Renal Biopsy

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20.1 Introduction

The development of renal biopsy is tightly bound to the birth of nephrology. This specialty did not stem from internal medicine and the study of kidney diseases was mainly an interest of physiologists. The performance and interpretation of renal biopsy were, along with the introduction of dialysis and transplantation, major drivers in determining the emergence of nephrology as a specialty in the 1960s.

The history of the renal biopsy is very interesting. It is difficult to identify who actually performed the first biopsy, as this depends on the definition of biopsy (e.g., open, closed) and/or on the indication (e.g., as part of another procedure or as a goal in itself). The importance of renal pathology in nephrology, taking advantage of renal biopsy, was underlined in 1951 by Iversen and Brun in Copenhagen in a study of 42 patients dialyzed for acute renal failure as the underpinning cause (amyloidosis, diabetic nephropathy, hypercalcemia, and chronic glomerulonephritis) was identified and treated while awaiting the recovery of diuresis [1]. In this study, the biopsy was performed with patients in sitting position; intravenous pyelography was performed to visualize the lower right pole and the needle used (length 180 mm, diameter 1.9 mm) was connected to a syringe that was taking off a core piece of kidney by vacuum section, but the adequate tissue was obtained only in 53% of biopsies. A minimum of bleeding complication of transient gross hematuria was reported. In 1954, Kark and Muehrcke in Chicago modified the procedure by placing the patient in the prone rather than in the upright position with a pillow under the abdomen to lift up the right kidney to avoid the spleen [2]. They used an exploring needle to localize the kidney prior to the insertion in blind approach of a biopsy needle, the Franklin modified Vim-Silverman needle, a precursor of the needle used today. The renal tissue was trapped in the needle and then sheared off obtaining a success rate in 96% of biopsies and no major complication was reported. The anatomical landmarks of percutaneous renal biopsy were the XII rib, the ilium (iliocostalis angle), and the spinous apophysis of lumbar vertebra. Intravenous pyelography was

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used to detect the lower pole of the kidney and the measurements were transferred back to the patient. Furthermore, a magnifying glass was used to observe the presence of glomeruli and to increase the efficiency of the technique.

In 1957, in Italy Dr. Bonomini faced several difficulties in introducing renal biopsy into clinical practice because it was still considered too risky for the patient, and yielding unreliable results. Indeed, the judging committee stated that percutaneous renal biopsy was too dangerous and ethically unacceptable when the book "*La biopsia renale percutane*a" by Leonardi and Ruol was presented for a prestigious Italian medical award [3].

In 1960, at the first meeting of the International Society of Nephrology in Evian and Geneva, several papers discussed about renal biopsy. In March 1961, in the United Kingdom, an influential CIBA Foundation Symposium on "Renal Biopsy, Clinical and Pathological Significance" marked the advent of this technique.

In the following years, ultrasound, the imaging technique with the lowest associated risk, was used to localize the lower pole of the kidney, and it has been since then widely adopted and improved. Recently, the application of molecular biology techniques in the analysis of renal biopsy has allowed a better definition of the pathogenesis of renal diseases and has opened new avenues to identify targeted therapies. On the other hand, renal biopsy is a "*conditio sine qua non*" for the correct diagnosis of acute and chronic renal diseases which key aspects can be summarized as follows. The procedure provides diagnosis and modifies the clinical diagnosis in 25–50% of cases. The histological diagnosis guides treatment by describing the reversibility and activity of lesions and may change the therapy in 30–40% of patients. Furthermore, the renal biopsy predicts prognosis by assessing specific pathologic features and the extent of changes and also validates outcomes when used as an endpoint in clinical trials.

