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Tissue Sealants in Laparoscopic Conservative Renal Surgery

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Thanks to the widespread diffusion of imaging techniques and health preventive programmes, the modern urologist is increasingly involved in the management of incidentally diagnosed renal masses. These lesions are often limited in size (<40 mm in diameter), peripherally located, and with benign histology in nearly 20–25% of the cases [1].

Standard radical nephrectomy appears to be an excessive treatment in such cases, and nephron-sparing surgery has gained wide acceptance in the urologic community for the treatment of small renal neoplasms, with oncologic results similar to those obtained with a more radical procedure [2]. Open partial nephrectomy is a major surgical procedure with potential morbidities, often requiring large skin incisions and muscles divaricating due to the retroperitoneal deep position of the target organs, with a disproportion in comparison to the dimensions of the lesions to be excised. Minimally invasive surgery (laparoscopy) is also experiencing a widespread diffusion among urologists and laparoscopic nephron-sparing techniques have been reported to reduce morbidity related to open conservative surgery on the kidney. Nevertheless, laparoscopic partial nephrectomy or tumourectomy has to be considered as probably one of the most challenging procedures in laparoscopy urology, especially for control of bleeding from the cut renal parenchyma [3,4].

The evolution of haemostatic techniques and suturing in laparoscopic surgery has allowed for a widening not only of surgical indications but also for an increasing number of surgeons to approach minimally invasive procedures.

Adequate haemostasis of the renal surface is essential for laparoscopic nephron-sparing surgery because uncontrolled bleeding may cause significant complications and even conversion to laparotomy. As a general rule, haemostasis during laparoscopic surgery plays a pivotal role and aims to primarily prevent bleeding or at least early vascular and bleeding control. Because even minor bleeding may cause impaired vision due to significant light absorption by dark blood staining of the adjacent tissues, compromising the advantages of the magnified vision offered by the laparoscope, a wide variety of tissue sealants have been adapted or developed for laparoscopic surgery and purposed especially for nephron-sparing surgery.

Kaouk and Gill [5] duplicated laparoscopically the standard nephron-sparing technique performed in open surgery, with hilar clamping, cold excision of the neoplasm with adequately clear surgical margins, suturing of the collecting system, when required, and closing haemostatically the renal defect with the use of ''sutured bolster'' using ''cigarettes'' of oxidised regenerated methylcellulose (TaboTamp, Surgicel). Haemostasis is achieved by coaptation and approximation and by the compression on the tissue of the reperfused renal parenchyma. Nevertheless, this technique requires great suturing skill, especially in cases of bigger lesions, with the potential risk of prolonged warm ischaemia time, with the well-known negative subsequences.

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The use of tissue sealants in partial nephrectomy or tumourectomy allows for a fast parenchyma, vascular, and collecting system repair and reduces not only the overall operative time but particularly the warm ischemia time. Therefore, the negative impact on the renal function of temporary vascular clamping can be reduced, of pivotal importance especially in patients with a solitary kidney or with impaired renal function [6].

Among all the haemostatic tools available, ''glues,'' or tissue sealants, are the only really adequate alternatives for bleeding control of the cut renal surface, and their use as unique haemostatic agents is adequate in cases of small peripheral lesions. However, in cases of larger lesion excisions, Johnson et al. [7] reported that use of sealants in association with ''sutured bolster'' offered better results compared to the use of sealants alone.

Although a number of sealant products have been proposed as haemostatic agents, the ideal sealant is still in waiting, even if most of the available ones can be used efficaciously in renal-spring surgery. Sealants can be divided into two categories: nonbiologic and biologic (derived from living beings, either human or animal).

Among the nonbiologic glues, the best known is probably 2-octyl-cyanoacrilate. Primarily used for skin closure, it creates a fixed and watertight lining over the cut renal parenchyma within 2–3 min. To work, it requires a bloodless field, so that preventive haemostasis with hilar clamping is essential to achieve this dry field. Particular care must be paid to avoid accidental contact with the surrounding tissues during its positioning to avoid gluing of other structures, such as renal pedicle or ureter. All the biologic sealants include thrombin or fibrinogen or both. They are the terminal product of the clotting process and their use determines a fibrin matrix over the site of apposition. Probably the most famous are fibrin glues (Tissuecol, Crosseal, Tisseel). They combine, in two separate syringes injected simultaneously in the site of action, human thrombin and fibrinogen and create a veil that seals small vascular lesions and favours haemostatic processes. When fibrin glues are used in sandwich with oxidised regenerated methylcellulose, the created compound has an optimal ability to seal not only the vascular structures, but with a leak point pressure of more than 50–80 mm Hg it seals also excretory system infractions [8]. Moreover, fibrin glues are resistant to the action of urine when in contact with the sanguineous urine in case of calyx opening during surgery [9].

Gelatin matrix haemostatic sealant (FloSeal) is a more recent solution widely used as a haemostatic sealant. It is a combination of a bovine gelatin-based matrix with a bovine-derived concentrated thrombin component. This viscous collagen matrix requires active bleeding to be activated and work, promoting coagulation and haemostasis at the site of bleeding; it requires 1–2 min of delicate compression on the cut edge of the parenchyma after its apposition.

In cases of peripheral small renal lesions, argon beam coagulation offers a surface coagulation sufficient for minor capillary bleeding and can be efficaciously used in conjunction with other tissue sealants [10].

All the biologic ''glues'' used to date in conservative renal surgery, as shown, are derived from humans or animals, with all the potential risks (although very improbable) of disease transmission and significant costs for their production and conservation. In this issue of *European Urology*, Schips and coworkers [11] proposed an innovative sealant to be used during partial nephrectomy. The Vivostat system has the innovation of being an autologous fibrin glue, so that it can be prepared directly from the patient during the surgical procedure. To our knowledge it is the first report of an autologous fibrin glue used in renal surgery and the authors report good results in terms of reduced blood loss and absence of postoperative bleeding or urinary leakage, showing adequateness of this sealant in urologic surgery.

Successful haemostasis and control of the excretory system are of pivotal importance in laparoscopic conservative renal surgery and can increase the surgical indications for laparoscopic partial nephrectomy. Moreover, the ability to control bleeding more easily from the site of excision has widened the number of surgeons who feel comfortable with this challenging surgical procedure. Nevertheless, urologists should have a detailed knowledge of the available sealants, especially in terms of their biophysics and the spectrum of effectiveness, to choose the most adequate one in their hands.

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