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Lack of usefulness of ureteral reconstruction with free bladder mucosa flap in dogs confirmed by microangiography

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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Background: There is a paucity of data addressing the blood supply in the surgically reconstructed ureter, and complete lack of microangiographic studies of the reconstructed ureter with the use of a free bladder mucosa flap. The present study evaluated the blood supply in the reconstructed dog ureter after a 5-centimeter segment resection, supplemented by a tube constructed from a free bladder mucosa flap.

Material/Methods: Female mongrel dogs (n=29) were used in this study. Under general anaesthesia, a 5-centimeter autologous free bladder mucosa flap was used to construct a tube, which was afterwards grafted to replace a 5-centimeter ureter resection. After a period of 3 months (n=2) and after 1 year (n=2), microangiography was performed to assess the revascularization of the grafted ureter.

Results: In our study, we observed the continuity of the ureter, but the grafted reconstruction was narrowed by the cicatrization in about 86% (n=25) of cases. This resulted in the development of hydronephrosis, as described in previous publications. The ureteral wall was covered by a normal urothelium, but consisted of fibrous connective tissue, which failed to restore a regular (normal) coat. The reconstructed segment showed no smooth muscle cells. A few smooth monocytes were found only at the border with intact portions of the ureter. The microangiography performed at the end of the experiments showed no vascularization of the restored segment of the ureter.

Conclusions: The experiments showed a whole regeneration of urothelium in the transected and reanastomosed ureters. However, there was no regeneration of the muscular coat and a complete lack of revascularization.

Keywords: Ureter • Resection • Reconstruction • Microangiography

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Background

Partial ureter defects may result as a consequence of iatrogenic and morbid causes.

One of the methods of partial ureter substitution is the use of free bladder autologous mucosa flaps. This method has been in use for about 50 years. Despite previous reports describing the benefits of this method, in reconstructive surgery, up to now, it has not been used in clinical practice. Our poor morphologic results with the use this method prompted us to perform microangiography of the newly constructed part of the ureter with this method to definitively resolve the problem of neovascularization in this area.

Material and Methods

The experiments were carried out on 29 mongrel dogs, as previously described [1–4]. All animals were operated on in the same manner (Figure 1), with general endotracheal anesthesia. After grafting, the restoration of the ureter was assessed. Four of the experimental animals were additionally subjected to perfusion of the vascular bed with a radiopaque medium called Micropaque (barium sulphuricum) (Nichols Roche, France, distributed by Schering Germany). This was done to ascertain neovascularization in the supplemented part of the ureter by a tube constructed from the free mucosa flap of the urinary bladder. Microangiography was performed after a longitudinal median laparotomy of 3–4 cm over the kidney vessels. The aorta was ligated and a cannula connected with the perfusion set (Figure 2) was inserted into the aorta.

To avoid errors in performing the operation and interpreting our results, we carefully studied the literature [5–12] and consulted with other investigators about the principles of this kind of experiment.

The perfusion of 500 ml 30% Micropaque (barium sulphuricum) (Nichols Roche, France, distributed by Schering Germany), with 0.9% NaCl was transfused and subsequently 30% Micropaque (barium sulphuricum) (Nichols Roche, France, distributed by Schering Germany) with 10% buffered formalin. Perfusion was performed under constant pressure of 140/80 mm Hg, at the temperature of 37°C, for 30 min. Perfusion was stopped when venous effusing white Micropaque was visible. After the procedure, all the experimental animals were euthanized and the samples were harvested and stored for 6 h at –20°C. Then, a segment of ureter measuring 10 cm in length was excised (5 cm above and 5 cm below the graft suture site), showing the surface vessels filled with Micropaque (Figure 3). At the end of the procedure, the specimen was stitched on the celluloid plate and harvested with 10% formalin, buffered to 7.6 pH. After 14 consecutive days, the specimens

