

NEPHRON SPARING SURGERY IN RENAL CELL CARCINOMA

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ABSTRACT

Partial nephrectomy is more and more performed for patients with a single small kidney cancer, not only in an imperative, but more and more often in an elective situation in the presence of a normal contralateral kidney. Kidney cancer is often detected incidentally and it is difficult to distinguish on the imaging between a small benign or malignant solid kidney tumor. Although the complication rate of partial nephrectomy might be higher than that of radical nephrectomy, the main problem with kidney sparing surgery is the chance of local recurrence due to incomplete resection or kidney recurrence due to the multifocality.

Partial nephrectomy for renal cell carcinoma remains controversial but is increasingly accepted under condition of an appropriate patient selection, an expert surgery and an adapted follow-up.

Key words: kidney, carcinoma, renal cell, kidney neoplasms, tumor, nephrectomy, partial
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INTRODUCTION

Prostate and bladder cancer are much more frequent than kidney cancer but the mortality from renal cell carcinoma is twice as high than that from bladder and 3 times as high than that from prostate cancer.

In recent years however the clinical picture of renal cell carcinoma has changed, and although an increased incidence of renal cell carcinoma is reported, a majority of tumors are now detected in an early stage (1). Most tumors are no longer presenting with the clinical picture of hematuria, flank pain and a palpable tumor with or without metastases. The use of ultrasound and computerized tomography (CT) scan is responsible for a frequent detection of asymptomatic low stage tumors that could not require radical nephrectomy to achieve cure.

Surgical resection indeed remains the only effective therapy for renal cell carcinoma. Classically a radical nephrectomy is performed through an abdominal incision allowing early ligation of the renal artery and vein and removal of the kidney with the adrenal gland within Gerota's fascia. It is question-

able whether this extensive surgery has to be applied for small incidentally diagnosed lesions. Also in other fields of oncologic surgery the concept of radical surgery was challenged and more conservative approaches that spare a certain amount of single or even paired organs has become standard.

Since small adenocarcinomas of the kidney have the propensity to microscopic vascular invasion and thus metastatic potential, a watchful waiting policy (2) can only be proposed in a highly selected group of patients. Tumors of 3 cm in diameter or smaller can give rise to metastases (3). On the other hand, a certain number of small solid tumors are benign. A small renal oncocytoma, angiomyolipoma or metanephric adenoma can often not be recognized prior to surgery. If all suspicious solid tumors were to be treated by radical surgery, a significant number of kidneys without malignancy would be resected. This has been one of the factors in favor of conservative kidney surgery together with a significant increase of incidentally detected small tumors.

In presence of a normal contralateral kidney, small tumors can be amenable for so-called elective kidney sparing surgery aiming at cancer cure with

preservation of as much nephrons as possible. In patients with solitary kidneys, with bilateral tumors, with threatened kidney function or von Hippel-Lindau disease, the kidney sparing surgery is done for imperative indications aiming at cancer cure with avoidance of renal failure that would necessitate dialysis or subsequent kidney transplantation.

KIDNEY SPARING SURGERY FOR KIDNEY CANCER

Radical nephrectomy has for long been considered as the standard treatment since surgery is the only treatment modality that brings cure. There is much less consensus about what the extent of surgery must be. Despite the number of retrospective, often single center studies there is still debate about the value of routine lymphadenectomy and/or adrenalectomy and it has never been shown that radical nephrectomy provides better survival than simple nephrectomy. This last issue introduces the value of the application of even more conservative resections and partial nephrectomy. The number of imperative indications for kidney-sparing surgery has been rather constant during the last years, while the number of elective indications is steeply increasing.

A partial nephrectomy for renal cell carcinoma was first performed more than a century ago (4). Sixty years later Vermooten (5) reported on the indications for conservative surgery in certain renal tumors. He showed that the histologic growth pattern of most small clear cell carcinomas is well suited to local resection. Since then nephron sparing surgery has become an acceptable therapeutic option for selected patients with renal cancer (6). The surgery is often technically challenging but it was shown feasible to locally resect bigger or even centrally located tumors that would normally require radical nephrectomy. So the complication rate of this type of surgery has recently become more than acceptable.

