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Construction of an artificial urinary conduit – preclinical study in a porcine model

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Purpose

The aim of this study was to assess the tissue-engineered conduit for urinary diversion in a porcine model. Propsed method was created in order to replace ileaum segment currently used as a standard method for creation of urinary diversion after cystectomy.

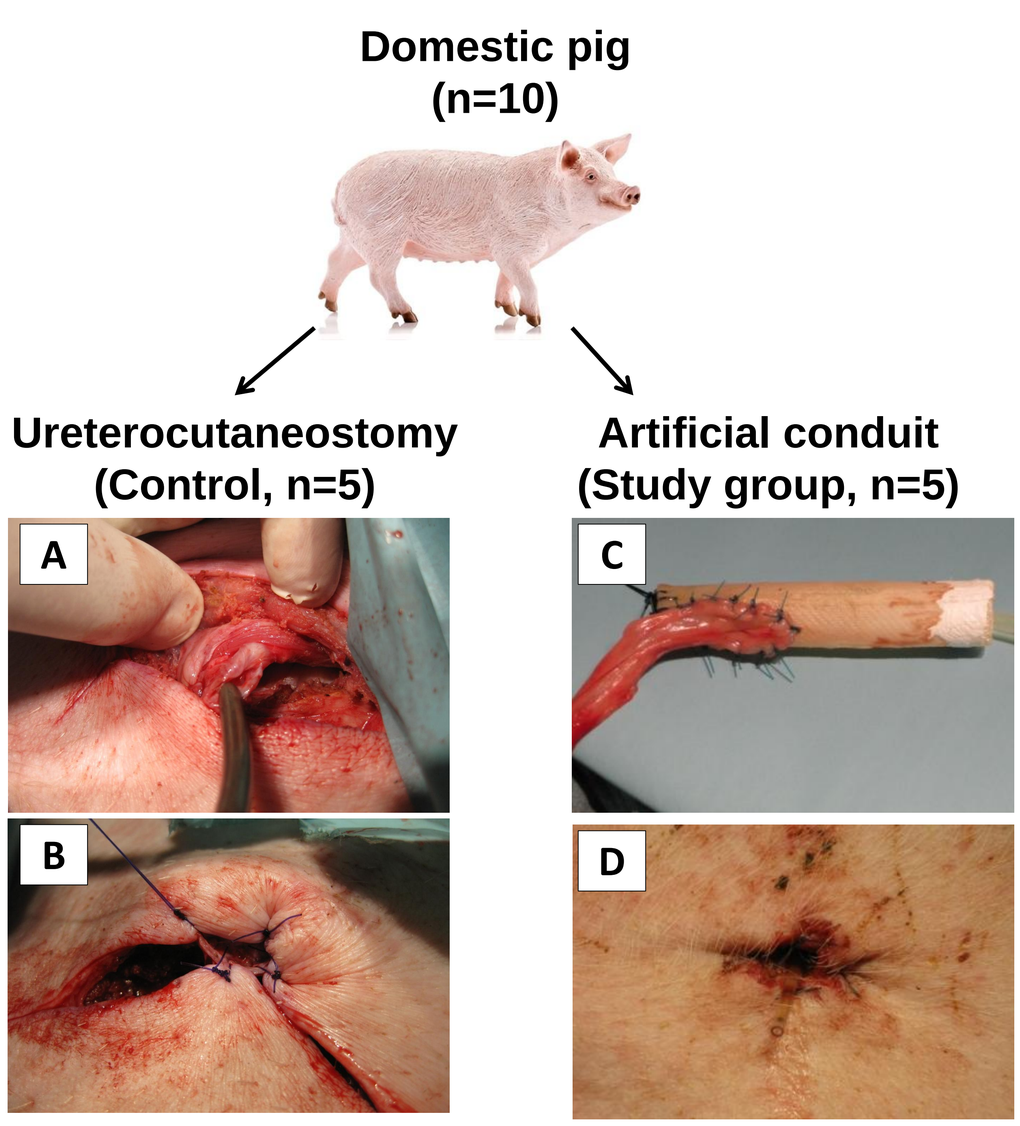

Fig.1 Study groups. Ureterocutaneostomy construction (A, B). Method of ureter connection with artificial conduit (C), direct connection of artificial conduit with skin (D).