20.2 Indications for Renal Biopsy

In clinical practice there are numerous indications for renal biopsy. In the presence of acute kidney injury and increased serum creatinine, renal biopsy may be indicated if the ultrasound imaging does not show a reduced kidney volume or there are no other contraindications. The presence of proteinuria at urine analysis is an indication for renal biopsy since it is usually a sign of increased permeability of glomerulus or of failure of tubular reabsorption (usually, it leads to low-level proteinuria). Proteinuria of 1–3 g/day is usually asymptomatic, while higher levels lead to nephrotic syndrome and edema. Nephrotic syndrome defined as proteinuria >3.5 g/day, hypoalbuminemia, edema, hyperlipidemia, and lipiduria is due to increased glomerular permeability to albumin and other plasma proteins and is a mandatory indication to biopsy in adults and in children with atypical features. The presence of hematuria, asymptomatic or symptomatic (gross hematuria), isolated or associated with subnephrotic proteinuria, is an indication to perform a renal biopsy, since it is usually a sign of glomerular inflammation and disruption of the glomerular basal membrane, especially when red blood cell casts are found in urine analysis. When hematuria is combined with acute renal failure and red cell casts, the term nephritic syndrome should be used.

Nephritic syndrome is characterized by hematuria, proteinuria, elevated serum creatinine, and loss of function due to decreased glomerular blood flow, hypertension, and edema for salt retention. Finally, renal biopsy should be performed when there is a renal involvement during systemic diseases (Table 20.1).

In case of transplanted kidney, any cause of allograft dysfunction that is not readily explained by pre-renal or post-renal causes will usually prompt a biopsy.

20.3 Contraindications for Renal Biopsy

In advanced chronic kidney disease, renal biopsy is generally contraindicated, whereas in case of potentially reversible moderate dysfunction a renal biopsy can be taken into account. The absolute contraindication to perform a renal biopsy is generally the following: uncontrolled bleeding diathesis, uncontrolled severe arterial hyperten-

Table 20.1 Common indications for biopsy of native and transplanted kidneys

Native	Nephrotic syndrome
	Proteinuria >1 g/day (unless likely diabetic nephropathy)
	Hematuria of likely renal origin with additional evidence of glomerular disease
	Suspected multisystem disease (e.g., ANCA vasculitis, SLE, cryoglobulinemia)
	Suspicion of "intrinsic" renal disease: renal impairment or active urinary sediment (e.g., glomerulonephritis or tubulointerstitial nephritis with urine dipstick abnormalities)
	Assessment of response to therapy (e.g., following immunosuppression for glomerulonephritis)
Transplant	Unexplained allograft dysfunction
	Assessment of therapy response (e.g., following treatment of rejection)
	"Protocol" biopsy in patients at high risk of rejection

Table 20.2 Contraindications

Absolute	Anticoagulant therapy or coagulopathy (unless supported by clotting factor transfusion)
	Hypertension >160/90 mmHg
	Morbid obesity
	Platelet count $<50 \times 10^9$/L (unless supported by platelet transfusion)
	Polycystic kidney disease
	Acute kidney infection
	Hydronephrosis
Relative	Other bleeding diathesis (including uremia)
	Antiplatelet therapy within 7 days
	Single functioning native kidney
	Small, scarred kidneys (typically <9 cm in bipolar length)
	Uncooperative patient

sion, solitary kidney, multiple renal cysts, renal mass or renal neoplasm, acute pyelonephritis and perinephric abscess, end-stage or near-end-stage kidney disease with small kidneys, patients unable to cooperate, obese patients, or patients with respiratory difficulties (Table 20.2).

However, the list of contraindications needs to be evaluated in each case. Indeed, the approach in high-risk patients has changed rapidly, as new techniques develop and a consensus statement is necessary. The same contraindications reported for the native kidney are valid for the transplanted kidney.

20.4 Equipment

Equipment includes drapes, disinfectant sponges, gauze pads, blade scalpel 11, anesthetic syringe, 10 mL of 1–2% lidocaine anesthetic solution, and automatic spring-loaded biopsy gun (with 14/16 gauge [4] and 15/19 cm long needle with a penetration depth of 22 mm and sample notch of 18 mm) but some (although not all) studies indicate lower yield with smaller (18-gauge) needles [5, 6]. Other factors, such as patient characteristics (e.g., kidney size) and operator experience, may also affect diagnostic yield. Sterile gloves, eye protection, gown, surgical cap, mask, spinal anesthesia needle (22 G × 120 mm), needle guide sterile kit, and full-size sterile drape are also required (Fig. 20.1). Ultrasound machines with convex array, high resolution, and Doppler schedule are preferred for this procedure. Additional equipment needed is the following: sterile transduction gel, acoustically transparent sterile transducer sheath, software with marks of guide with an inclination of 20–30°, and sterile rubber bands or clips to secure the sheath around the transducer.

