Urol Res (1982) 10:277–283

Urological Research

The Upper Urinary Tract Following a Ureteroneocystostomy (UNC) in an Animal Experiment: II. Morphological Findings

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Accepted: June 4, 1982

Summary. This report deals with the macroscopic and microscopic histopathological findings of the upper urinary tract following a unilateral ureteroneocystostomy (UNC) in dogs. Both sides, operated and unoperated, were examined. The area of antireflux surgery was of particular significance. The decrease of flow which was always present on the operated side was caused by submucosal oedema of the bladder and not by the fatty tissue deposited intramurally or by the bladder muscle itself. The morphological findings were less pronounced than was to be expected following the significant obstruction on the operated side caused by anti-reflux surgery (ARS) and shown by the flow measurement and the sequential findings on scintigraphy.

Key words: Anti-reflux surgery, Ureteroneocystostomy, Histology of urine retention, Histology of the vesicoureteral operation area.

Introduction

Postoperative, temporary urinary obstruction following antireflux surgery (ARS) is well known to urologists. The aim of this study and of the previous one [4] was to undertake a systematic examination of the functional morphological changes following ARS of the UNC type.

A study of this type has not been available up to now. Because the same dogs were used to gather the various functional findings and the morphological findings represented in this study, it is possible to draw conclusions between the degree of urinary hold-up and the extent of the histopathological changes.

Material and Methods

In an initial study eight female German shepherd dogs (mean body weight 26 ± 4.9 kg body weight) evidenced, by means of a standardised flow measurement, a significant decrease of flow postoperatively as well as on the 1–5th day after the operation [4, A Series]. Unilateral, right sided anti-reflux operations (ARS) according to the Politano and Leadbetter method [6] were performed on a further 24 female German shepherd dogs of mean body weight 27,5 kg (20–35 kg) and mean body length of 112 cm (100–120 cm).

Anaesthesia was induced with pentobarbital-sodium intravenously and after intubation, artificial respiration was maintained using a N_2O gas–oxygen mixture in the ratio 1 : 3 with a respiratory volume of 6 l/min[1,2]. Continuous monitoring of blood pressure and pulse by a pressure transmitter was performed during the operation[3,4] via the brachialis artery. Continuous analysis of the end expiratory CO_2-concentration[5] was also monitored.

Operation

The ARS was performed on all 24 dogs according to Politano and Leadbetter [6], but in contrast to the method applied in humans, however, with a transperitoneal approach.

Specimens and Histopathology

Following completion of the appropriate clearance studies rapid intravenous injections of potassium chloride were given on the postoperative day 1 (series B), day 7 (series C) or day 28 (series D) until the circulation was arrested. Immediately afterwards bilateral nephroureterectomy and cystectomy were carried out – the right-sided nephroureterectomy and cystectomy were undertaken en bloc (Figs. 1–4). The specimens were conserved in 7% Formalin. Macroscopic assessments, microsections, hematoxylin-eosin-staining and assessments were performed by the pathologist without his having any knowledge of which specimens belonged to which test series.

1 Nembutal^R; manufactured by Deutsche Abbott, Ingelheim, FRG
2 Engström Respirator ER 321, system 300, manufactured by LKB medical AB Brømma, Sweden
3 Pressure recorder Statham P 23 Db; made by Statham, Hato Rey, Puerto Rico, USA
4 Meßbrücke Hellige MA 88K; manufactured by Hellige, Freiburg, FRG
5 CO_2-Spirometer URAS; manufactured by Hartmann & Braun, Frankfurt, FRG