Materials and methods

Tissue engineered tubular scaffolds were used for construction of the artificial urinary conduits. Conduits were sterilized and implanted as an incontinent urostomy using right ureter. A 10 male pigs were operated and divided into two equal groups: in 1st Group (Control) ureterocutaneostomy were created, in 2nd Group the ureter was connected with scaffold conduit directly with the skin (the artificial conduit model). Computed tomography was used to confirm the patency of created diversions. Morphological and histological analysis was used for evaluation of diversion construction efficiency. The observation time was six months.

Results

All animals survived the experimental procedures and 6-months follow-up. The patency of ureterocutaneostomy (1st Group) was between 3 to 12 weeks compared to 18 - 22 weeks for artificial conduit (2nd Group). In the case of 2nd Group the prolapse of tissue-engineered conduit was observed between 3 and 4 weeks after surgical procedure. The remnants of the implant created a retroperitoneal post-inflammation tunnel which constitutes urostomy. Computed tomography and histological evaluation showed that the prolapse of a tissue engineered scaffold was related to the disruption of the scaffold integration process with adjacent tissues as a result of developing biomaterial infection.

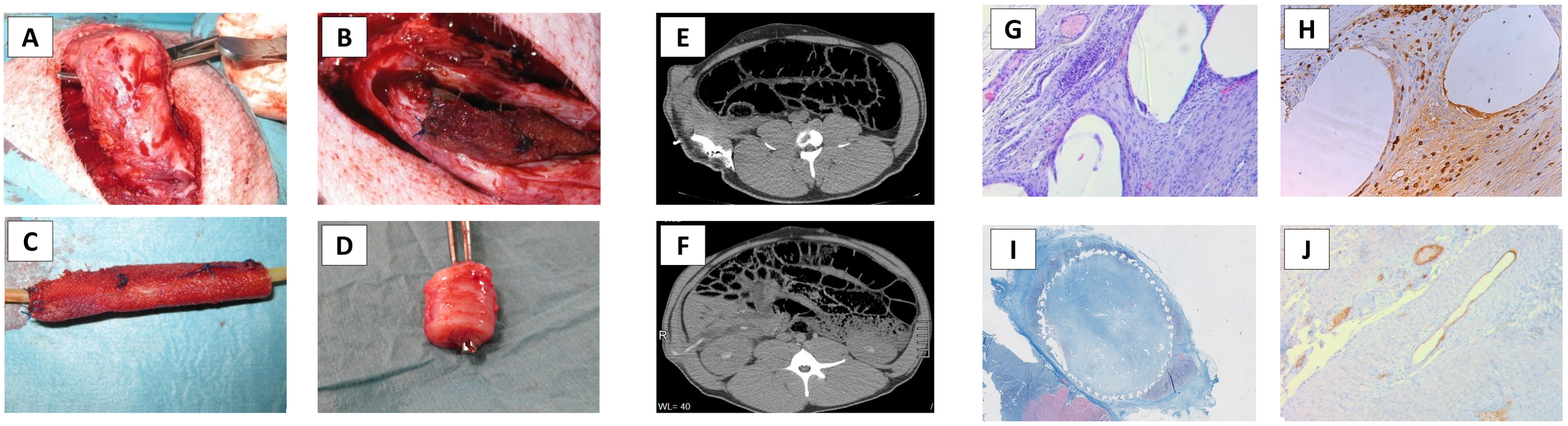

Fig.2 Analysis of tissue-engineered conduit after end of 6-month follow-up. A-D: Gross examination of tissue engineered conduit. Scaffold covered with connective tissue (A); lack of integration of artificial conduit with native tissues, presence of inflammation is visible (B); artificial conduit after removal from tested animals (C); the part of tunnel through which the catheter went outside (D). E-F: Computed tomography analysis showing patency of created urinary diversion using artificial tissue engineered conduit. G-J: Histological and immunohistochemical analysis, hematoxylin and eosin staining showing presence of inflammation process (G); presence of lymphocyte confirmed by CD3 staining (H); presence of smooth muscle (I) and connective tissue(J) regeneration confirmed by Trichrome Masson and CD31 staining respectively. Light microscope, magnification 10X (G, H, J) or 1X (I).

Conclusions

1. The simultaneous urinary diversion using tissue-engineered scaffold connected directly with skin is not appropriate method for clinical application, despite appearance of post inflammation tunnel.
2. Our results showed that there is emerging need for searching a new method solving the urinary diversion after cystectomy.

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