Many investigators have published their experience with imperative kidney sparing surgery in patients who could not undergo radical nephrectomy and have demonstrated the validity of this surgical approach. The survival data have been excellent and the average 5-year tumor specific survival rate was

reported to be nearly 90% (7-9). Obviously much lower 5-year survival rates are obtained when patients are operated for larger tumors with higher stage at diagnosis or with lymph node invasion (10). The survival of most patients who have progression after imperative conservative surgery is indeed determined by the presence of occult metastatic disease that was not recognized at the time of surgery. A smaller number of patients can present local recurrence that could have been avoided by a radical instead of a partial nephrectomy. A retrospective analysis of all reports on conservative resections in imperative indications showed a local recurrence rate of 7.5% (0-12%) (11). Whether the local recurrences were due to incomplete resection or to multifocality of the tumor is not clear, but often locally advanced tumors were operated for which a higher risk of local recurrence can be anticipated. In patients with small tumors, no local recurrences were reported (12,13). In a comparative non-randomized study of partial versus radical nephrectomy for small low stage tumors, the cancer specific 5-year survival rates were 100% following kidney sparing and 96% following radical surgery (14). When a patient progresses after kidney sparing surgery the outcome is often poor. Patients with local recurrence will have simultaneous metastases in a range between 25 to 67% (14) but those with local recurrence without metastases can still be cured by salvage surgery (10).

One can expect that the complication rates in patients treated with imperative kidney sparing surgery are higher than in those treated with radical nephrectomy. Indeed, arteriovenous fistula, pseudoaneurysm formation, urinary fistula or bleeding can occur, although a comparative (non-randomized) study has not shown a significant difference in complication rate between the 2 approaches (14).

Since the imperative conservative surgery showed acceptable results the indications for its use has continued to increase over the past several years. It is now accepted that patients with von Hippel-Lindau (VHL) disease should be managed by nephron sparing surgery. In VHL disease, patients have often extensive multifocal disease and multiple precancerous cysts. In these cases, the goal of nephron sparing surgery is not to cure but to buy time. It is

only when the tumor gets a certain size that surgery is recommended (16).

The same strategy could apply to patients with multifocal and often bilateral papillary renal cell carcinoma although bilateral nephrectomy is classically recommended. Nowadays conservative surgery is also accepted in patients with a poorly functioning contralateral kidney or with a contralateral kidney whose function is expected to deteriorate in the future. Urologists are enlarging the spectrum of imperative and relative indications for nephron sparing surgery to encompass patients with diabetes, arterial hypertension, renal artery stenosis, etc (17). In view of the expansion of the indications for conservative surgery, the technique was expected to be advocated also in presence of a normal contralateral kidney.

ELECTIVE KIDNEY SPARING SURGERY

The results achieved in imperative indications have shown that kidney sparing surgery can be cancer curing even in the case of larger and locally advanced or centrally located tumors. Classically the selection criteria for nephron sparing surgery in an elective situation are limited to clinically low stage tumors that are located underneath the renal capsule.

These are exactly the tumors where radical nephrectomy will bring cure in virtually 100% of patients while radical surgery is expected to have an even lower morbidity than a conservative surgical approach.

Several mainly European medical centers have reported in the early 1990's the treatment results of nephron sparing surgery in patients with a normal contralateral kidney and without any urological disease that could compromise renal function. The table summarizes the most relevant data (Table-1). Most of these reports emerged from single centers with data that were comparable in respect of tumor size, follow-up duration, disease free survival and the incidence of local recurrence. Two reports concern multicenter experience (18,19) where not all data on tumor size or follow-up, or disease free survival were available.