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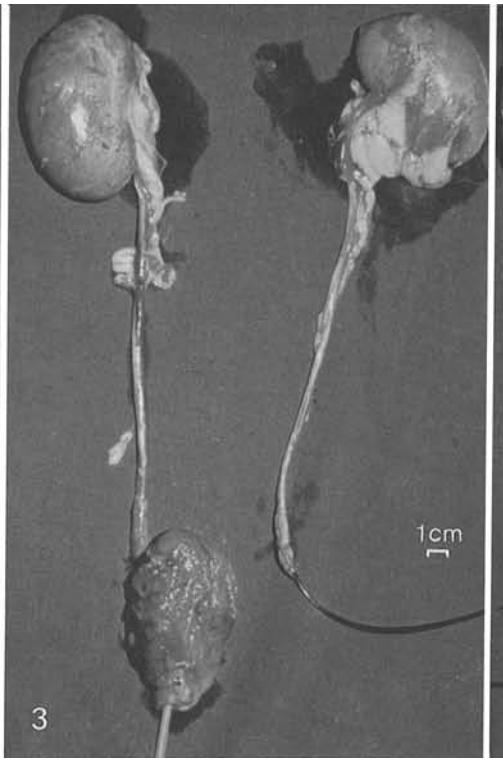
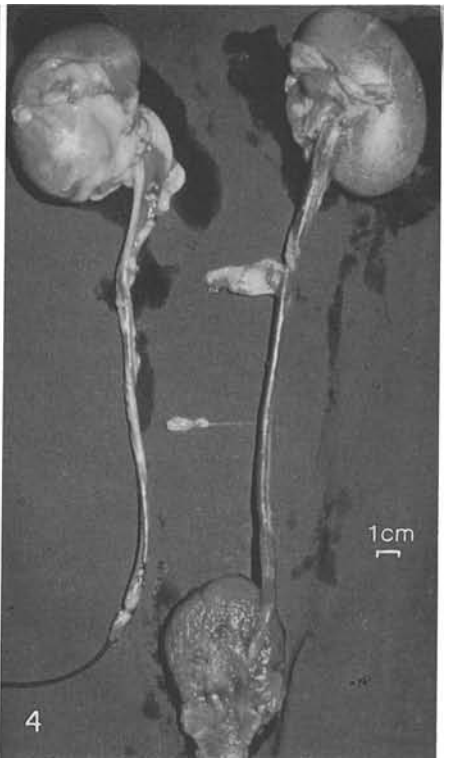
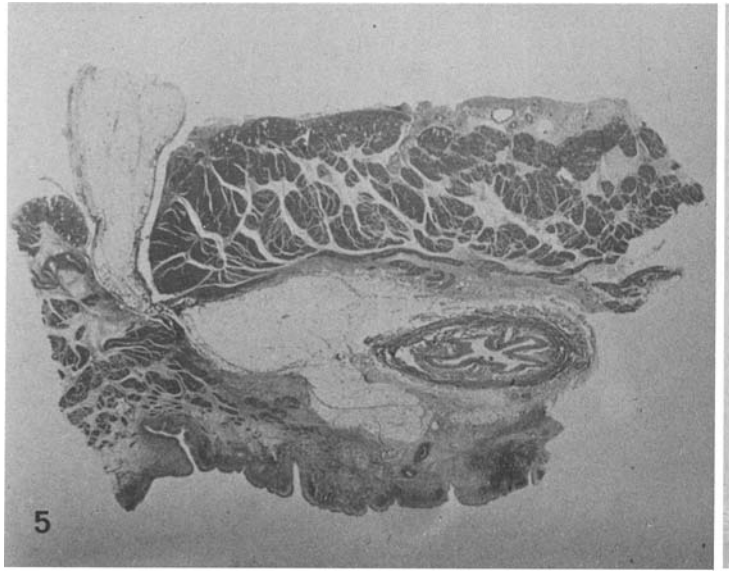
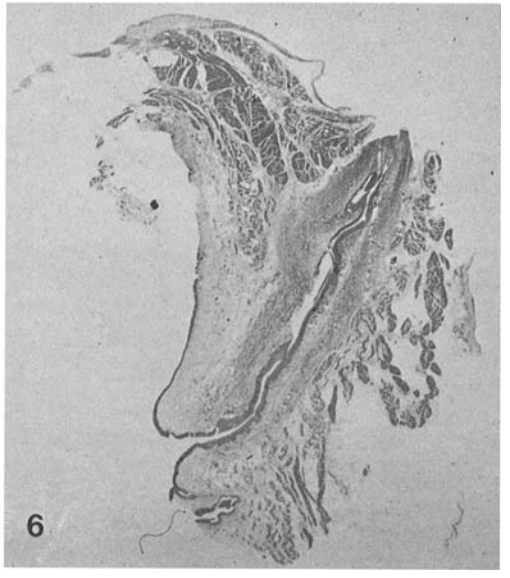