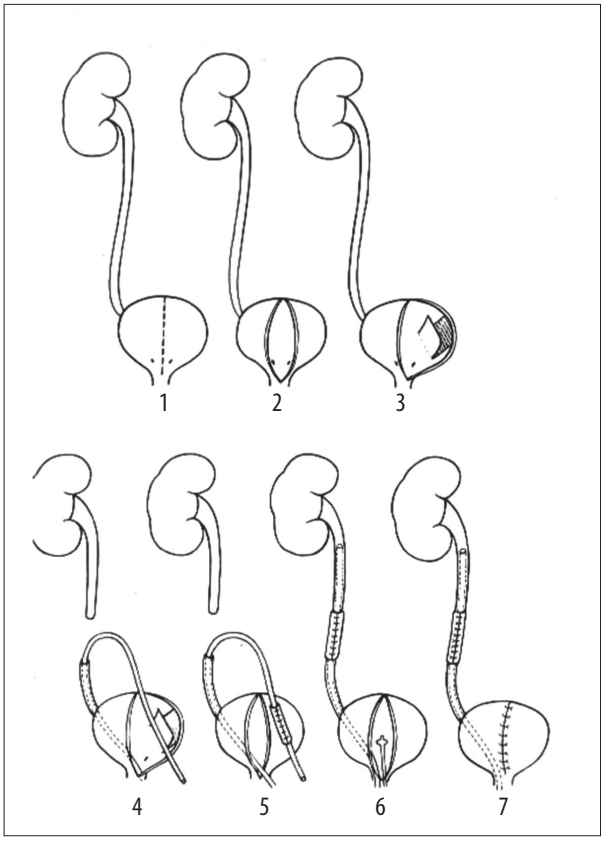

Figure 1. Schema of the performed operation.

were irradiated to show the visible net of the new vascular bed (Figure 4). Then, they were cut into 2-mm-thick slices using a microtome and were irradiated by direct exposure and visualized on celluloid film. We used a copper anode lamp (Russia) for structural investigations of BSW-9. Exposure time was 10 min, electric voltage 20 KV, and current intensity 5 mA. We used single-sided celluloid film type TN-12, (Bydgoszcz Manufacturing Fotochemic Plant, Poland), which allowed us to obtain image of capillaries of up to ×100–200, because these celluloid films contain a one-sided photosensitive layer. A stepwise process of the ureter substitutions from 1 dog is shown in Figures 1–3.

Results

Microscopic evaluations showed the complete regeneration of the mucosa of the supplemented ureteral segment [1–4]. The defects in the ureters were not bridged by the smooth muscle [1–4]. The experimental findings showed a massive periureteral fibrosis, due to reparative or reactive process, which was considered as the main reason for the failure of our interventions [1–4]. One of the most common causes of scarring or stricture of the ureters is ureter surgery. The reason for this is that the arteries going to the uterus are very close to the ureters. During surgery, these arteries are tied off or sealed and the ureter can

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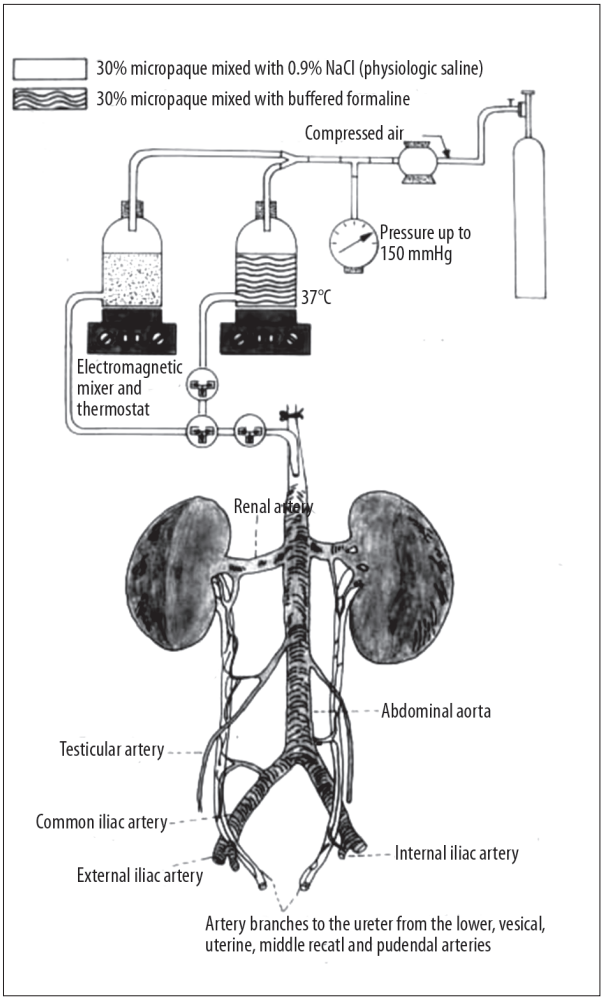

Figure 2. Scheme of perfusion of the vascular bed with Micropaque (Nichols).