From the single center reports it can be concluded that the disease free survival is about 100% and local recurrence is an exceptional event. When the single center reports are analyzed, only 3 patients have presented local recurrence. This is a 10 times lower recurrence rate than that obtained for kidney sparing surgery performed in imperative situations. It is apparent that patient selection must at least be

Table 1 – Results of elective nephron sparing surgery for renal cell carcinoma

	Number	Mean Size (cm)	Follow-up (months)	Disease-free Survival	Local Recurrence
Selli et al. 1991 (ref. 43)	20	3.4	31	90%	0
Provet et al. 1991 (ref. 48)	19	2.6	35	100%	0
Licht et al. 1994 (ref. 12)	17	3.6	38	100%	0
Belussi et al. 1997 (ref. 18)	320	< 5.0	12-60	?	5 (1.4%)
Brisset et al. 1989 (ref. 49)	15	3.5	40	100%	0
Steinbach et al. 1991 (ref. 50)	72	3.2	40	90%	2 (2.8%)
Taari et al. 1993 (ref. 51)	10	3.7	48	100%	0
Moll et al. 1993 (ref. 52)	105	4.0	42	100%	0
Petritch et al. 1990 (ref. 19)	52	?	42	96%	2 (4.0%)
Morgan & Zincke 1990 (ref. 8)	20	3.1	46	100%	0
D'Armiento et al. 1997 (ref. 53)	19	3.34	70	96%	0
Van Poppel et al. 1998 (ref. 54)	51	3.0	78	98%	0
Herr 1999 (ref. 55)	70	3.0	120	97%	1 (1.4%)
Total	783				10 (1.3%)

partially responsible for these excellent treatment results. Unfortunately it has not been clarified in the single center reports whether the local recurrences were due to incomplete resections (recurrence in the tumor bed) or to tumor multifocality (recurrence elsewhere in the kidney), the former being an avoidable and the latter an unavoidable event.

Although the excellent tumor control is the strongest argument in favor of kidney sparing surgery for easily resectable tumors in carefully selected patients, other arguments have been used in order to favor a conservative approach. A relevant issue is the fact that the preoperative imaging techniques cannot evaluate the malignant potential of small solid renal tumors. While a large oncocytoma may be suspected on CT scan and a huge angiomyolipoma will be recognized without problems on ultrasound or CT it is much more difficult to predict the pathological diagnosis of very small solid kidney tumors. Fine needle aspiration cytology or biopsy is not advisable or even contra-indicated when surgery will anyway be performed (20).

The presence of a tumor pseudocapsule that often surrounds the smaller renal cell carcinoma makes a nephron sparing approach very appealing. The tumoral pseudocapsule is intact in 80% of all renal cell cancers smaller than 7 cm (21) and more recently it was shown that in more than 90% of kidney cancers there is no peritumoral infiltration (22).

The risk of impairment of renal function caused by radical nephrectomy is another argument in favor of the use of conservative surgery. The risk of contralateral kidney function loss after total nephrectomy because of hyperfiltration is limited and it was shown that two thirds of the renal parenchyma need to be removed before the remaining nephrons are damaged (23).

The risk of developing a metachronous contralateral renal cell carcinoma is reported to be 1 to 4% (24). This risk must be higher in papillary renal cell carcinoma. Since a contralateral recurrence will still be amenable for surgery, this is a poor argument in favor of nephron sparing surgery.

The major debate regarding elective nephron sparing surgery concerns the risk of local recurrence that can occur up to 20 years after surgery. In-

complete resection is one of the causes of local recurrence while multifocality can be responsible for a kidney recurrence that was either not detected at the time of surgery or that subsequently developed elsewhere in the kidney.