Figs. 1–6. Dog 46, day 7 postoperatively. Urogram 10 min (**Fig. 1**) and 30 min (**Fig. 2**) after the infusion of 100 ml Conray 60 (Manufacturer: Byk-Gulden, Konstanz). On the *right* still some slight dilation of the renal pelvis and the ureter compared to the *left*. The ectomy specimens from ventral (**Fig. 3**) and dorsal (**Fig. 4**) were taken directly after the urogram macroscopically, showing a slight degree of dilation of the right ureter in the entire extravesical area. Microscopically (**Figs. 5 and 6**) hematoxylin-eosin-stain, maginfication 37,5x. Longitudinal section in the *ARS area* containing a plentiful supply of fatty tissue encircling the ureter, somewhat above the ureteroresical anastomosis (**Fig. 5**), no pathological changes on the non-operated uretero-vesical junction on the *left side* (**Fig. 6**)

Table 1. Pathological-anatomical findings from day 1 postoperatively (B series). No specimens were taken from dog 47. Modified according to Heising (1980)

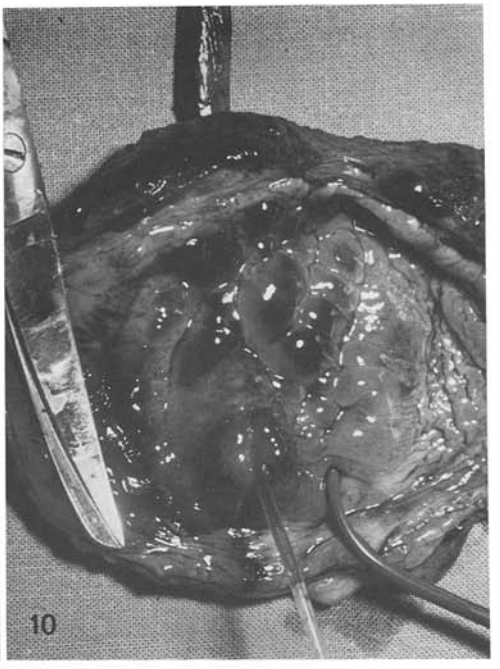
Dog	Operated side renal pelvis (macroscopic)	Bladder, area of implantation	Ureter intramural	Ureter extramural	Non-operated side	
					Ureter	Bladder, area of the ureter ostium
39	Slightly dilated	Submucosal oedema granulocytosis haemorrhage of the bladder and ureter mucosa	Slightly compressed	Slightly ectatic	NAD[a]	NAD
44	As 39	As 39	As 39	As 39	NAD	NAD
45	As 39	As 39, but slightly pronounced	As 39	As 39	NAD	NAD
49	Definite hydronephrosis	As 39	Compressed	Dilated	Slightly dilated, beginning of a granulomatous inflammation	Oedema of submucosa, beginning of granulomatous infiltration
50	Slightly dilated	As 39, however submucosal oedema more strongly pronounced	As 39	As 39	NAD	NAD
51	Normal	As 39, however submucosal oedema more strongly pronounced	Normal	NAD	NAD	Acute cystitis
52	NAD	As 39, but submucosal oedema more strongly pronounced	NAD	NAD	NAD	NAD

