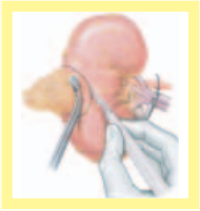
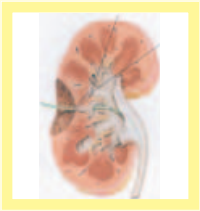
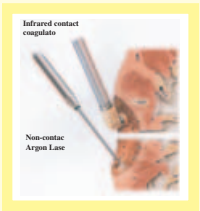
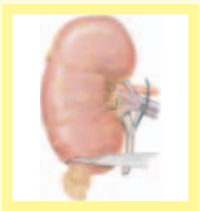
Surgery Illustrated









Surgical Atlas

Cone/wedge resection of renal cell carcinoma

S. PAHERNIK, R. GILLITZER and J.W. THÜROFF
Department of Urology, Johannes Gutenberg University, Mainz, Germany

ILLUSTRATIONS by STEPHAN SPITZER, www.spitzer-illustration.com

PLANNING AND PREPARATION

PATIENT SELECTION AND INDICATIONS

Nephron sparing surgery (NSS) is the treatment of choice in patients with localized RCC when preservation of renal parenchyma is mandatory, such as in bilateral RCCs, RCC in a solitary kidney and chronic renal failure (imperative indication). In addition, NSS may be used in patients with small, peripherally located RCC of up to 4 cm in diameter in the presence of a normal contralateral kidney (elective indication). The cancer-specific survival rates of these patients are comparable to those in patients treated by radical nephrectomy. NSS is also indicated in patients with renal tumours of unknown grade.

Preoperative imaging usually comprises ultrasonography of the kidneys or IVU and CT or MRI. Angiography is only required in centrally located or large tumours in solitary kidneys for vascular orientation of surgical planning.

PATIENT PREPARATION AND POSITIONING

Patients receive compression stockings and are shaved before surgery. The patient is positioned in an overstretched lateral position. The surgical approach is a supracostal, extraperitoneal flank incision above the 12th or 11th rib, depending on size and location of the tumour and position of the kidney. In patients with a high risk of requiring temporary dialysis after surgery, vascular access is established for the dialysis.

When the collecting system is opened intraoperatively and requires nephrostomy or stent drainage, antibiotic prophylaxis with a cephalosporin is used. Subcutaneous prophylaxis for deep vein thrombosis is started the evening after surgery and patients are mobilized the day after surgery.

In addition to instruments used for radical nephrectomy, the following specific equipment is used:

Slush ice for cold ischaemia
Vessel loops
Bulldog or Edwards clamps for clamping the renal vessels
Argon beam laser or infrared sapphire coagulator for parenchymal haemostasis

Suture material:
For ligating bleeding vessels:
4/0 polyglactin braided (Vicryl®, Ethicon)
4/0 polyglycolic acid coated, braided (Safil®, Braun)
For closing the renal capsule:
4/0 or 5/0 polydioxanone, monofilament (PDS®, Ethicon)
4/0 or 5/0 poly p-dioxanone, monofilament (Mono-Plus®, Braun)
Absorbable polyglactin kidney mesh bag
For closing the collecting system:
6/0 polyglactin braided
6/0 polyglycolic acid coated, braided
For fixing the ureteric stent:
4/0 polyglytone (Caprosyn®, Tyco)
4/0 polyglycolic acid absorbable (Safil Quick®, Braun)