Local tumor recurrence is due to tumor persistence during surgery followed by new tumor growth that becomes detectable during the period of follow-up. Local recurrence is more common after imperative nephron sparing surgery and it is believed that the difference in local tumor control between imperative and elective cases is due to incomplete resection and not to the synchronously unsuspected tumor or the metachronously developing tumor. Incomplete resection occurs when larger tumors are treated that are less well circumscribed and less easily resectable. Many of these tumors would, in the presence of a normal contralateral kidney, not be treated by nephron sparing surgery. Also in an elective situation local tumor recurrence in the tumor bed was described. This must be related to the surgical technique, mostly when simple tumor enucleation, relying on the tumoral pseudocapsule is performed. Although small renal cell carcinomas have often a well-defined pseudocapsule, it can be absent or incomplete or invaded by adenocarcinoma (25). Therefore, when the resection is not performed within the safe rim of healthy parenchyma this can lead to incomplete resection, leaving behind microscopic residual tumor. Surgeons who perform simple tumor enucleation will advocate frozen section biopsies at the resection margins and apply coagulation of the tumor bed by any means (26). Although no randomized study has shown the advantage of a tumor resection within healthy parenchyma above simple tumor enucleation it is obvious that, on a theoretical basis, simple enucleation must be less adequate.

While local recurrence due to incomplete resection is avoidable, kidney recurrence due to multifocality is not. The multifocal nature of renal cell carcinoma is well documented not only in case of larger tumors but also in those measuring less than 3 cm in diameter. There can be a genetically determined tumor multicentricity as in von Hippel-Lindau disease, in hereditary renal cell carcinoma and also in papillary tumors (27) but also sporadic renal cell

carcinoma can present with secondary or satellite lesions. The occurrence of multifocality as reported is summarized in Table-2. The variation in the reported occurrence of multifocality is due to the varying completeness of the pathological examination of the kidneys. A second factor is a possible different incidence of hereditary or papillary renal cell carcinoma. Unfortunately, the incidence of these conditions has not been accurately reported in the different studies.

The table shows that there is some confusion about the incidence of secondary lesions with primaries smaller than 3 cm. While it was formerly believed that the incidence of multifocality was negligible or very low in smaller tumors, a careful analysis showed that when the number of secondary renal cell carcinomas is related to only those kidneys that have a primary smaller than 3 cm, multifocality occurs between 10 and 18%. It is not clear why, while this multifocality should be responsible for kidney recurrences after nephron sparing surgery in 10 to

recurrences could not have reported on these, resulting in a positive reporting bias. More importantly however the unknown natural history of small renal cell carcinoma must be acknowledged. It is not known when a small satellite lesion will become an overt, by imaging detectable, tumor. One could also postulate that removal of a bigger primary tumor could result in the spontaneous regression of smaller secondary lesions or to a situation where these lesions remain dormant for a longer period of time. This is only hypothetical but some similarity with an immunologically determined spontaneous regression of metastatic disease after removal of the primary tumor could be postulated.

Tumor multifocality is an unavoidable problem. With the use of optimal preoperative imaging multifocality can often be recognized before surgery. This allows the urologist to properly plan either a partial or a radical nephrectomy and these issues can be discussed with the patient. When a

Table 2 – Occurrence of multifocality in renal cell carcinoma (RCC)

Author	Number of Kidneys Examined	Secondary RCC No. (%)	Secondary RCC with Primary ≤ 3 cm Related to all Kidneys No. (%)	Secondary RCC with Primary ≤ 3 cm Related to Kidneys with a Primary ≤ 3cm No. (%)
Mukamel et al. 1988 (ref. 38)	66	13 (19.7)	2 (3)	0%
Cheng et al. 1991 (ref. 56)	100	7 (7)	0	?
Jacqmin et al. 1992 (ref. 57)	727	53 (7.3)	10 (1.8)	13%
Oya et al. 1995 (ref. 58)	108	7 (6.5)	2 (1.9)	12%
Kletscher et al. 1995 (ref. 59)	100	16 (16)	5 (5)	?
Whang et al. 1995 (ref. 60)	44	11 (25)	?	10%
Nissenkorn & Bernheim 1995 (ref. 61)	27	3 (11.1)	1 (3.7)	?
Chinaglia & Belussi 1997 (ref. 62)	387	12 (3)	3 (0.8)	18%
Total	1559	122 (7.8)	23 (1.5)	10-18%

18%, local recurrences in the actually reported series is 10 times lower. The reasons for this discrepancy are multiple. The actually available follow-up in the different reports is still relatively short. There could be a different incidence of papillary tumors, which are much more prone to behave in a multifocal way. In addition, centers that have local recur-

satellite is recognized during surgery it can still be decided whether a second partial nephrectomy or a radical nephrectomy is performed. Finally, when the multifocal behavior results in a late kidney recurrence salvage remains possible with either a repeat partial nephrectomy or total excision of the renal remnant (28).

