1 Suturing Techniques in Robot-Asssisted Partial Nephrectomy (RAPN)

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1.1 Introduction

Over the years, there has been an evolution in renorrhapy techniques in minimally invasive partial nephrectomy (MIPN). Earlier, the approach was to minimize intra-operative complications (avoid blood loss, avoid urine leakage when opening the collecting system). Nowadays, we try to minimize the ischaemic effect of our renorrhaphy technique to optimize renal function [5].

Unfortunately there is no consensus about the best renorrhaphy technique. Studies are limited, most of them without information on the tumor complexity and only assessing the early postoperative functional outcome. In the following content, we'll try to summarize the variety of techniques.

1.2 Classic Renorrhaphy

A classical renorrhaphy typically consists of a double-layer technique with a medullary suture (inner layer) and a cortical suture (outer layer).

Depending on the lesion's growth pattern, it's important to be aware of the anatomy of the intraparenchymal arteries. With a deep resection, there needs to be attention for the radial anatomy of the renal lobe (the pyramid) and its respective interlobar arteries. The renal parenchyma will be devascularised when they have been included in the medullary suture [5]. With a deep needle passage, you also

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should try to avoid the involvement of the urinary collecting system (UCS). When the UCS is opened during tumour excision, you should use superficial sutures or single re-absorbable clips to achieve a watertight closure of the defect [2].

The medullary suture is often performed in a knotless fashion using a running suture fixed by clips. These clips better be re-absorbable to avoid decubitus and potential migration into the UCS [2].

When performing the cortical suture, the orientation of the needle should be at right angles with respect to the line of the arcuate arteries. If the suture has been performed superficial enough in order to avoid the involvement of the arcuate arteries: the blood supply to the medullar parenchyma by the vasa recta is spared [5]. The cortical suture is used to re-approximate the renal defect, often performed using a sliding-clip technique. With this techniques it's possible to allow more precise control and readjustment of the tension placed during suturing, reducing both warm ischaemia time (WIT) and risk of the 'cheese-cutting effect' associated with conventional parenchymal sutures [3].

1.3 Single Versus Double Layer

In the systematic review of Bertolo et al. [2], a comparison was made between single-layer vs double-layer groups. There was a significant advantage in terms of operating time (mean difference −11.13 min [95% CI −20.14, −2.13]) and WIT (−3.39 min [95% CI −4.53, −2.24]) favouring the single-layer technique. Conversely, no significant differences were found in terms of blood loss, postoperative complications and urinary leakages.

Renal function (pre- and postoperative estimated glomerular filtration rate (eGFR)) was analysed, comparing single-layer versus double-layer groups. There was a benefit in functional outcome in favor of the single-layer technique (3.19 ml/min, 95% CI 8.09; 1.70, $p = 0.2$ versus −6.07 ml/min, 95% CI 10.75; 1.39, $p = 0.01$) [3].

Bahler et al. [1] investigated the feasibility and safety of omitting cortical renorrhaphy during robot assisted partial nephrectomy (RAPN). Without differences in postoperative complications, they found a significantly higher renal volume loss if cortical renorrhaphy was performed (assessed by software-based volumetric assessment on computed tomography scans). This finding was suggested to be secondary to the hypoperfusion of the parenchyma that occurs during cortical renorrhaphy.

Overall, a single-layer renorrhaphy technique appears to be feasible and safe in selected cases of MIPN, with clear advantages in terms of reduced WIT. According to the available evidence and expert opinion, when single-layer renorrhaphy is attempted, the cortical rather than the medullary layer should be omitted [3].

1.4 Running Versus Interrupted Suture

The systematic review of Bertolo et al. [2], found six studies that compared running vs interrupted suture. The groups were comparable in terms of age, body mass index (BMI) and tumour size. A running suture resulted in a significant advantage in terms of operating time (mean difference −17.12 min [95% CI −24.30, −9.94]), WIT (mean difference −8.73 min [95% CI −12.41, −5.06]) and occurrence of postoperative complications (odds ratio 0.54 [95% CI 0.32, 0.89]) and transfusions (odds ratio 0.30 [95%CI 0.15, 0.59]).