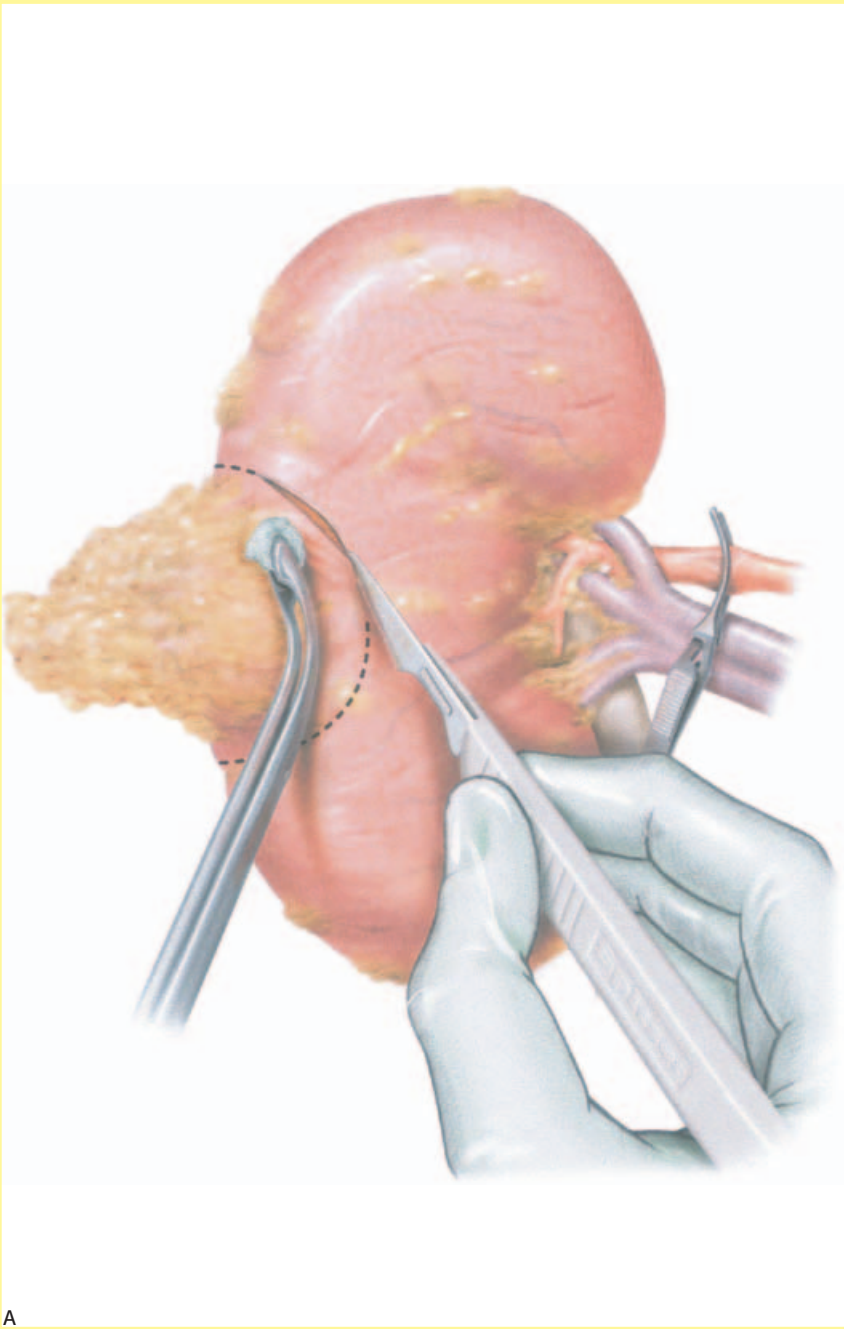
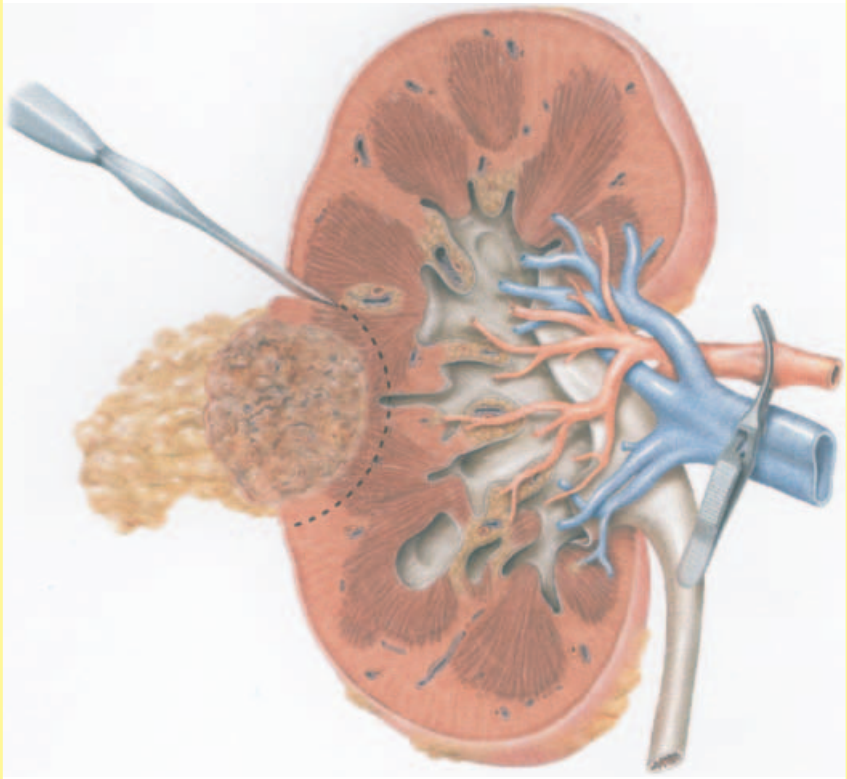


Figure 1

After opening Gerota's fascia the kidney is completely mobilized, leaving the perirenal fat attached to the tumour. The renal vessels are exposed and secured by vessel loops. Clamping of the artery may not be necessary in small peripheral tumours. When renal ischaemia is required, the kidney is placed into a bowel bag, which is loosely tied around the renal hilus and has its bottom excised to be filled with slush ice. Ten minutes before clamping the renal artery, 20 mg of furosemide are administered intravenously. After clamping the artery with a bulldog or Edwards clamp, renal hypothermia is induced with slush ice. It is generally not necessary to clamp the renal vein. The fibrous renal capsule is incised at a 2–4 mm from the tumour either in a circle (cone resection) or an ellipse (wedge resection), depending on the size and location of the tumour and its intraparenchymal or exophytic extension (Fig. 1A). About 2 mm of normal renal parenchyma have to be removed with the tumour (Fig. 1B). The cone resection (Fig. 1C) allows maximal preservation of renal parenchyma while the wedge resection (Fig. 1D) allows easier re-approximation of renal parenchyma because of the extra excised wedges of normal kidney especially in lateral tumours of the midportion of the kidney.