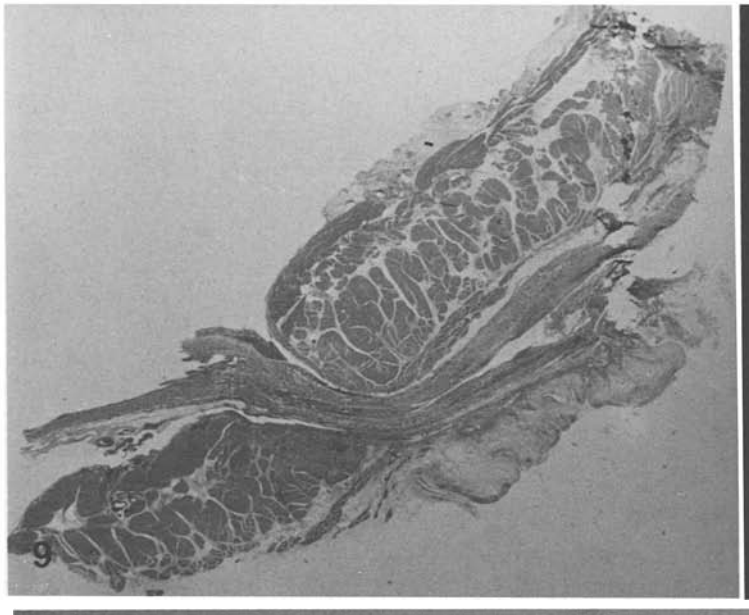
a NAD = no appreciable disease

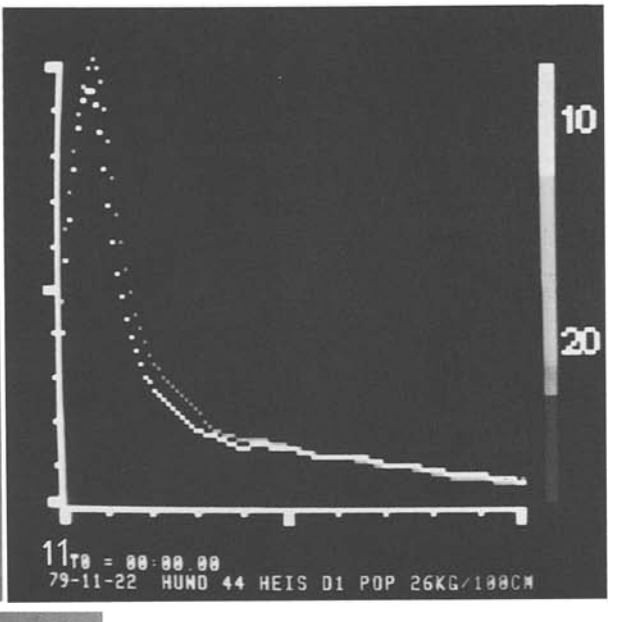
Table 2. Pathological-anatomical findings from day 7 postoperatively (C series). No specimens were taken from dog 28. Modified according to Heising (1980)

