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Experimental Data on the Application of a Stoma Prothesis in Cutaneous Ureterostomy

R. Harzmann[1], L. I. Kobashi[2], D. A. Raible[3], K.-H. Bichler[1] and St.-H. Flüchter[1]

[1]Department of Urology, University of Tübingen, Tübingen, Federal Republic of Germany

[2]Tustin Medical Center, Santa Ana, California, USA

[3]Bentley Incorporation, Irvine, California, USA

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Summary. The main problem with urinary diversion via cutaneous ureterostomy is stomal stenosis. Results with experimental and clinical implants of carbon polymer stoma prostheses (max. clinical observation period: 31 months) for vesicostomies have encouraged us to find out whether implants of this material would be suitable for cutaneous ureterostomies as well. The first step was dilatation of the ureters in 16 mongrel dogs, 4 mini pigs and 4 sheep. This was done by knotting a thread over a splint which had been introduced into the ureter. After 7 days the ureter was ligated prevesically and a carbon polymer stoma was implanted into the ureter.

37 of the 48 stoma implants were well tolerated and provided water tight urinary drainage; slight encrustation occurred but, radiologically, a smooth flow of contrast medium was seen. Ten of these 37 cases had transient urinary leakage. Eleven of the 48 stoma implants were unsuccessful because of insufficient healing, urinary extravasation, parastomal inflammation or severe encrustations.

The results of these experiments on animals would seem to justify initial clinical use. It is conceiveable that in this way stomal stenosis of the cutaneous ureterostomy can be avoided.

Key words: Cutaneous ureterostomy, Stomal stenosis, Carbon polymer implant, Urinary diversion.

INTRODUCTION

Skin problems with urological stomata often arise because the skin around the stoma is continuously in contact with urine. This leads to difficulties in handling adhesive systems needed for urinary diversion. For this reason various experimental and surgical concepts have been developed to connect the diversionary system over a stoma prosthesis directly to the stoma without any dermal contact (1, 2, 4). Another way, though not indicated in cutaneous ureterostomy, is the transformation of the incontinent stoma into a continent one (3, 5, 8).

The stoma of a cutaneous ureterostomy is also prone to stenosis, particularly in patients who have had previous irradiation and a lifelong ureteric catheter becomes necessary. Some improvements are being studied, notably with a surgical technique published by Rodeck (7), which, with the help of a tapering dermal flap, creates a wide stoma.

Our investigations with stoma protheses led to the establishment of a carbon polymer implant which has been tested for 4 years in urinary diversion procedures (1, 2). The knowledge obtained thereby resulted in the clinical application in 14 vesicostomies. The observation period is at present 33 months. The satisfactory results encouraged us to perform further experimental studies on cutaneous ureterostomies. This was done with the intention of:

1. developing a technique which prevents stoma stenosis,
2. avoiding contact between skin and urine collecting devices and
3. providing a technically simple alternative to permanent nephrostomies, which now as before are unsatisfactory.

The findings of a study of an experimental cutaneous ureterostomy with a stoma prosthesis are reported here.

MATERIALS AND METHODS

A new carbon polymer material developed in 1963 was used. The qualities of this material have

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been studied since 1971 with various clinical problems (1, 2, 6). Among the physical properties of the material to be emphasized are the high degree of purity (99,9% pure carbon), hardness (7-8 on Moh's scala), light weight (specific gravity 1,5) and good electrical and thermal conductivity (comparable to series 300 steel). The tensile strength is nearly 1,406 kg/sq. cm, the compression strength is 7.030 kg/sq. cm and Young's module is 3-4 Mill. x 10^6. Of special significance for urological problems are the chemical and galvanic inactivity as well as the surface smoothness and tissue-toleration even over long periods. When various difficulties in production had been mastered (e.g. thermal degradation), implants 2 and 4 cm in length with an interior diameter of 3 and 6 Charr. (on the anastomosis side) were developed. A transverse plate with wide perforations was designed for fixation of the implant into the fascia and a Dacron velour sleeve guaranteed firm implantation into the connective tissue. Details of the stoma can be seen in Fig. 1.

The test animals were 16 mongrel dogs, 4 mini pigs and 4 sheep. Since these species of animal all have narrow ureteric lumina, a clearly defined, incomplete ureteric stenosis was made 7 days before the cutaneous ureterostomy by knotting a thread of cat-gut over an intraureteric splint (9) (Fig. 2). This procedure led to a rapid dilation of the ureter in all cases, which made the stoma implantation possible. Each of the animals was prepared in this way for the implantation at intervals of 2 to 3 months, first on the left, then on the right.