PRACTICAL GUIDELINES

The technique of conservative renal cancer surgery has been well described although some details on preoperative work-up, the surgical act and the follow-up need further discussion (29-31).

Preoperative Work-up

A renal mass that is amenable for conservative surgery will often be found incidentally on imaging. The differential diagnosis includes the following conditions: atypical or complicated renal cysts, cystic adenocarcinoma, oncocytoma, angiomyolipoma, metanephric adenoma, metastatic tumor and pseudotumor. The CT scan is the most frequently performed investigation to assist in the diagnostic process (32). Magnetic resonance imaging (MRI) has not been found to be superior to CT scan in predicting the pathologic diagnosis for small renal neoplasms although its role could probably continue to increase (33). On the other hand, MRI has the advantage over CT to be useful in the evaluation of renal masses in patients with compromised renal function or with a history of allergic reaction to contrast media (34). MRI can also be useful to demonstrate the presence of a pseudocapsule and can therefore be helpful to establish which tumors could be safely treated by enucleation (35).

The spiral CT with image reformatting and MRI can also provide a tridimensional picture of the tumor in coronal and sagittal planes. These images are very useful for the selection of patients who can undergo a safe tumor resection. They can adequately show the relation of the tumor to the renal vessels, the renal sinus and the pelvicaliceal system.

Vascular studies with arteriography or digital intravenous subtraction angiography can have some importance in challenging kidney sparing procedures in imperative situations (36). Mostly arteriography is now considered to be superfluous. It can illustrate major arterial branches supplying the tumor that can be selectively ligated during surgery and minimize blood loss (31).

The preoperative preparation also includes information of the patient who needs to know that during the surgery it might become necessary to pro-

ceed with a radical nephrectomy and realize that a more strict follow-up schedule might be useful in order to identify local or kidney recurrence. Also information of the anesthesiologist and the theater staff is mandatory. The preparations before surgery and the intraoperative measures are different for a simple enucleoresection of a small peripheral tumor and for a centrally located larger tumor that can necessitate hilar clamping, kidney cooling and more complicated intraoperative anesthesiological care.

The Surgical Procedure

Although laparoscopic surgery is making progress and has shown to be feasible in experienced centers to safely remove small kidney cancers, the open surgical procedure remains standard (37).

Every incision that offers adequate exposure of the retroperitoneum can be used. Most urologists recommend the use of an extrapleural flank incision to the 11th or 12th intracostal space but others find the transperitoneal approach appropriate. Flank incision is mostly preferred because once the kidney has been completely mobilized on its pedicle it can be easily brought out of the wound, even in obese patients. Other advantages are the non opening of the peritoneal cavity and earlier postoperative recovery.

After the incision of the skin and the oblique abdominal muscles, Gerota's fascia is opened and the vascular hilus is dissected. This must enable clamping whenever this could become necessary during surgery. In an elective situation, hilar clamping is most often not indicated while in imperative indications it is very often used sometimes in combination with cooling. Simple digital compression or a small bulldog clamp can be used. Routine vascular clamping must be avoided since secondary arterial thrombosis after arterial clamping can occur.

The entire kidney capsule has to be exposed and inspected for the presence of secondary tumors. After adequate preoperative imaging the tumor itself can be approached and the peritumoral fat left on it. The renal capsule should not be stripped off since nearly all multifocal tumors are located immediately beneath the renal capsule (38). Moreover, this might increase morbidity without permitting the detection of small intraparenchymal secondary tumors.