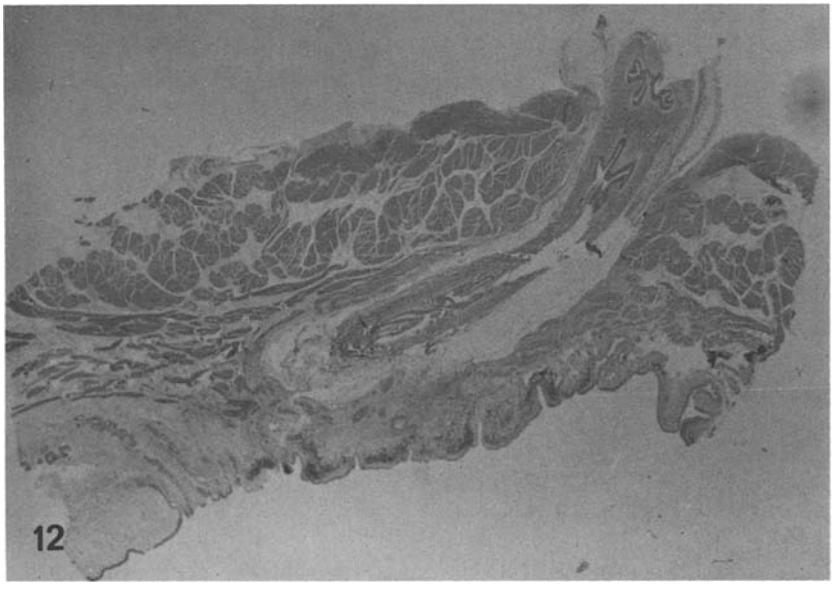
Dog	Operated side renal pelvis (macroscopic)	Bladder, area of implantation	Ureter intramural	Ureter extramural	Non-operated side	
					Ureter	Bladder, area of the ureter ostium
20	Slightly dilated	Slight submucosal oedema, granulation siderophages	Slightly compressed	NAD[a]	NAD	NAD
22	As 20	As 20	As 20	NAD	NAD	NAD
24	As 20	As 20	As 20	Slightly dilated	Slightly dilated, slight inflammation	Slight cystitis
36	Distinctly dilated	Pronounced oedema of submucosa, otherwise as 20	As 20	Slightly dilated	Slightly dilated slight inflammation	Slight cystitis
41	NAD	Partly ulcered moderate oedema definite granulation	NAD	NAD	NAD	NAD
43	Considerable hydronephrosis	Prounced oedema of submucosa, pronounced submucosal inflammation	Clearly compressed in the muscle area	Extremly dilated	NAD	NAD
46	NAD	As 20	NAD	NAD	NAD	NAD

a NAD = no appreciable disease









Figs. 10–12. Dog 44, day 1 postoperatively, macroscopically following vertically opening of the bladder (**Fig. 10**, natural size) implanted ostium marked by PVC splints. *Left* ostium marked by the curved catheter. Very pronounced oedema of the submucosa on the *right* side (Table 1), however without any significant decrease of the urine flow (**Figs. 11 and 12**). The time activity graph 26 min after infusion of the radioisotope (**Fig. 11**) shows almost the same outflow conditions of both kidneys. Microscopically (**Fig. 12**, hematoxylin-eosin-stain, magnification 37,5x) some periureteral fat, otherwise without path, findings

◀ Figs. 7–9. Dog 50, day 1, postoperatively. In the urogram 10 min (**Fig. 7**) and 30 min (**Fig. 8**) after infusion of 100 ml Conray 60 a distinct decrease of the urine flow on the *right*. Papillary affluence blockage. Medial displacement of the *left* ureter due to the experiment. The longitudinal section through the ARS (**Fig. 9**, hematoxy-lin-eosin-stain, magnification 37.5x) shows a discrete narrowing of the ureter lumen in the area of the bladder mucosa. Musculature without pathological findings. Secondary findings: microscopically pronounced bleeding in the mucosa of the bladder and ureter

Table 3. Pathological-anatomical findings from day 28 postoperatively (D series). No specimens were taken from dog 16. Modified according to Heising (1980)

Dog	Operated side renal pelvis (macroscopic)	Bladder, area of implantation	Ureter intramural	Ureter extramural	Non-operated side	
					Ureter	Bladder, area of the ureter ostium
11	NAD	Clear oedema of mucosa, periureteral fatty tissue	Surrounded by soft connective tissue, otherwise NAD	NAD[a]	NAD	Loose connective tissue in places
13	NAD	As 11	Chronic inflamation, oedema	Chronic inflammation, otherwise NAD	NAD	NAD
14	NAD	Slight inflammation, slight fibrosis	Slight inflammation slight fibrosis	Slight inflammation, slight fibrosis	NAD	NAD
15	NAD	As 11, additional localised inflammation	As 14	As 14	Slight inflammation and fibrosis	NAD
17	NAD	As 11	As 14	As 14	As 15	NAD
18	NAD	As 11	As 11	NAD	As 15	Loose connective tissue in places
30	Slightly dilated	Haemorrhagic cystitis, otherwise as 11	As 11	NAD	NAD	NAD