20.5 Preparation of the Patient

The evening before the procedure the patient should have a light meal and an enema should be administered. On the morning of the biopsy, the patient must be fasting. Any antihypertensive drugs should be regularly given. A peripheral vein must be cannulated and blood pressure should be measured. The bladder must be emptied. Although kidney biopsy is very important for diagnosis, prognosis, and appropriate therapy, the risk/benefit ratio must always be assessed, especially for bleeding complications.

A successful procedure depends on patient-related factors, such as a thorough preparation of the patient, clinical, laboratory, and instrumental monitoring post-procedure and procedure-related

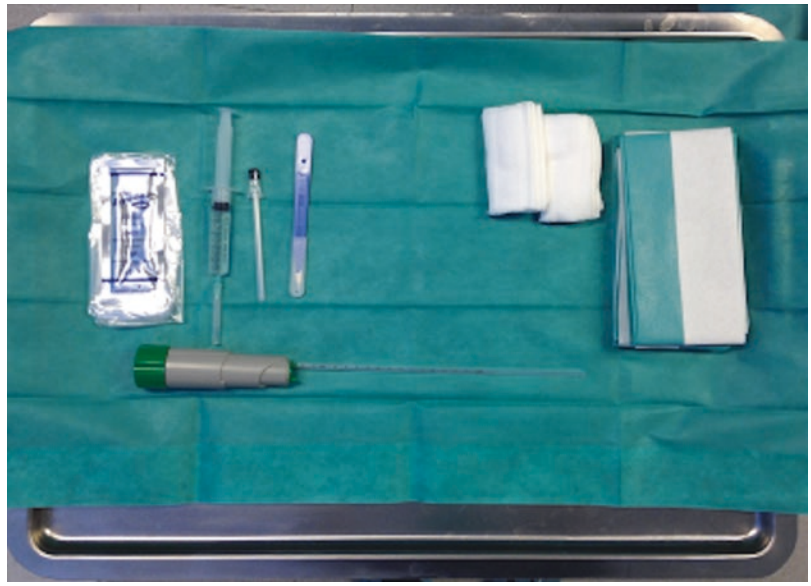

Fig. 20.1 Complete kit to perform renal biopsy: sterile gloves, gown, surgical cap, spinal anesthesia needle, needle guide sterile kit

factors, for example adequacy of specimen-handling techniques, consensus approach on clinical indications, and experience of the operator.

A first question in clinical practice is about choosing whether to perform the renal biopsy on inpatients or outpatients.

Shortening the after-biopsy observation period (e.g., outpatient management or 6–8-h monitoring) may reduce the safety of procedure.

However, a study has shown that complications occur in 89% of patients within a 24-h period. Therefore, after biopsy, an observation up to 24 h remains optimal, but since 11% of major complications occur after 24 h, some patients may require a longer period of hospitalization [7].

The prerequisites of procedure are focusing on medical history and examination of the patient, ultrasound evaluation of the kidneys (form, size, and cortical thickness), bleeding time, and laboratory data such as hemoglobin, platelets, prothrombin time, partial thromboplastin time, blood group, and sometimes dosage of von Willebrand factor and lupus anticoagulant. A specific test has not been established that can select patients with a major risk of post-biopsy bleeding and the impact of bleeding time on the complication rate is controversial [8]. In the future, evaluating some measure of platelet function, through a platelet function analyzer (PFA-100), may have a role in predicting risk.

The alterations of coagulation parameters should be corrected prior to the renal biopsy depending on the cause: erythrocyte transfusion in case of anemia, infusion of coagulation factors (e.g., factor VIII) if plasma levels are reduced, or administration of desmopressin acetate (DDAVP, dosage of 0.4 μg/kg/intravenous or 0.3 μg/kg/subcutaneous) if bleeding time is prolonged.