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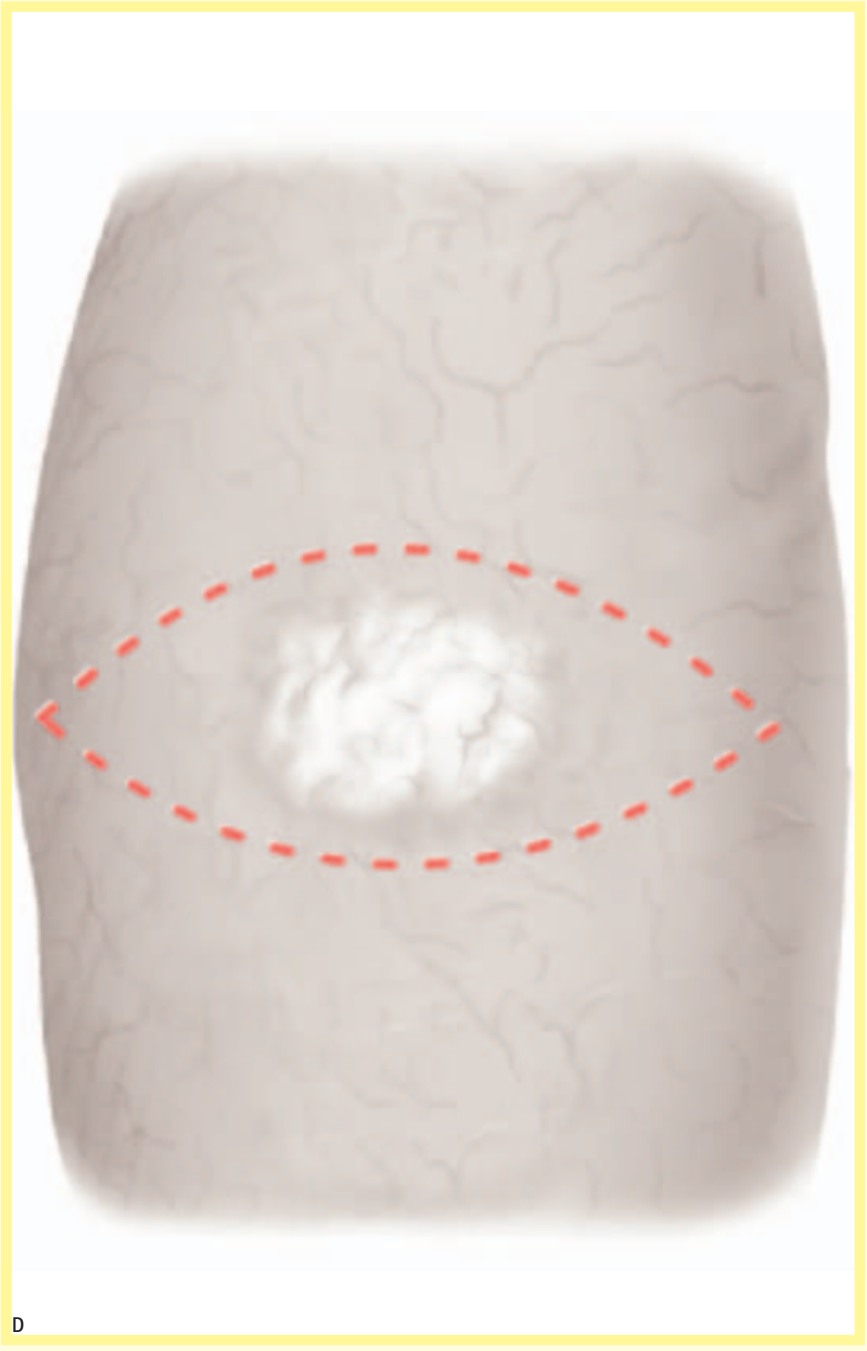

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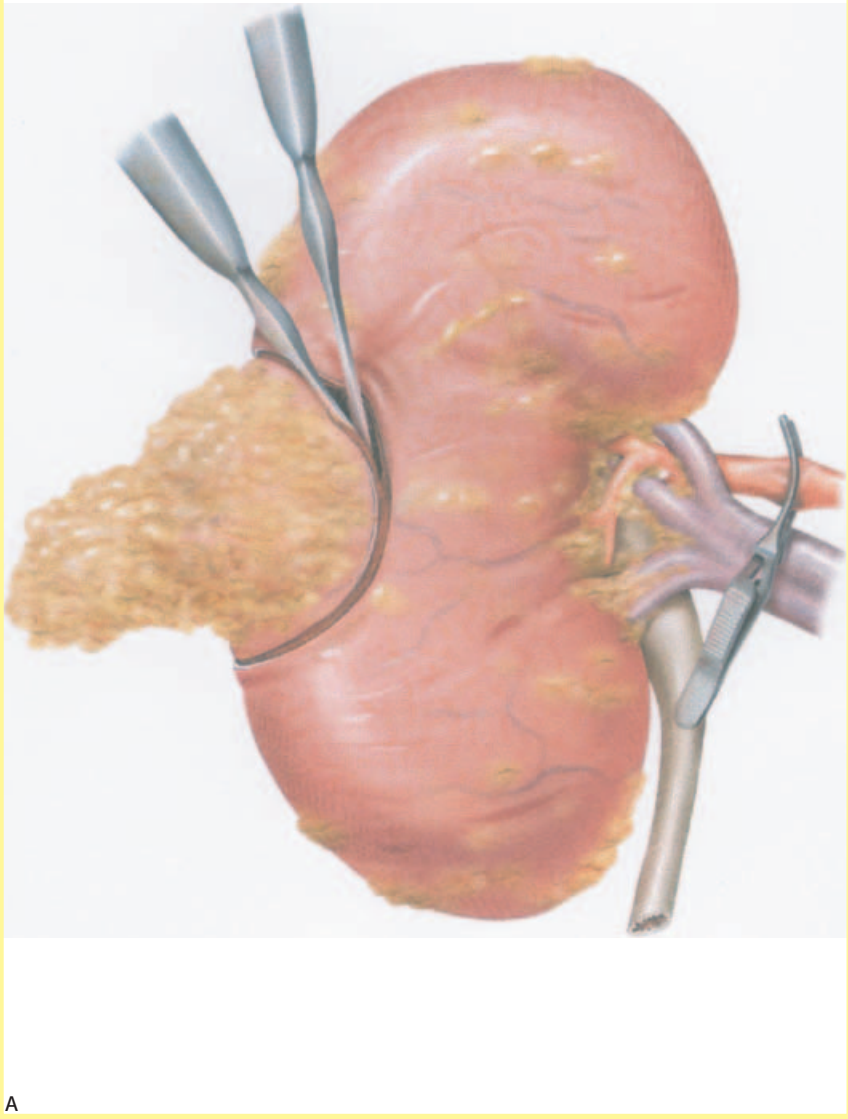
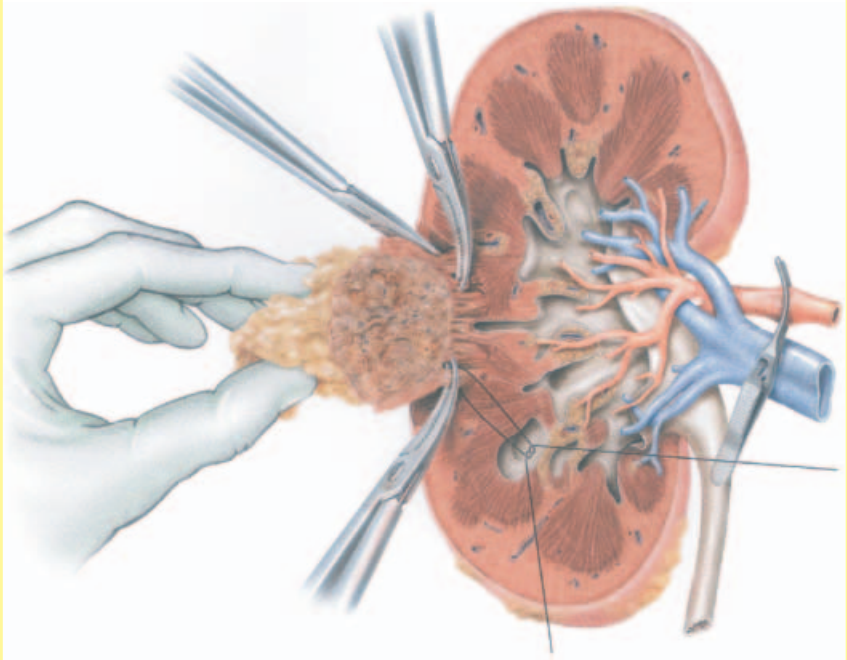