[a] NAD = no appreciable disease

The following were assessed individually: the renal pelvis on both sides only macroscopically, the bladder on the operated side, the area of implantation, the intramural and extramural ureters, macroscopically and microscopically; on the non-operated side the ureter and bladder in the area of the uretric ostium both macroscopically and microscopically.

Results

The results of the pathological and anatomical examinations are summarised in Tables 1–3 for the postoperative days 1, 7 and 28. From 1 dog of each group no specimens were taken.

Illustrations 1–4, 7, 8, 10, 13, 14 show typical macroscopic and radiological findings. Illustrations 9 and 12 show typical microscopic findings for day 1 postoperatively, for day 7 postoperatively the illustrations 5 and 6 and for day 28 the illustrations 15 and 16.

The appropriate descriptions of the findings are to be found in the legends.

The morphological findings can be summarised as follows:

1. The marked formation of oedema in the submucosa of the bladder in the implantation area was the cause for the pronounced postoperative prevention of flow [4].

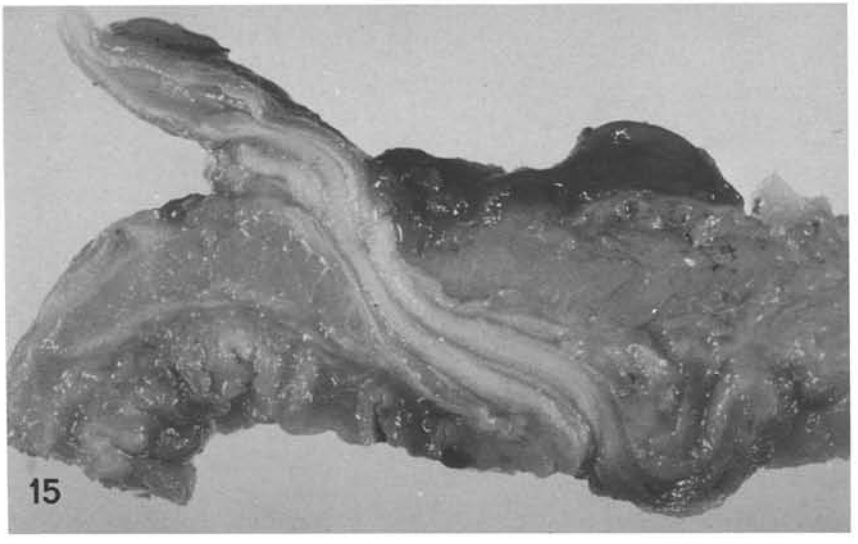
2. Although the formation of oedema in the submucosa of the bladder decreased from day 1 to day 28 after the surgical intervention, it was still in evidence in almost all of the animals at all three times.