All antiplatelet or anticoagulant drugs should be stopped. Antiplatelet agents should be withdrawn from 5 to 10 days before the biopsy, for warfarin and dicoumarol drugs 5 days of interruption is needed, while for novel oral anticoagulant drugs (e.g., apixaban, rivaroxaban, dabigatran) 1–2 days is enough.

During the withdrawal period, sodic heparin or low-molecular-weight heparins should be administered and interrupted 12 h before the renal biopsy.

The management of patients who have an elevated thrombotic risk is different. Those taking two drugs (aspirin plus clopidogrel) for recent (<6–12 months) angioplasty and coronary stents should stop clopidogrel 5 days before the biopsy maintaining the administration of aspirin; tirofiban, an antiplatelet agent characterized by short plasmatic half-life, should be introduced 3 days

before the biopsy and withdrawn 8 h before the biopsy. This approach presents an intermediate hemorrhagic risk but an elevated thrombotic risk; thus the patient should be monitored for 24 h after the renal biopsy in intensive cardiologic unit. A specific informed consent for cardiologic risk should be obtained.

As regards this crucial point attaining the risk management, an explicit informed consent, personally signed by a conscious patient and specific for the procedure of renal biopsy, should be obtained. The informed consent occurs in various steps; first, the physician who prescribed renal biopsy should inform the patient about the benefits deriving from a certain diagnosis and specific treatments. In the second step, the operator should describe the phases of the procedure, the possible complications, and the means to prevent and treat them.

Finally, the patient should confirm the consent or the refusal to procedure; for underage patient or the patient unable to understand, the physician should conform to the law of his/her country.

20.6 Position of the Patient

Kidney biopsy is usually performed in prone position (Fig. 20.2a). Lower pole of the left kidney is chosen to lower the risk of major hemorrhagic complications. If the patient is obese or has breathing difficulty, supine anterolateral position (SALP) may be more suitable (Fig. 20.2b). A recent study has shown that performing renal biopsy in SALP in obese patients ensures greater comfort and less breathing difficulties when compared to prone position, with no reduction in diagnostic yield or increase in complications [9].

20.7 Ultrasound Survey

A renal biopsy is typically performed by a suitably trained nephrologist or radiologist and ultrasounds are employed in both prebioptic and postbioptic phases.

20.7.1 Prebiopsy Ultrasound Study

Before performing the PRB, some recommendations are essential to reduce the risk of complications.

Prebioptic ultrasound study is essential to assess the presence of anatomical abnormalities of the kidney (e.g., presence of multiple cysts, hydronephrosis, solitary kidney) that may represent a risk factor for complications.

Prebiopsy renal study should be performed in the B-mode and with color Doppler (CD) in order