A

Figure 2

Using brain spatulae, the renal parenchyma is sharply and bluntly separated in the renal cortex and only bluntly in the medulla along the parallel structures of tubules and collecting ducts of the renal papillae (Fig. 2A). Small vessels are coagulated and large vessels are oversewn with 4/0 polyglycolic acid, which does not melt during the following coagulation. At the base of the resection, major vessels are clamped and ligated (Fig. 2B).



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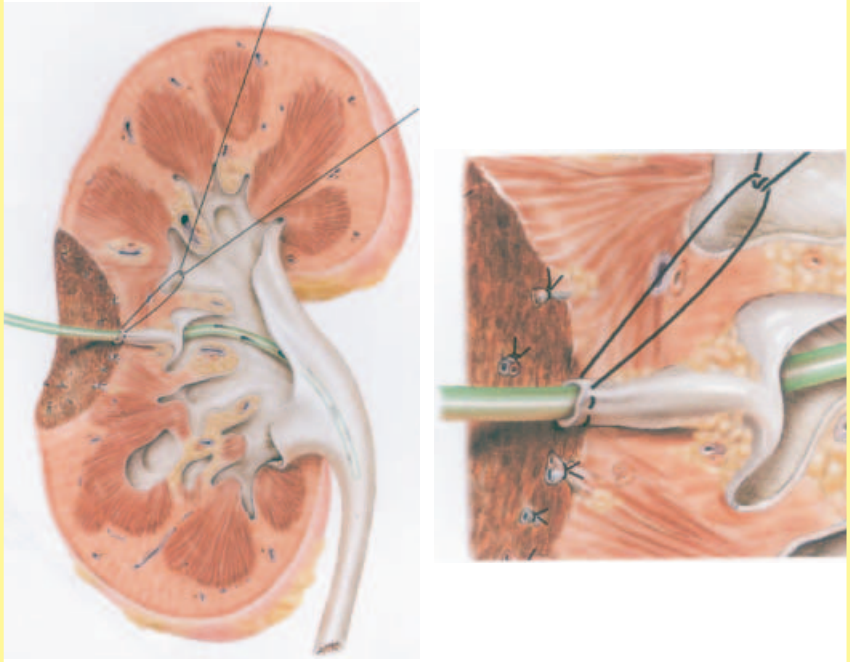
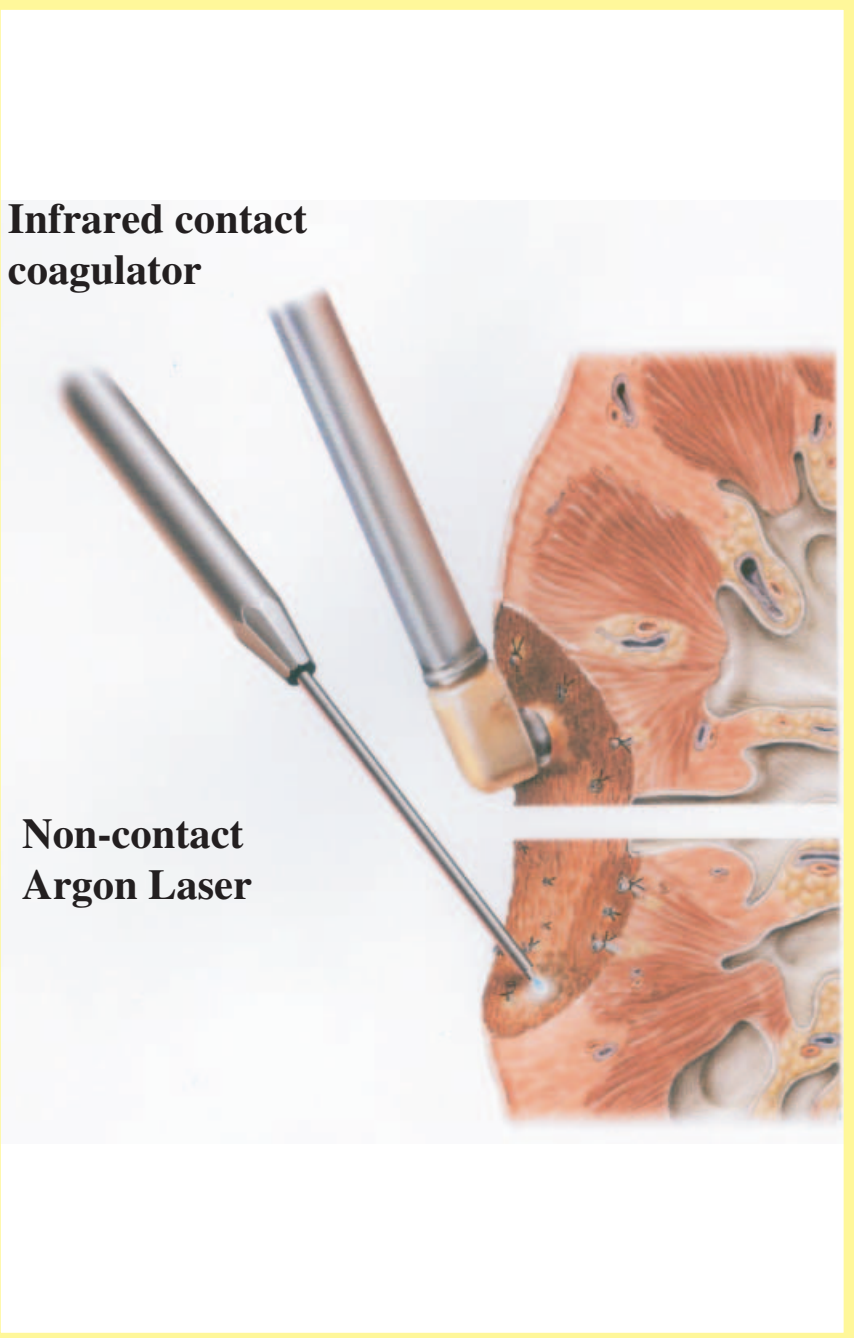