Implantation was done through a pararectal, extraperitoneal approach. Because of the formation of plications in the ureter itself at the level of the anastomosis in 5 cases, further ureteric anastomoses with the implant were secured with a Dacron velour shell which was laid over the anastomosis. The connection between the ureter and the stoma prosthesis (Fig. 3) was established by means of 4-0 Prolene interrupted sutures between the ureteric musculature and the Dacron mantle. Details of the operative procedure are

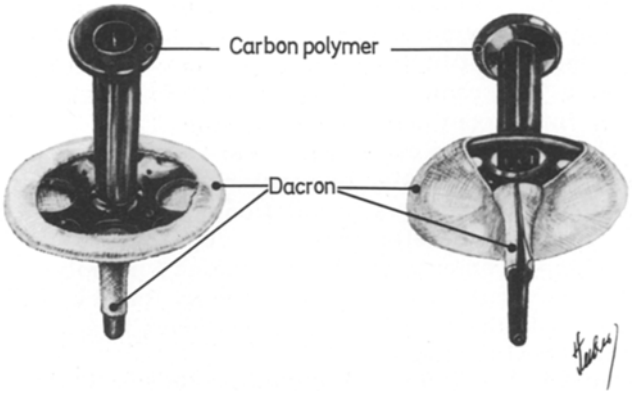

Fig. 1. Schematic representation of the carbon polymer stoma for cutaneous ureterostomy

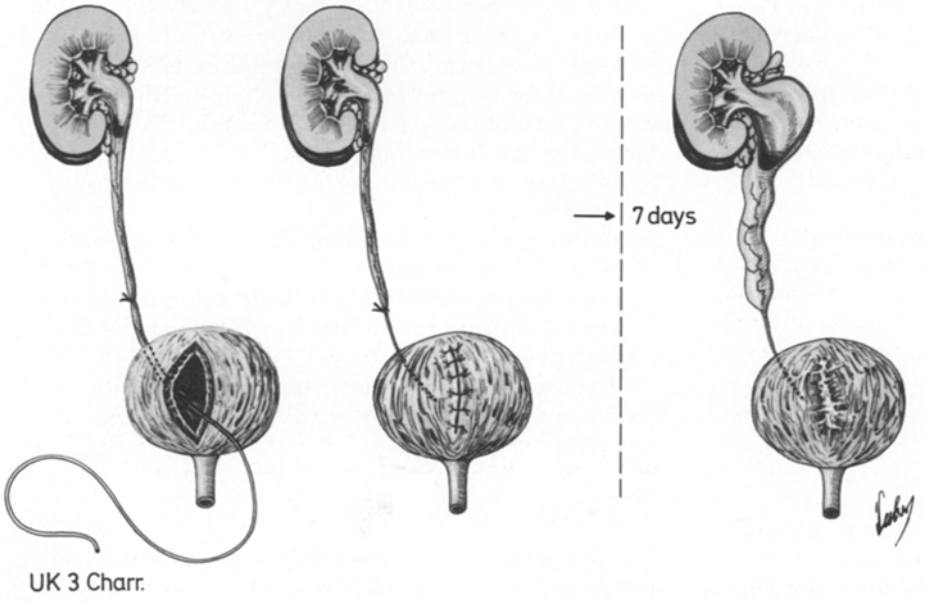

Fig. 2. Technique for the defined, experimental dilatation of the ureter (9). Ureteric ectasia, which occurs within 7 days, makes implantation of the stoma prosthesis possible