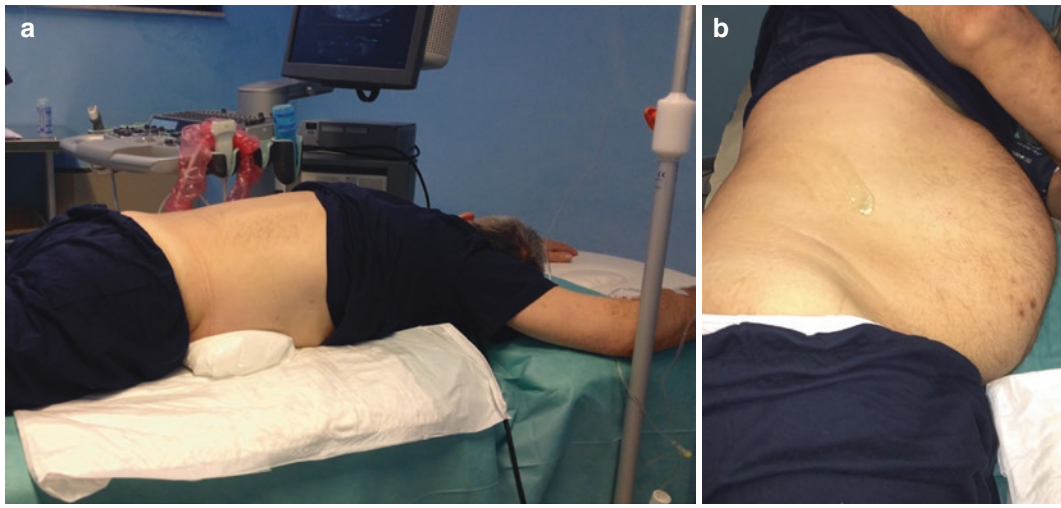

Fig. 20.2 Patient position. It is preferable to perform the biopsy with the patient in the prone position (**a**), if a patient is obese the supine anterolateral position is recommended (**b**)

to identify anomalous vessels that might be damaged by the needle during the procedure (Fig. 20.3), allowing the operator to choose the right kidney, when safer.

Anomalous vessels have been detected in about 10% of patients during the ultrasound study; complication rate appears to be reduced when color Doppler is performed [10].

Preparation of the patient needs an attentive medical history and examination, and renal ultrasound evaluation of form, size, and cortical thickness (Fig. 20.4). Furthermore, ultrasound guidance during the procedure allows the visualization of the biopsy needle and its path, with better performances than free-hand renal biopsy and a drastic reduction of the incidence of postbioptic complications, even in case of inexperienced operators [11].

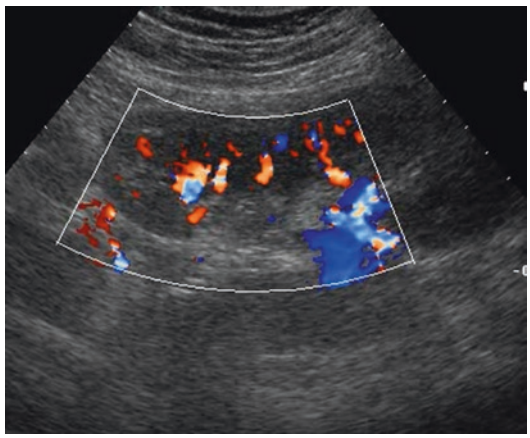

Fig. 20.3 Pre-biopsy evaluation. It is essential to evaluate renal vasculature with color Doppler to identify the presence of an abnormal vascularization

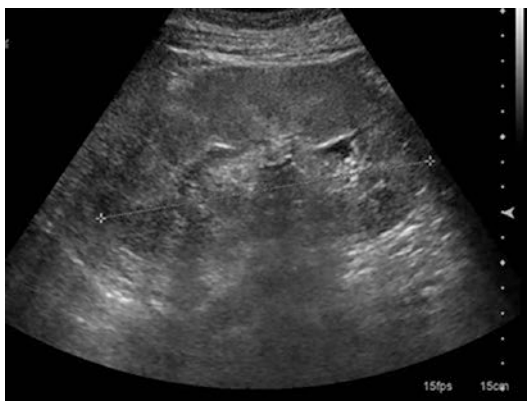

Fig. 20.4 Pre-biopsy evaluation. It is essential to evaluate the size of the parenchyma and the cortical thickness of the kidney

20.7.2 Procedure of Renal Biopsy

A rigorous algorithm describing the procedure step by step may increase the ratio of benefit/harm.

A meticulous preparation of the patient, including the informed consent, the biopsy technique, and the adequacy of management of the renal specimen, increases the benefits and provides diagnostic and therapeutic aspects. The reduction of risks depends on the operator's expertise and accurate clinical, laboratory, and instrumental postbioptic monitoring, even if the patient is asymptomatic.

In the clinical practice, renal biopsy may be performed on inpatients or outpatients. The most used is the eco-driven technique in prone position or, especially for obese patients, in anterior-lateral position (SALP).

The left kidney is preferred for the greater distance from the vena cava and the inferior pole for the greater and easier accessibility. The use of the lower pole compared to a mesorenal area, in addition to reducing the risk of damaging the vessels to the renal hilum, allows to sample more renal cortical tissue.

