsatisfactory urinary drainage. Nine cases are classified as having grade-II or worse hydronephrosis. These are all symptomless and infection is absent. Three show progression in the size of the lesion and the remaining 6, diminution. Thirteen had evidence of pyelonephritis, but in those still living the attacks are mild and controlled by antibiotics. Two cases of hyperchloraemia acidosis are mentioned, but these 2 patients had previously been given a sigmoid transplant and developed severe acidosis. An ileum conduit was constructed to relieve this complication. Both cases are now symptomless. There have been no late deaths from renal causes. All these patients wear a Rutzen bag or similar type of stick-on ileostomy container. Wilson²² reports a case of temporary acidosis occurring during the 2nd and 4th post-operative weeks. This patient's pre-operative urogram showed delayed excretion at 10 and 20 minutes. A later urogram was normal. Annis²⁰ reports 4 cases without complications and Bill *et al.*,²¹ 2 cases.

In the caecal group, Merricks²⁶ reports the largest series, with 18 cases, and Harper²⁷ reports 7. One death due to renal causes is reported. Here transplantation was performed on the ureter of a sole remaining kidney. The patient developed anuria, but at post mortem this was shown to be due to obstruction and kinking of the ureter at the anastomotic site. The kidney was healthy. If a nephrostomy had been performed or the operation site inspected, Merricks feels the patient would have been saved. There were 2 cases of acidosis. In the first, the condition was controlled with sodium bicarbonate (but, in an addendum, it is stated the condition was no longer present). In the second case, it would appear that the electrolytic upset was due to a jejuno-colic anastomosis performed for acute obstruction. The kidneys and ureter were reported to be normal at necropsy. No cases developed pyelonephritis or hydronephrosis.

Bricker raises two objections to the caecal substitute. He feels the risk of acidosis is very much reduced if the urine is brought to the surface immediately. This supposition is shown to be incorrect in the above-mentioned cases and, as shown earlier, the reduction depends on the absence of renal damage. His second objection is that it is impossible to get the caecal bladder continent. Merricks reports that all his patients were continent. Peck,²⁸ Santander,²⁹ Schmitz³⁰ and Wenger³¹ report 7 out of 7 cases continent. Harper's patients were all continent. Lapidès³² (4 cases) and Bricker²⁴ (6 cases) have the only patients reported incontinent.

A summary of these results is seen in Table I for comparison with the B.A.U.S. figures. In the latter series, the figures for complications do not apply to the whole series but only to the period since the recognition

cannot be considered an added disability. On the other hand, it is an operative procedure which carries greater risks for the patient. It is more time-consuming and requires a bigger exposure, a greater mobilization of

TABLE I

Operation	No. of Cases	Post-operative Deaths				Acidosis %	Late Deaths	
		Renal %	Others %	Hydro-nephrosis %	Pyelo-nephritis %		Renal %	Others %
Sigmoid Implant	1,673	5.7	15.3	55	52	81.7	12.1	28.2
Ileal Conduit	113	6.1	8.8	7.9	11.5	0.8	0	27.4
Caecal Bladder	25	4	20	4	0	temporary 4	0	28

of acidosis and incidentally since the extensive use of antibiotics. The amazing drop in the incidence of late renal complications and deaths should be noted. 'Other' deaths in the table include death from recurrent carcinoma, pulmonary and cardiovascular complications and various abdominal complications such as peritonitis, ileus, burst abdomen, etc.

The indications for a substitute operation are as yet not clear cut. The follow-up period of the published work is too short for it to be said that a new operation, free of complications, has firmly established itself. Stones have been reported in the caecal bladder. The possibility of carcinoma developing as a result of long-continued irritation must be considered. The possible development of pyelonephritis and acidosis cannot be denied, although it seems unlikely that contracture of the substitute bladder, as reported by Jewitt¹² in the recto-sigmoid in dogs, will occur. Certain conditions admit of no practical alternative to this new procedure. In any operation requiring pelvic clearance, either a caecal bladder or an ileal conduit is essential. There are few conditions for which sigmoid transplantation has been advised, where today a substitute bladder would not be more acceptable from the point of view of post-operative longevity. In cases where the surgery is purely palliative, as in inoperable carcinoma of the bladder, and where only a short-term survival is expected, then sigmoid transplantation may still be the operation of choice, but only if carefully performed by the newer techniques.