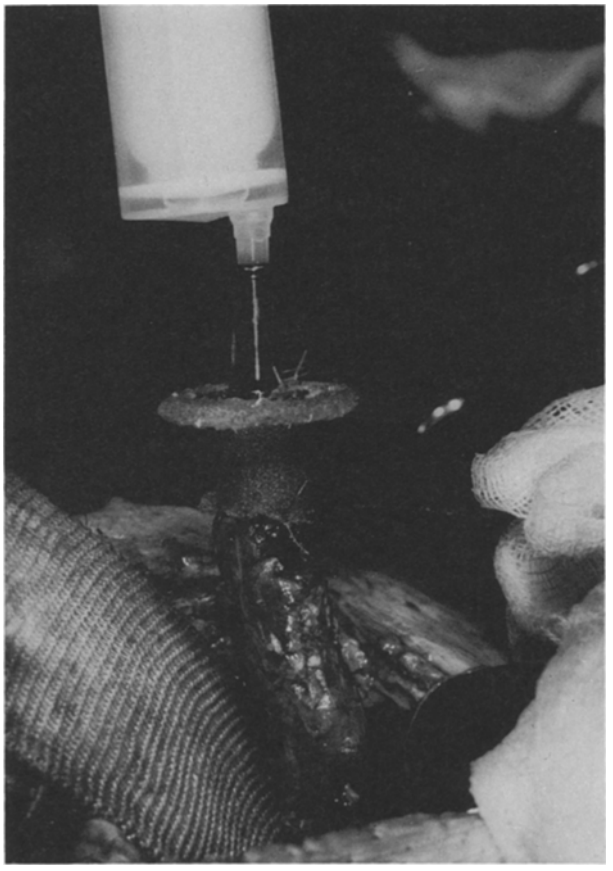

Fig. 3. Intraoperative view of an experimental cutaneous ureterostomy using a stoma prosthesis: anastomosis between the Dacron and the ureter

shown in Fig. 4. It proved essential to lead the stoma out through a separate incision in the skin. To avoid retraction of the stoma, the transverse plate and the surrounding skin were tied together with sutures. In order to secure the anastomosis, the ureter was intubated for 7 days with a splint.

7, 14, 21 days and 3 months following surgery tests were undertaken to check the continence of the stoma by retrograde pyelography or excretory urography. Beyond this, checks of the urine status and the creatinine were done. In the 5th, 7th and 12th postoperative months the implants with the distal ureter were removed on one side from each of 3 animals and the area of the anastomosis studied histologically. Finally, after 14 months the animals were sacrificed. Histological studies were again performed after the patency of the ureter had been checked and an analysis of any salt deposits was done by means of polarisation microscopy and chemical determination.

RESULTS

Defined dilatation of the ureter proved to be an efficient technique and led to no complications which might have interfered with the implant. Even the implantation of the ureteric stoma caused no difficulties. It led in 27 of the 48 ureters to a primarily water tight urinary diversion. Two animals died of uremia or sepsis as a result of unnoticed plication formation in the area of the anastomosis. Ten ureters showed transient leakage up to the second postoperative month. Four ureters healed incompletely which caused permanent urinary extravasation. Six stomas broke off outside the dermal level as a result of being bitten by the animal without this having any influence on the leakage rate.

Eight of the finally water tight 37 ureterostomies showed moderate to marked dilatation of the prestomal ureteric section. The cause was stomal encrustations which varied in intensity in each case. Analysis showed the typical constellation of stone caused by infection. Ten of the 37 continent stomas had significant urinary tract infections (Coli, Proteus vulgaris). Table 1 shows all results of the stoma surgery.

37 of the 38 stoma implants healed well with little or no reaction (Fig. 5a). Peristomal inflammation was observed in nine cases and abscess formation in two (Fig. 5b). The results were nearly identical in dog, pig and sheep. Histologically a narrow binding of the connective tissue from the ureter with the Dacron velour was found (Fig. 6b).

DISCUSSION

Our experience with the ureterostomy device confirms the satisfactory data on experimental and clinical use of a vesicostomy stoma prosthesis of the same material (1, 2). While the tissue-compatibility of the implant was certainly good, in 14 cases the anastomosis leaked either transiently or permanently. The danger of a stoma break (n = 6) should be pointed out. This made care and observation of the animals correspondingly painstaking. It could be shown that ureteric plication could be avoided by means of a suitable surgical technique. Obviously, the area of the stoma prosthesis itself is not a essential factor in the origination of a functional stenosis because of its short length. The majority of the animals with implants showed only moderate dilatation of the ureters and renal pelvis, demonstrated on retrograde pyelography and excretory urography. Marked ureteric ectasia was observed only in those cases where serious encrustations occurred (n = 8). This situation required repeated mechanical cleaning of the stoma lumen. Preventive measures such as changing the urine pH were not undertaken at this time.