20.7.3 Performing the Biopsy in the Prone Position

The patient is placed in a prone position, possibly with a pillow under the abdomen in order to reduce the physiological dorsal lordosis and bring the kidney closer to the surface (Fig. 20.5).

The sterile field is prepared by disinfecting the skin region involved in the procedure and covering the remaining areas with sterile drapes. Operators must operate in sterile conditions. The ultrasound probe used during the biopsy procedure is usually a 3.5 MHz convex probe and it is covered with a suitable sterile probe cover; sterile gel is used. The preliminary ultrasound visualiza-

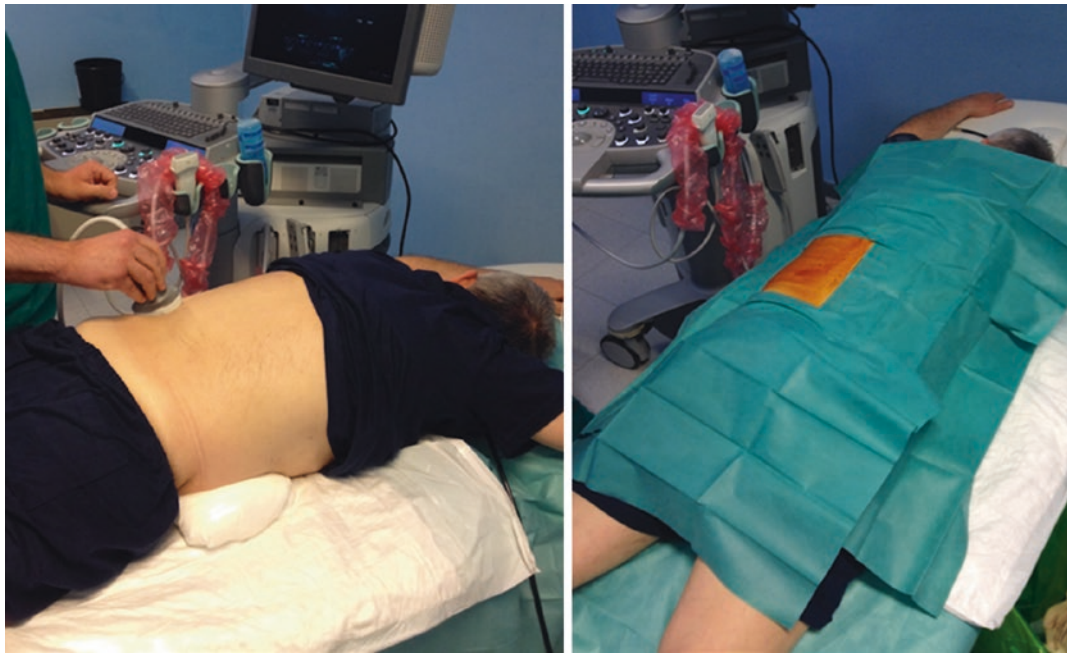

Fig. 20.5 To perform renal biopsy with prone patient, it is recommended to introduce a pillow under the abdomen to reduce the dorsal lordosis, thus bringing the kidney closer to the skin

tion of the lower pole of the left kidney is performed, assessing the most favorable trajectory for the introduction of the needle. The ultrasound device is programmed to highlight on the monitor the trajectory of the needle, and the probe is equipped with a needle guide.

We proceed to local anesthesia. Sometimes a skin incision may facilitate the entry of the needle to reach the kidney.

Under ultrasound guidance, the biopsy needle is introduced with an inclination of about 20° or 30° through the subcutaneous tissue, the muscular planes, and the fascia, until it stops immediately above the renal capsule (Fig. 20.6). A color box is placed to evaluate the presence of anomalous vessels. In the presence of abnormal vessels, the operator chooses whether to change trajectory to avoid them or to perform renal biopsy at the lower pole of the contralateral kidney.

Renal biopsy should be performed in B-mode.

In this phase, the collaboration of the patient is fundamental, who must maintain a short-time apnea in order to avoid displacement of the kidney simultaneous to the respiratory acts.