No significant differences were found between pre- and postoperative eGFR in both patients who received an interrupted suture (WMD −4.88 ml/min, 95% confidence interval [CI] −11.38; 1.63, $p = 0.14$) or those who received a running suture (−3.42 ml/min, 95% CI −9.96; 3.12, $p = 0.31$) [3].

1.5 Barbed Versus Nonbarbed Suture

The introduction of barbed sutures further reduced operating time and WIT (as compared with non-barbed sutures), with the added advantages of reduced blood loss [2].

The systematic review of Zhan et al. [6], compared the use of a self-retaining barbed suture (SRBS) with a non-SRBS for parenchymal repair during laparoscopic partial nephrectomy (LPN). They found a shorter WIT ($P < 0.00001$), a shorter overall operative time ($P < 0.00001$), a lower estimated blood loss ($P = 0.02$) and better renal function preservation ($P = 0.001$) with a SRBS. There was no significant difference between both sutures with regard to complications ($P = 0.08$) and length of hospital stay ($P = 0.25$).

Not only during cortical renorrhaphy, but also for inner-layer renorrhaphy, some authors reported a reduced renorrhaphy time while using a SRBS [2].

1.6 Hemostatic Agents

To complete haemostasis, some surgeons prefer the use of haemostatic agents (fibrin glues, gelatin-based sealants (i.e. FloSeal; Baxter Healthcare, i.e. Veriset; Medtronic) or human fibrinogen and thrombin fleece (i.e. TachoSil; Nycomed). In the early robotic experiences, surgical bolsters were used to fill the renal defect after inner-layer renorrhapy. Nowadays they are rarely used [2].

In the systematic review of Bertolo et al. [3], there were no studies who compared the differential role of renorrhaphy techniques and haemostatic agents on PN outcomes.

1.7 Selective Suturing—Sutureless Technique

The sutureless technique was developed to retain more renal parenchyma and protect renal function. After excision of the tumour (if possible clampless), forced bipolar or monopolar coagulation is carried out on the tumour bed. When persistent arterial bleeding is observed, a selective suturing is achieved. If not, then it is possible to perform a sutureless technique. A hemostatic agent is then applied to the tumour bed.

Farihna et al. [4], compared selective-suturing or sutureless RAPN (suRAPN) and standard RAPN (stRAPN). Overall, 29 patients (31%) were treated with suRAPN. Only one suRAPN patient experienced intraoperative complications ($p = 0.9$). Two suRAPN patients (6.9%) and four stRAPN patients (13.8%) experienced 30-d postoperative complications ($p = 0.3$). Operative time (110 vs 150 min; $p < 0.01$) and length of stay (2 vs 3 d; $p = 0.02$) were shorter for suRAPN than for stRAPN. The trifecta outcome (warm ischemia time < 25 min, negative surgical margins, and no perioperative complications) was achieved in 25 suRAPN patients (86%) and 20 stRAPN patients (70%; $p = 0.1$). Specifically, WIT < 25 min was reported for 28 (97%) suRAPN patients versus 25 (86%) stRAPN patients. Negative surgical margins were reported for 28 (97%) suRAPN patients versus 28 (97%) stRAPN patients. Finally, only one suRAPN patient (3.4%) versus five stRAPN patients (17%) experienced postoperative AKI ($p = 0.2$). At 6-mo follow-up, the median eGFR decrease was −5.6 (IQR: −3.4–8.3) for the suRAPN group versus −9.1% (IQR: −7.3–11) for the stRAPN group ($p < 0.01$).

1.8 Conclusion

This chapter provides an overview of the different renorraphy methods during MIPN. Over the last decade a transition from double-layer renorraphy towards single layer and sutureless renorraphy can be noted in order to optimally preserve residual kidney parenchyma. Existing evidence indicates that this might lead to better kidney function preservation without increasing peri-operative complications.

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