Some centers are using intraoperative ultrasonography and color Doppler studies (39,40). In our experience, multifocality that has not been recognized on the actually available preoperative imaging has not been detected by ultrasound during the open surgery. The use of ultrasound is however useful to evaluate the extent of intraparenchymal tumors and to delineate tumors that does not cause any bulging of the renal cortex (41).

In most patients an in situ procedure on a well mobilized kidney is easily performed after adequate dissection of renal artery and vein. One can use ultrasound aspiration or waterjet dissectors, an argon laser beam, a microwave tissue coagulator or a contact Nd Yag laser. It is not proven that such techniques have definitive advantages over the conventional surgical technique and it will prolong the procedure.

Tumor resection should always be attempted within healthy parenchyma. The tumor will be removed with a rim of normal tissue of at least a few millimeters while simple enucleation is avoided because of the possibility of pseudocapsule invasion or perforation. A resection with limited margins achieved by tumor enucleation should not be recommended even in patients with small tumors (42). The resection of the tumor with a few millimeters of healthy parenchyma around the pseudocapsule has been called enucleoresection (43) or excavation (44). The renal capsule is incised with the cold knife at a few millimeters around the exorenal part of the tumor. The excavation can then be continued with both sharp and blunt dissection. Bleeding vessels can be stitched and when a calyx is opened, it should be meticulously closed to prevent urinary fistula. It is important to immediately mark the incised calyx with a stitch while proceeding with the excavation. Indeed the calyx can retract and is not easily recognized once the tumor has been completely removed. Double J catheters or nephrostomy tubes are almost never necessary. The injection of methylene blue into the collecting system may help in recognizing an opened calyx (45).

For larger tumors of the upper or lower pole, a partial nephrectomy will be a safe procedure while for midrenal tumors wedge resection is more advisable. The artery and vein can be clamped when convenient, even without cooling. The resection is then

limited in time but one can easily allow warm ischemia during 10 minutes. In some instances a specific feeding artery can be clamped or ligated. When more complicated resections are attempted it is good to perform a hilar clamping and to apply surface cooling. It is good to administer mannitol 20% in a half-hour infusion before cooling. Ice sludge can be applied during 25 minutes. Resection in a cooled and clamped kidney allows time consuming complicated resections and allows a meticulous reconstruction of the pelvicaliceal system and the kidney.

It was suggested to use frozen sections of the resection margins during the conservative procedure. This can be indicated in imperative situations when it is not always possible to obtain macroscopically safe margins. In elective indications the tumor should by definition be easily resectable within normal parenchyma. One can then rely on the macroscopic aspect of the margin immediately after resection. When there is doubt about the margins, frozen sections are mandatory.

When the incision in the renal capsule and within the parenchyma is properly planned one is almost always able to close the defect after repair of the urinary tract and hemostasis. It is therefore important to cautiously plan a fish-mouth-like incision that enables the surgeon to bring the cut edges together. Rather than using mattress sutures that do not allow easy approximation, interrupted sutures to close the parenchyma are used. These sutures can be tightened with the use of some fatty tissue or striated muscle or with exogenous material. Closure of the capsule should never be performed until the parenchymal bleeding has been adequately controlled. When arteries are left open and the urinary tract is not perfectly closed the patients can develop an arterioaliceal fistula with dramatic gross hematuria necessitating urgent selective embolisation of the feeding artery.

Sometimes the kidney defect is not amenable for closure. This can occur after enucleations or sparse enucleoresections. When the hemorrhage from the renal defect cannot be controlled sufficiently fibrin glue or hemostatic reabsorbable gauzes can be used.

After the placement of suction drains around the kidney the perirenal fat and Gerota's fascia are

closed keeping in mind the possibility of a later reoperation that might consist in a radical resection of the remnant kidney or in a second partial resection.

Follow-up after Kidney Sparing Surgery

In the early postoperative period, hemorrhage is the most common complication. Hemorrhage in the perirenal fossa is possible and will usually be recognized when the suction drains have been adequately placed. Surgical exploration is mostly the only solution.