Figure 3

The removed tumour is sent for frozen-section analysis of the central (tumour adherent) margins of resection. Additional random biopsies are taken from the resection bed of the preserved kidney to determine peripheral margins. If there is a positive margin, nephrectomy is usually required in patients with a normal contralateral kidney. In patients with imperative indications (solitary kidney, chronic renal failure, bilateral RCCs) immediate extended resection or radical nephrectomy followed by dialysis may be selected. The opened calyces and renal pelvis are reconstructed with 6/0 polyglycolic acid. When drainage of the collecting system seems to be mandatory, a 6–8 F ureteric stent is used as a nephrostomy and fixed by a 5/0 polyglytone purse-string suture.

Figure 4

An argon-beam laser or an infrared coagulator is used for coagulation. Both instruments provide the required haemostasis for parenchymal bleeding. The noncontact argon laser does so by superficial tissue carbonization, while the cheaper infrared contact coagulator produces heat necrosis of tissue to 1–3 mm deep, according to the exposure time (1–5 s), with little carbonization and tissue adherence. Hence, infrared coagulation may be used in addition to haemostasis for nonsurgical extension of the safety margin of resection. With both instruments, most monofilament sutures tend to melt, so that braided sutures should preferably be used for ligation or oversewing.



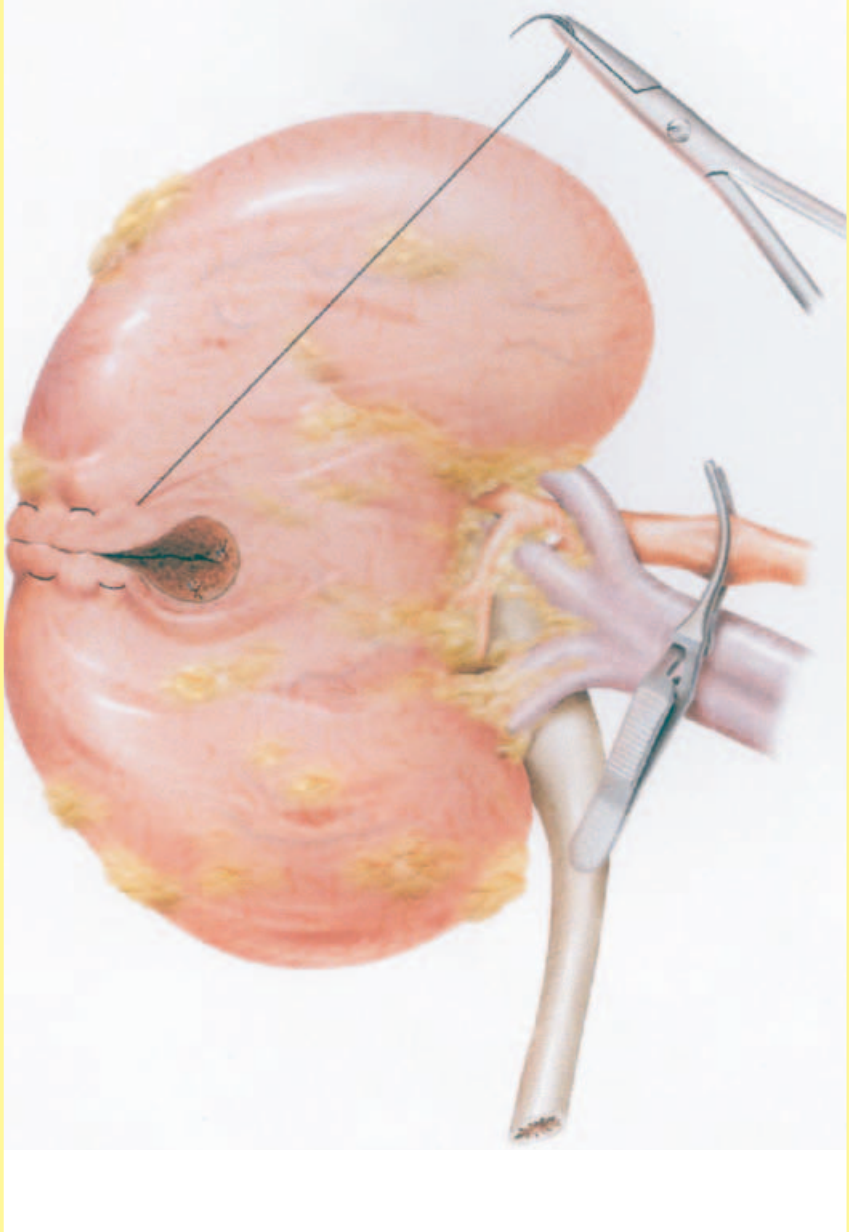
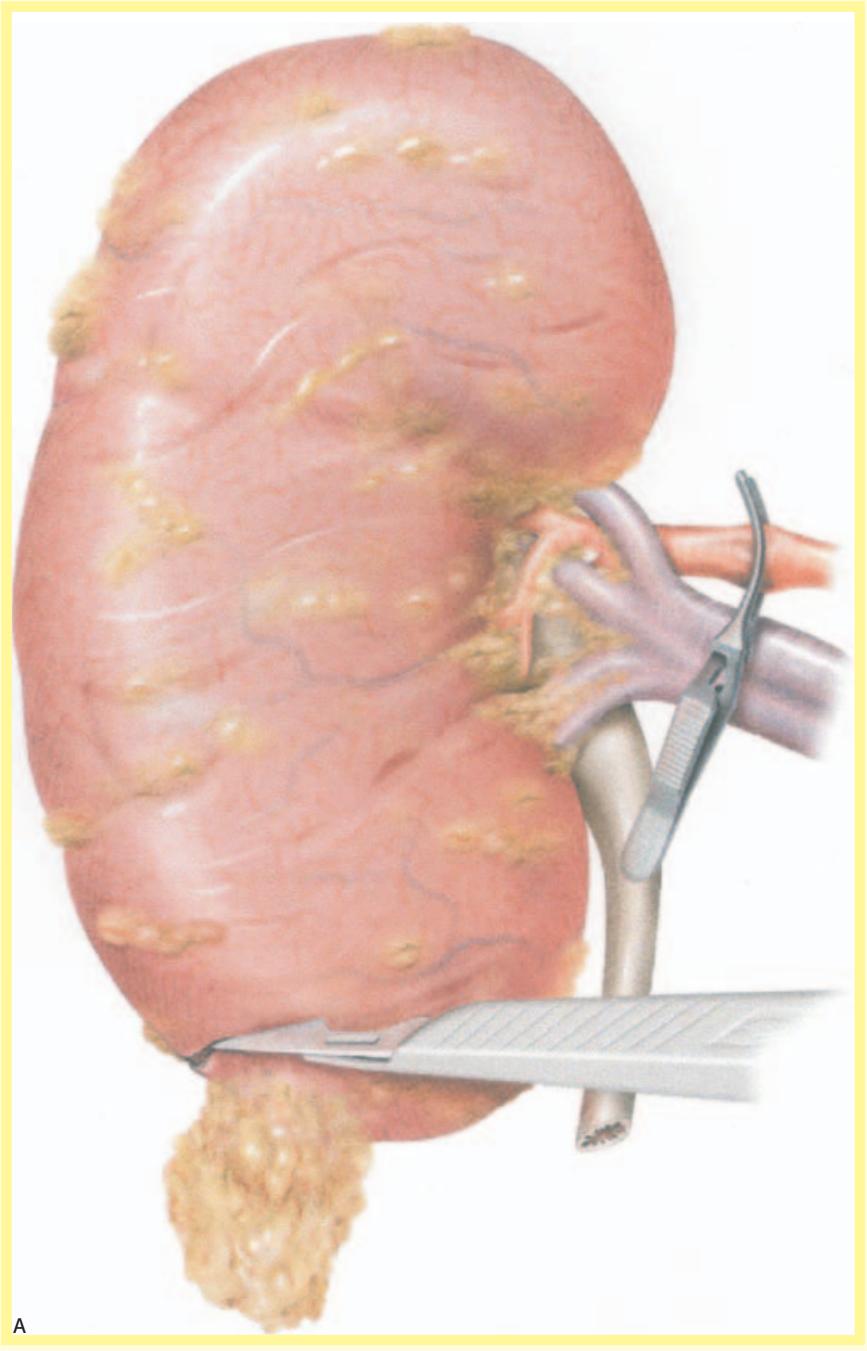