EXPERIENCE OF THE AUTHOR

In selecting an alternative operation to sigmoid transplantation, I was largely influenced by the high percentage of continency in caecal bladders. The continuous wearing of a Rutzen bag, with the care involved, is not a practical proposition with the rural or tribal Bantu. (If the patient is not continent, nothing is lost and a Rutzen bag may be worn.) Furthermore, caecal bladders have a capacity of between 350 and 550 c.c., so that catheterization is only necessary 3—4 times a day and, if fluids are withheld for 3 hours before sleep, the greater number will remain dry during the night. It is to be remembered that the majority of cases on whom this operation is performed suffer from a nocturia due to their original complaint, and to have that nocturia reduced to once nightly, if necessary using an alarm clock,

bowel is necessary, and the anastomosis is more difficult. For these reasons, its adoption as a routine in all patients is not advised. In poor-risk patients, or where other long procedures are performed at the same time, an ileal conduit may be the method of choice.

The choice therefore between an ileal conduit and a caecal bladder, in my view, is dependent on two factors. The immediate consideration is the ability of the patient to withstand a greater operative procedure with the possibility of more numerous and more severe complications. The other factor to consider is ability of the patient to deal with a post-operative disability. The rural and tribal Bantu can easily deal with a continent caecal bladder which he has to catheterize 3—4 times a day. His ability to deal with a Rutzen bag under primitive conditions is doubtful. The patient rapidly learns how to catheterize himself and is given an 18 French catheter on leaving the hospital. Continence may not be complete for 2—3 months, but most patients appear to be dry during the day after the first fortnight.

CASE REPORTS

Two cases are reported where the follow-up has been sufficiently long to demonstrate results and to show that the Bantu can satisfactorily deal with the residual debility. It is hoped to publish a follow-up on a larger series at a later date.

Case 1. A Bantu female aged 20, suffering from intractable vesico-urethro-vagino-rectal fistula. There was gross scarring and fixation of tissue. The anal sphincter was completely destroyed and the rectum split high up into the posterior fornix. A preliminary colostomy was performed and several attempts made to close the bladder fistula without success. No effort was made to repair the rectum on these occasions, so as to avoid any tension on the anterior sutures. Finally I repaired the rectum and reconstituted the anal sphincter. The colostomy was closed two weeks later and the patient has full faecal continence with voluntary control of the sphincter.

A substitute caecal bladder was made on 28 June 1954; the left ureter implanted by the method of Stiles and the right by the double-flap method. The post-operative course was smooth, but mucus production was excessive and the catheter required continuous changing. Since operation there have been no biochemical changes and an intravenous pyelogram at 2 months showed very mild dilation of the left kidney. The patient is fully continent day and night. A pyelogram done 6 months after operation demonstrates normal renal outlines. The girl is earning her living doing house-work.

Case 2. A Coloured male aged 55, suffering from a massive infiltrating carcinoma involving the whole of the left side of the

bladder but clinically not penetrating the wall. He was suffering from gross haematuria and his bladder was heavily infected. An intravenous pyelogram showed a left grade-III hydronephrosis and hydro-ureter. Blood and protein deficiencies were corrected before operation. A routine one-stage procedure including a total cysto-prostatectomy was carried out. The right ureter was implanted by Stiles's method, the left by the double-flap method. Post-operative convalescence was very slow but uneventful and at no time gave rise to concern. A post-operative intravenous pyelogram demonstrates normal kidneys and ureters on both sides. Blood chemistry is normal. I repaired a ventral hernia on this patient 6 months later. The opportunity was taken to inspect his peritoneal cavity. There were no enlarged glands and no evidence of recurrence. One small adhesion was present between a loop of ileum and the bottom of the pelvis. When last seen, he requested permission to return to farm work.

SUMMARY

A comparison is made between the well-established operation of sigmoid transplantation of the ureters and the newer operations.

The author's reasons for adopting the Gilchrist procedure are given.

The first 2 cases on whom this operation was performed are briefly described.

It is hoped to publish a larger series, with adequate follow-up, in the near future.

I wish to thank Dr. J. McLean, Medical Superintendent, Provincial Hospital, Port Elizabeth, for permission to report these cases.

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