The experimental results from cutaneous ureterostomies with an implant justify the use of correspondingly adapted implants in clinical practice

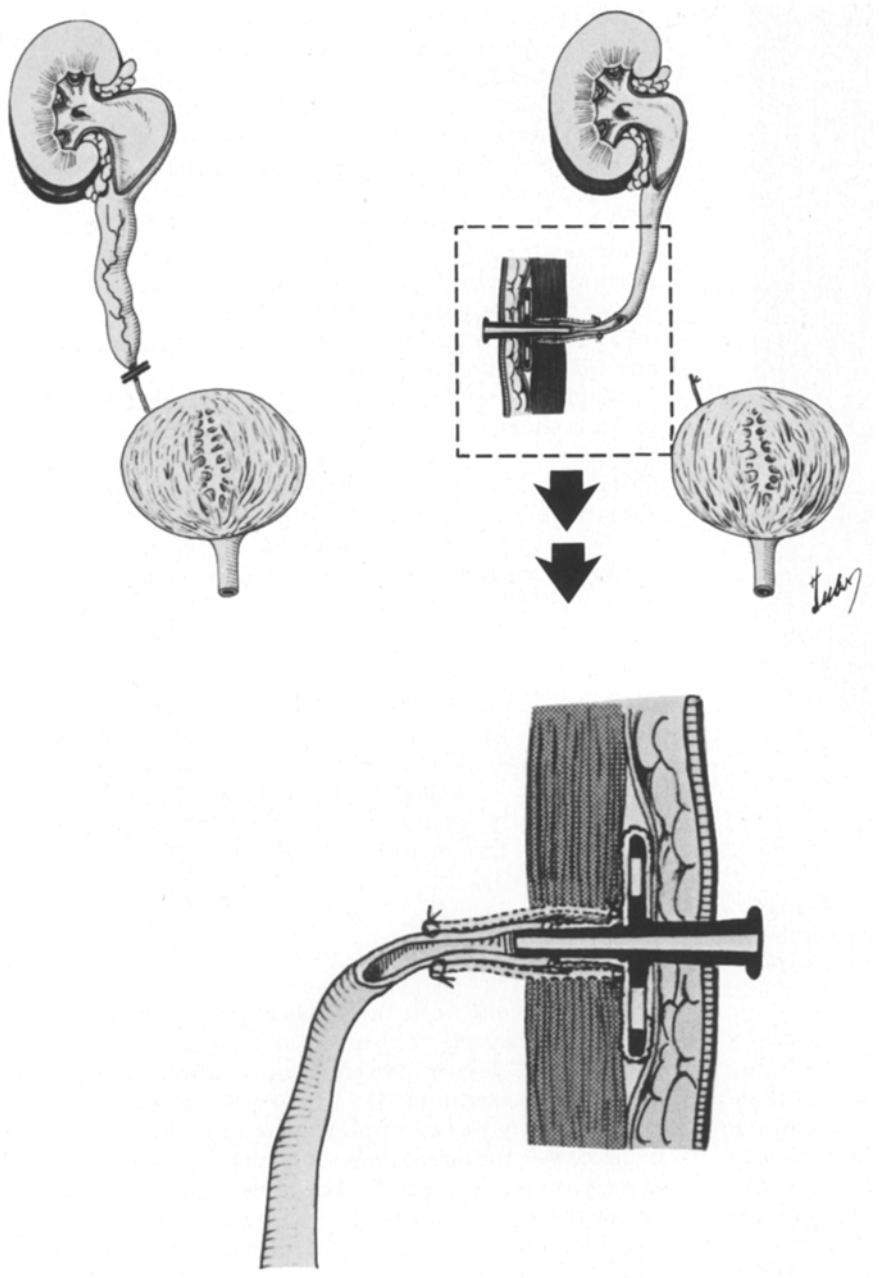

Fig. 4. Schematic representation of an experimental cutaneous ureterostomy using a stoma prosthesis

especially since stomal stenosis - the most important complication of the traditional cutaneous ureterostomy - was not observed. Should clinical application confirm the present experimental findings, the outlook for patients with a cutaneous ureterostomy would be much improved. It is conceivable that on this basis the indications for a nephrostomy, - an altogether unsatisfactory method of supravesical urinary diversion - , could be reduced in favour of the cutaneous ureterostomy, which has been relatively neglected up until now. With this in mind, we now have started clinical application of Carbon polymer implants for cutaneous ureterostomy.