Figure 5

Mostly the kidney can be closed by suturing the renal fibrous capsule without using parenchymal sutures, which damage preserved renal parenchyma and tend to tear through the tissue. The renal fibrous capsule is closed with a running monofilament mattress suture using 5/0 poly p-dioxanone; this is a most important step for haemostasis.

Figure 6

Cone resection of small tumours may be used with or without renal clamping (Fig. 6A). In smaller, exophytic renal tumours, the resection plane usually does not reach the medulla and collecting system (Fig. 6B), leaving a defect of the parenchyma, in which haemostasis is again achieved by suturing/oversewing of vessels and parenchyma coagulation, e.g. by argon laser (Fig. 6C). When a shallow defect cannot be closed by adaptation of the renal capsule, a free peritoneal patch may be used to cover the defect. Absorbable gauze or a pedicled perirenal fat flap may be additionally used as a filler to provide compression for supporting haemostasis (Fig. 6D).



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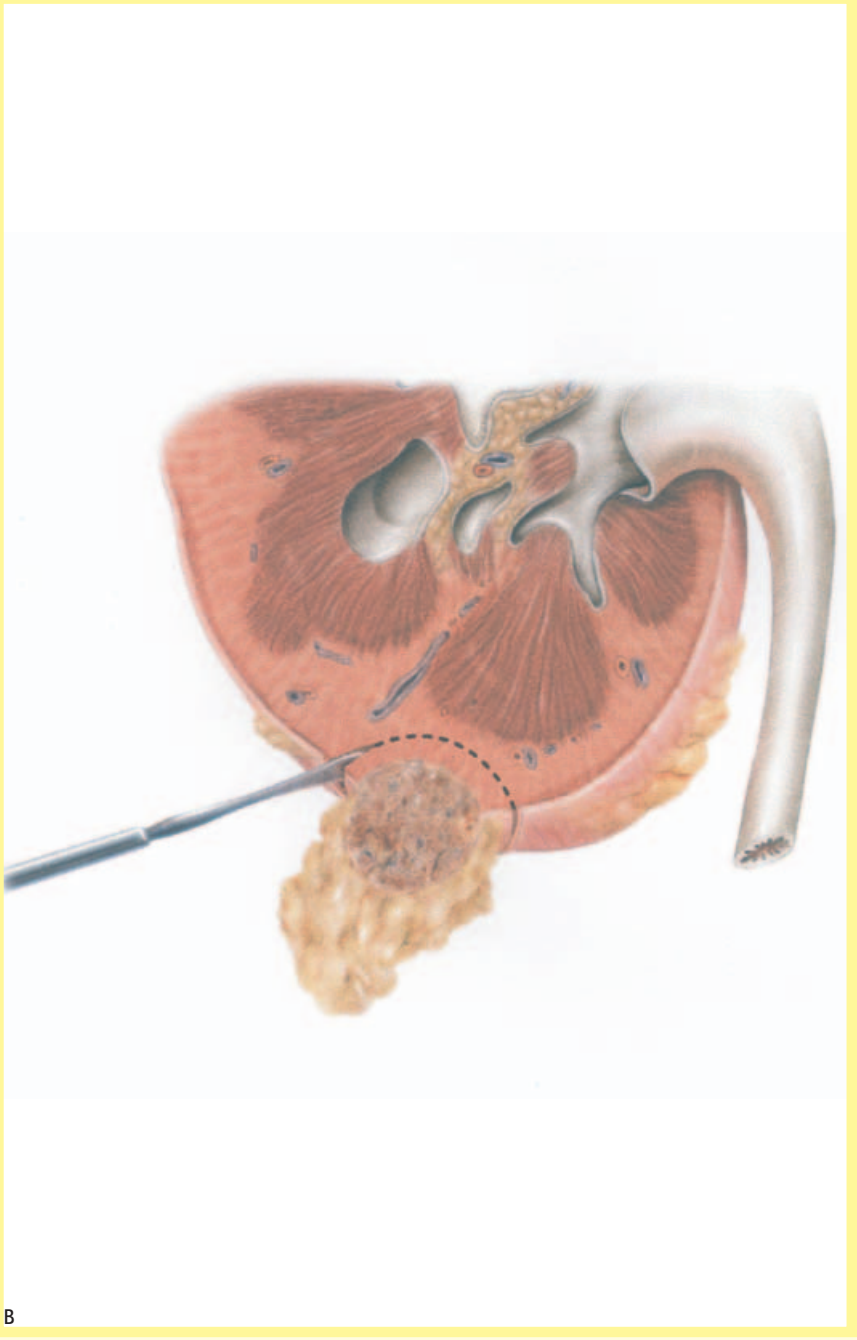