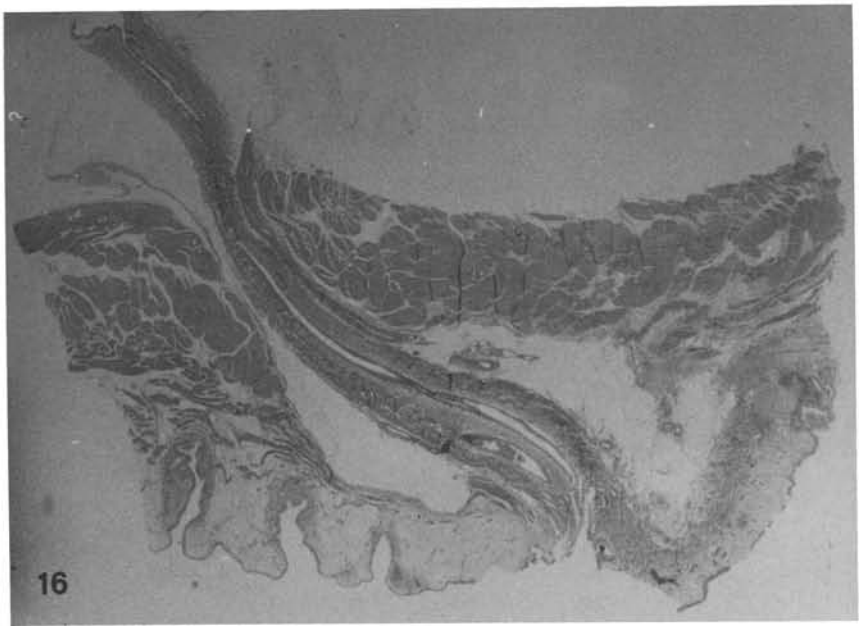
3. Periureteric fatty tissue, which was expressly not removed before the reimplantation, apparently does not restrict the lumen of the reimplanted ureter.

4. The haemorrhagic cystitis which is caused by the catheter can be ignored.

5. It was not possible to demonstrate haematoma formation in the submucosal tunnel [7] which might have been responsible for a luminal restriction.

6. The radiological findings (Figs. 1, 2, 7, 8, 13, 14) were not very impressive with respect to the obstruction. Because the urograms were taken immediately before the animal's death the slight obstruction to be observed in





Figs. 13–16. Dog 11, day 29 postoperatively. Urogram 10 min (**Fig. 13**) or 30 min (**Fig. 14**) after infusion of 100 ml Conray 60. Im comparison to day 1 and 7 postoperatively (**Figs. 1 and 2, 7 and 8**) only a slight dilation of the renal pelvis and the ureter on the *right* side. The right ureter no longer is filled over its total course (normal peristaltics?). The area of the anti-reflux operation shows a non-pathological ureter lumen, both, without staining (**Fig. 15**, magnification 37.5x) and after hematoxylin-eosin-staining (**Fig. 16**, enlargement 37.5x), however, bilateral periureteral fatty tissue and some bladder mucosa (from: Heising (1980)

the X-rays also corresponded to the appropriate morphological findings in the specimens.

Discussion

The morphological cause and extent of the postoperative decrease of the flow have already been described. Results of other authors on the same subject are not available. One particular piece of evidence concerning conditions after the extravesical ARS [7] is worth mentioning: following extravesical ARS a tunnel haematoma which was the cause of a restriction of the ureteric lumen was observable in all cases at various times after the operation. This was not the case after the UNC. This difference may have been due to the method used, since with the method used by Lich et al./Gregoir [1, 5] the continuity of the ureter was maintained. Bleeding in the area of the submucosal ureteric course, which, in the case of both methods was to be expected as a result of the preparation, can only flow out proximally in the case of an extravesical ARS. By contrast, in the case of UNC this bleeding in the area of the intramural course of the ureter can flow out distally, since the ureterovesical junction was only maintained by six stitches.

The results achieved in animal experiments do not necessarily permit conclusions to be drawn about these conditions in humans. However, the urinary tracts in dogs and man are very similar [2]. Thus, the following conclusion concerning conditions in humans seems permissable: the decrease of flow which occurs regularly on the correctly operated side is caused exclusively by the submucosal oedema of the bladder, and not by the periureteric fatty tissue attached intramurally or by the muscles of the bladder. Thus, a thorough removal of the periureteric fatty tissue of the distal ureter is not necessary making it possible to spare the arterial supply of the ureter to a large extent.

Acknowledgements. We are grateful to P. Esser, K. Uhlenbruck and D. Marosi for technical assistance and secretarial help.

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