When a urinary fistula occurs, a good suction drainage is of utmost importance. Mostly this will be sufficient to manage the situation but in some cases insertion of a double J catheter can be necessary. In that case it is important to also insert an indwelling bladder catheter in order to prevent persistent fistulisation during detrusor contraction.

Intrarenal bleeding is rare but can be a dramatic situation. Indeed a false aneurysm or an arteriocaliceal fistula can become obvious when the patient shows macrohematuria. Open surgical exploration is not mandatory in the absence of life threatening hypotension or shock. It is also not indicated to postpone any interventional radiological treatment even when the macrohematuria spontaneously subsides temporarily. The patients that are suspicious to have an arteriocaliceal fistula need to be managed by transarterial superselective embolisation of the feeding artery.

Renal arterial thrombosis can occur due to lesion of the intima of the renal artery after clamping of the vessel during surgery. This complication needs immediate reoperation for correction but is mostly only recognized later during follow-up and by then irreversible.

There are no randomized studies to compare the complication rates after nephron sparing surgery and after radical nephrectomy. The complications mentioned above would only occur after nephron sparing surgery, while after radical nephrectomy bleeding in the renal fossa is the only event. A comparative retrospective study reported no significant difference in complications between radical and partial nephrectomy (14) but this will need further confirmation in a randomized study.

Complications occurring in nephron sparing surgery can be managed conservatively and are associated with minimal serious morbidity. The majority of these complications can be managed nonoperatively or endourologically.

The patients that are offered nephron sparing surgery must have a clear understanding of the need of a strict follow-up schedule after surgery. As in patients with a solitary kidney or bilateral tumors, those who undergo partial nephrectomy need close monitoring of the renal remnant in order to detect local or contralateral recurrence. In case of local recurrence either because of tumor persistence or because of relapse elsewhere in the kidney secondary to multifocality, a second surgical treatment can be performed with a high probability of success.

There is no consensus on which laboratory and imaging studies should be performed to assess patients after partial nephrectomy. Since partial nephrectomy is not yet standard treatment for renal cell carcinoma, the oncological follow-up should maybe be more extensive. Anyway, the follow-up could be tailored on the pathological findings. Recent retrospective studies have shown that a symptom history, serum liver function studies and chest radiographs obtained every 6 months for the first 3 years and then yearly thereafter are sufficient measures to monitor these patients. It was suggested that in T1 disease only a symptom history is necessary (46,47). Further investigations by bone scan or CT of the brain or abdomen are considered to be warranted only in cases in which a carefully obtained relevant history and physical examination reveal any suspicious finding. Although this very minimal follow-up schedule might be reasonable we believe that patients should be subjected to a more comprehensive work-up and recommend ultrasound of both kidneys at 3-monthly intervals in the first year following surgery and at 4-monthly intervals during the second and third year together with a yearly contrast enhanced CT scan. The oncologic follow-up is continued lifelong with yearly follow-up examinations, which are to include ultrasound and/or CT scan.

CONCLUSIONS

Although some urologists still feel reluctant to offer a nephron sparing surgery to patients with small kidney tumors recent reports on the use of this approach indicate that it is becoming a more and more accepted treatment modality in properly selected cases even in the presence of a normal contralateral kidney. In experienced hands nephron sparing surgery has now been proven to be feasible and is curative in most if not all carefully selected patients with renal cell carcinoma. The selection of suitable candidates is the most important key to a successful outcome. It becomes imperative to study eventual differences in quality of life between patients that have undergone partial or radical nephrectomy.

There is no size limit for nephron sparing surgery and in an elective indication one should not take any risk concerning the surgical margins. The tumor must whenever possible be resected within a margin of healthy parenchyma. The patients must be well informed. Under these circumstances, a considerable group of patients will benefit from conservative surgery for renal cell carcinoma even in the presence of a normal contralateral kidney. In order to establish the role of this approach a randomized trial is being conducted by the Genitourinary Group of the European Organization for Research and Treatment of Cancer (EORTC) in collaboration with other North American Collaborative groups.

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