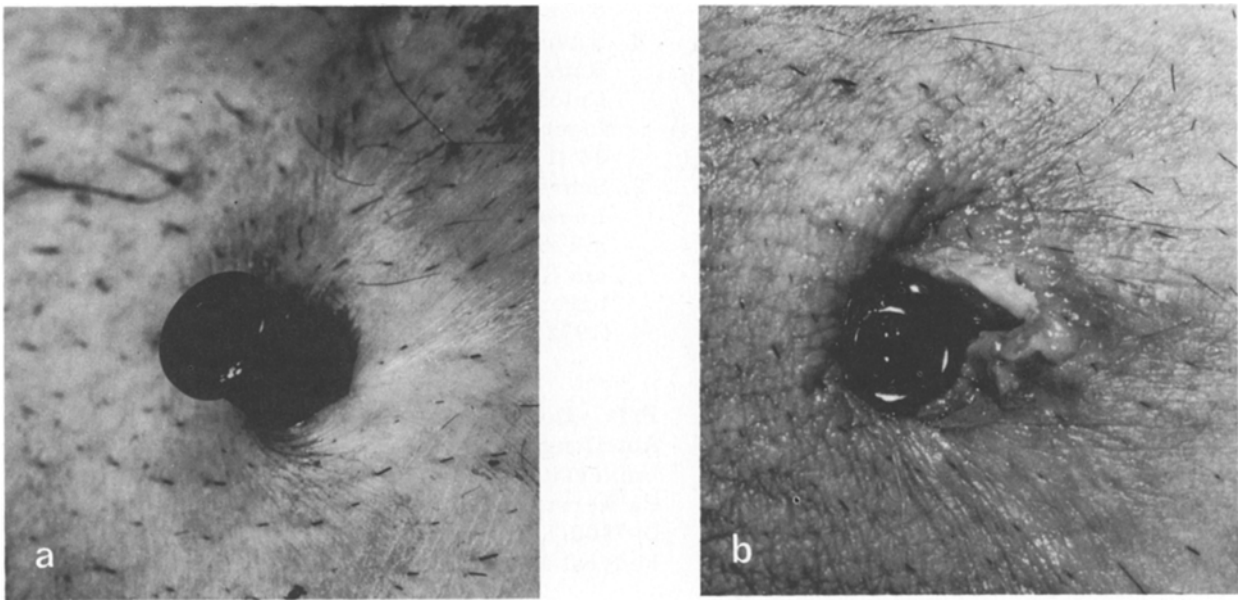

Fig. 5. Condition 3 months after experimental alloplastic cutaneous ureterostomy: a) little reaction, good healing, b) peristomal inflammation

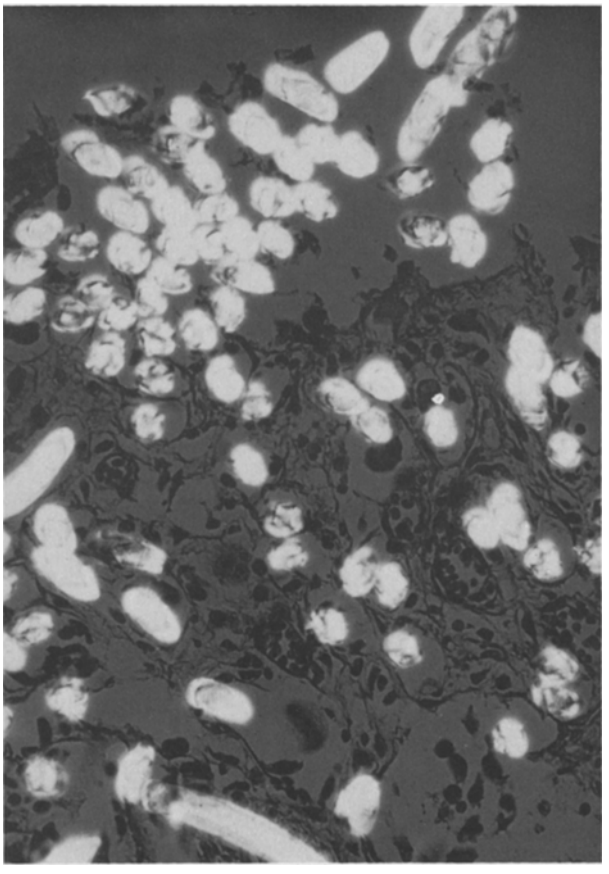

Fig. 6. Histological findings 7 months after cutaneous ureterostomy using prosthesis: narrow binding between connective tissue from the ureter with the Dacron fibers. The Dacron fibres can be recognized as transverse sections or the brightly shining structures

Table 1. Results of stomal prosthesis implantation in experimental cutaneous ureterostomies (n = 48)

Findings	n
Bend of the ureter in the area of anastomosis	5
Transient leakage	10
Permanent leakage	4
Stoma break (from bite)	6
Stomal encrustations	8
Ureteric dilatation	8
Urinary tract infection	10
Peristomal inflammation	9
Peristomal abscess	2
Good healing	37
Primary water tight urinary diversion	27

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Priv.-Doz. Dr. R. Harzmann
Abteilung für Urologie
Universität Tübingen
Calwerstrasse 7
D-7400 Tübingen
Federal Republic of Germany