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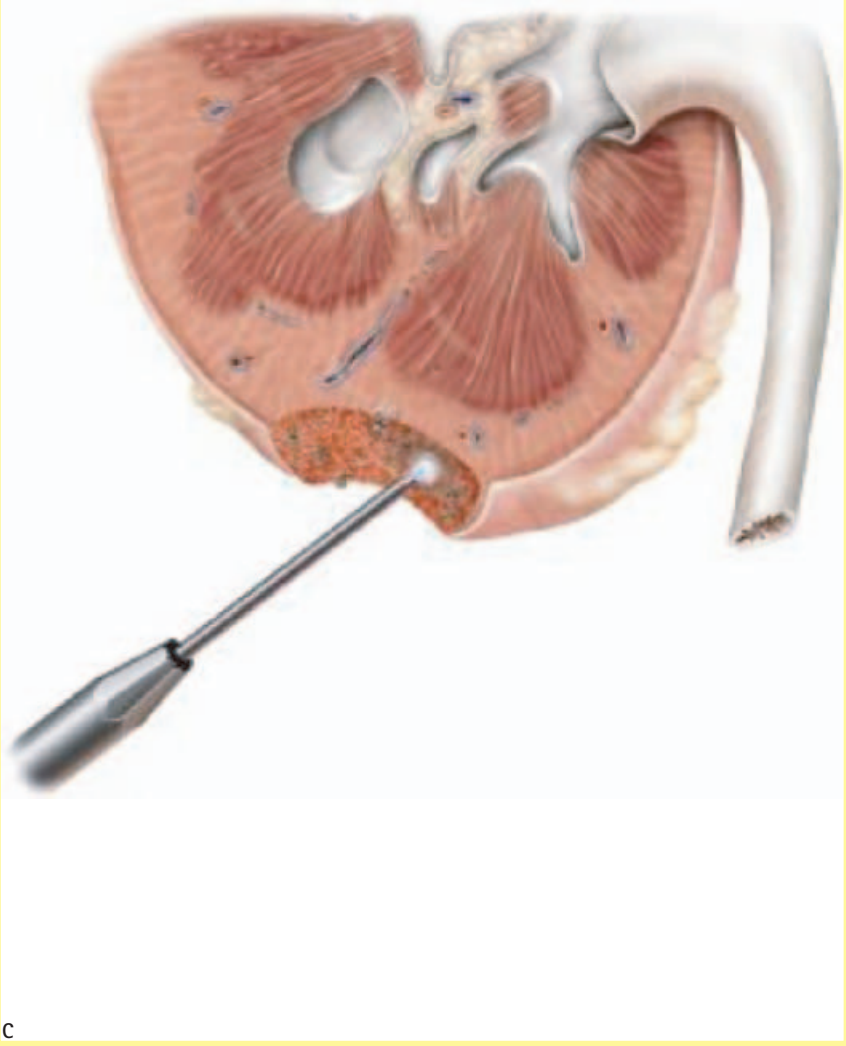

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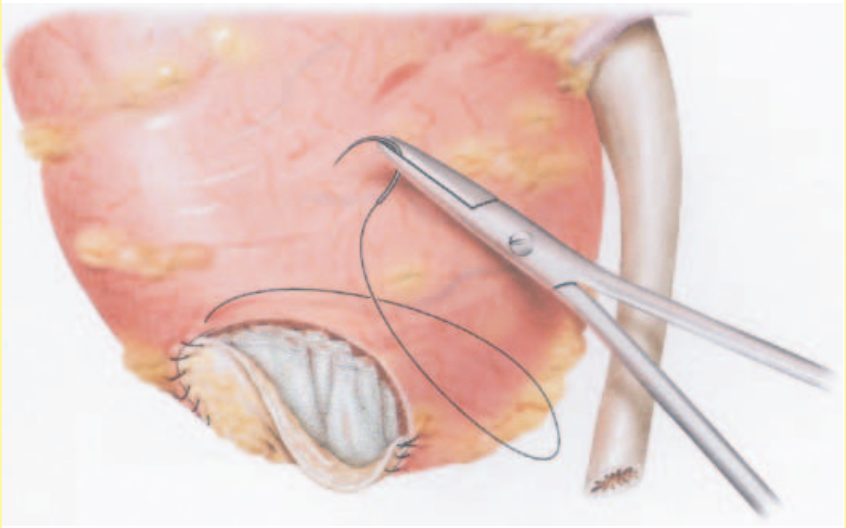