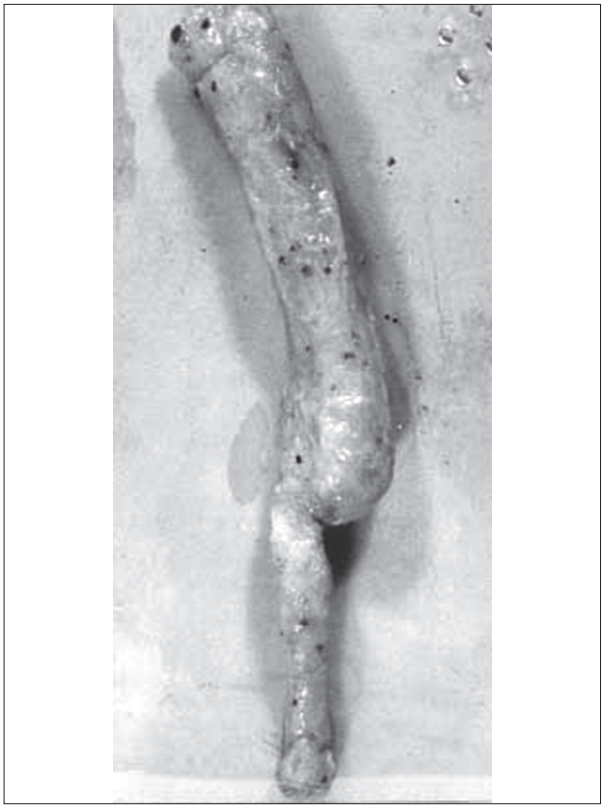

Figure 3. Gross appearance of the excised part of 1 ureter after performing of microangiography.

Figure 4. X-ray image of the excised part of 1 ureter after performing of microangiography.

be easily damaged. The amount of scarring and inflammation that occurs after surgery can be very dense and as a consequence leads to hydronephrosis and destroying the kidney.

The obtained results of the microangiographic investigations are shown in Figure 5 and 6.

Discussion

Previous reports [13,14] described the benefit of free autologous bladder mucosa graft for the reconstruction of the ureter. However, unpublished observations have generated a significant interest and a need to re-evaluate autologous ureter grafts constructed from the free autologous mucosa flap; therefore, this method has not been used in clinical practice.

It should be noted that the results of our previous studies [1–4] and of the present study do not support a free bladder mucosa flap as a viable clinical therapy for ureteral reconstruction, in spite of the positive reports of the above-mentioned authors.

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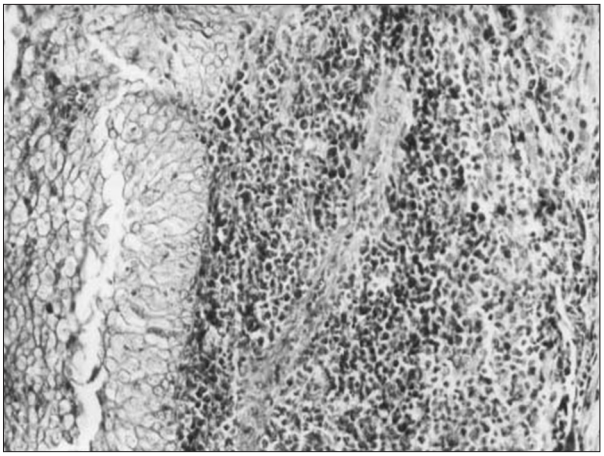

Figure 5. Magnified image. An arrow shows the location of the reconstructed part of the ureter. Above anastomosis, dilated ureter.

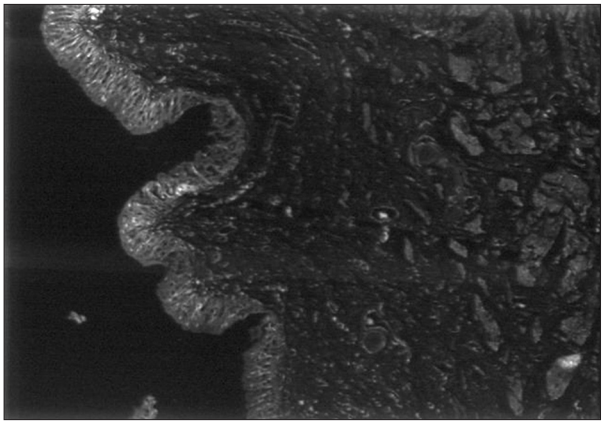

Figure 6. Microscopic image of ureteral wall reconstructed ureter with many infiltrations. HE ×200.

Conclusions

The present animal study suggests that the surgical ureteral reconstruction using this method or grafted tissue is not suitable to achieve clinically desirable results.

Acknowledgment

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Statement

All procedures and protocols were performed and approved in accordance with Guidelines of the Bioethics Committee on Animal Research of the Medical Academy Warsaw (since 2008 called Medical University Warsaw)

Conflict of interests

None.

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