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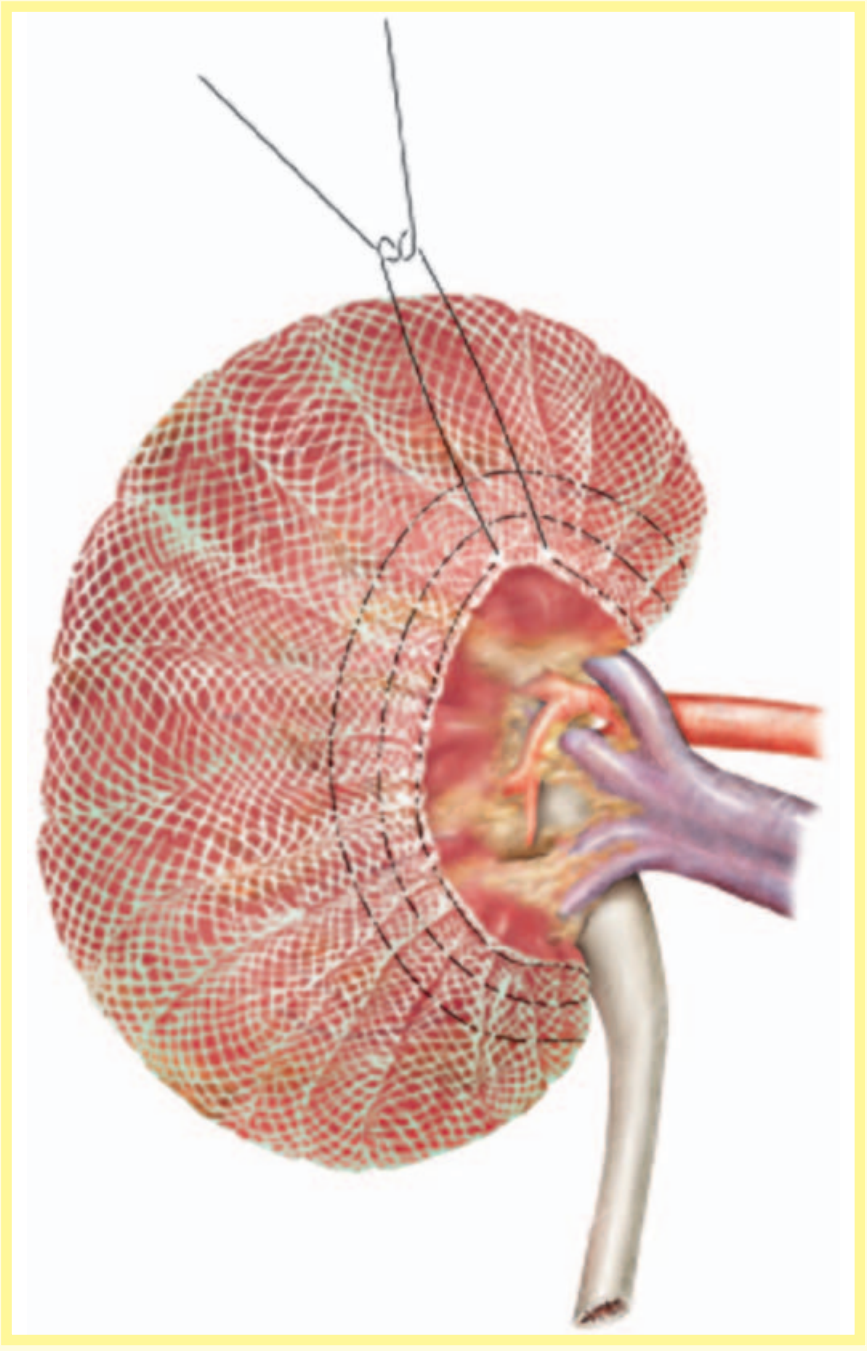
Figure 7

If a defect of the renal capsule cannot be closed because it is too large or fragile, and renal parenchymal compression is required for haemostasis, a specially fashioned polyglycolic acid mesh with integrated purse-string sutures is helpful. The mesh is available in different sizes and can be individually tapered by three integrated purse-string sutures (Fig. 7).



POSTOPERATIVE CARE

Fluids are given parenterally for 1–2 days; the patient is mobilized on the first day. The bladder catheter is removed after 1 or 2 days, depending on the need for fluid balancing. The perirenal drain is removed when fluid drainage stops. The nephrostomy catheter is removed after 7 days. Renal ultrasonography and IVU are used to ensure free urine drainage and absence of extravasation at 7 days or after removing the nephrostomy.

In case of RCC, the oncological follow-up should comprise baseline CT 3 months after surgery, when surgical oedema has subsided, and which serves as a reference for later follow-up CT. The baseline CT helps to avoid later confusion as to whether a renal irregularity is related to surgery and scarring, or to a possible tumour recurrence.

DIFFICULTIES AND TROUBLE-SHOOTING

In case of haemodynamically relevant postoperative perirenal or intrarenal bleeding, angiography with the option of superselective embolization of an arterial bleeding is an option. If there is no arterial bleeding, conservative management is preferable over surgical revision as the latter carries the risk of nephrectomy.

Urinary fistula or a urinoma are verified by examination of creatinine concentration from the drainage fluid. Imaging usually requires ultrasonography and IVU or CT. Drainage of the collecting system by retrograde placement of a ureteric catheter usually solves the problem of extravasation. When a JJ stent is placed, continuous bladder drainage is required to prevent reflux. Large urinomas must be drained percutaneously by ultrasonographically guided placement of a drainage system. In all cases of urinary extravasation (fistula, urinoma), antibiotic treatment is mandatory.

Renal failure secondary to ischaemic tubular damage is mostly temporary and requires haemodialysis in cases of solitary kidneys or chronic renal failure.

Dilation of the upper urinary tract may be caused by blood clots in the urine. If patients are symptomatic (fever, pain), drainage by means of a ureteric catheter/stent and antibiotics is required.