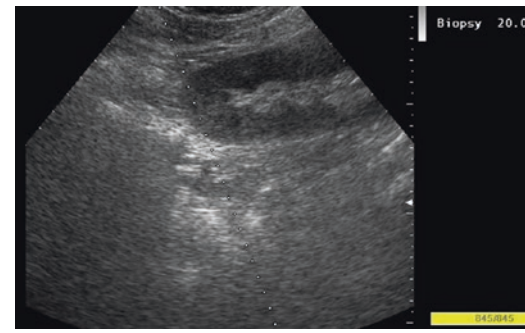

Fig. 20.6 The inclination of the biopsy needle must be about 20°–30°; it must cross the subcutis, the muscles, and the fascia and stop above the renal capsule

When the optimal position is reached, the needle is on the renal capsule, the patient is immobile, and the automatic needle is triggered, thus activating the descent of the mandrel at first and, then, of the shirt, imprisoning the sample.

The needle is extracted from the kidney and the biopsy sample is removed, and deposited on a gauze soaked in physiological solution or in a sterile container containing physiological solution.

Generally, two or three samples should be taken and evaluated by stereoscopic microscope to check the presence of cortical tissue and an adequate sampling of glomeruli.

Finally, a compression on the wound for 5–10 min and an ultrasonography check after 60 min should be done. In this phase, an early complication could be detected.

A further ultrasound and CD check are performed to exclude hemorrhagic complications and/or hemodynamic alterations (e.g., AVF) after the procedure.

The patient is transferred to the hospital bed, taking care to avoid sudden and supine movements. In this way the compressive and hemostatic effect of abdominal pressure is exploited.

During the post-procedure period, the patient is recommended bed rest in supine position for at least 24 h and blood pressure and arterial pulse are monitored; if necessary, hemoglobin and hematocrit are monitored every 4–6 h. The first postbioptic urine sample should be examined for macroscopic hematuria.

An ultrasound check should be done 24 h after the biopsy. Until that moment, the patient must rest in a supine position.

Good communication with the patient is essential for the entire duration of the procedure, since its collaboration is a necessary condition for the success of the biopsy and for the minimization of risks.

In developed countries numerous renal biopsies are performed in obese patients who have a high risk for bleeding complications, severe respiratory difficulties, and poorer ultrasound visualization of the kidney. Some technical precautions have been proposed in these high-risk patients, including computerized tomography guidance, laparoscopic renal biopsy, and trans-jugular biopsy.

However, computerized tomography guidance does not prevent the respiratory difficulties associated with the prone position, while laparoscopic renal biopsy, although safe and effective, requires general anesthesia and lengthy recovery times. Finally, trans-jugular renal biopsy is more invasive than percutaneous biopsy and yet is associated with a lower diagnostic yield due to the fact that the cortex is more distal.

20.7.4 Performing the Biopsy in the Supine Anterolateral Position (SALP)

This technique can be used in obese patients (BMI >30) to avoid some inconveniences, such as poor respiratory compliance for the prone position, deeper position of the inferior renal pole, and difficulty for some to maintain the same position for a long time. This technique has a significantly lower complication rate than the prone position and has excellent diagnostic power with a better compliance of the patient.

In the SALP position a towel is placed under the ipsilateral shoulder and gluteus to raise the hip by an angle of 30°. The ipsilateral arm is placed over the head of the patient while the contralateral is abducted and used for intravenous perfusion. The ipsilateral leg is slightly flexed over a pillow and the contralateral one is flexed and abducted. This position provides full exposure of Petit's triangle, thus providing enough space to perform ultrasound scanning and to easily orientate the ultrasound-guided puncture toward the inferior renal pole. After shaving and draping the chosen area, an ultrasound check of the kidney is performed to determine the ideal trajectory of the needle. The identification of the lower kidney pole with ultrasounds is easy and the quality of image resolution is high. After local anesthesia, an automatic needle is ultrasound guided to the capsule on the lower pole of the kidney and fired into the renal parenchyma.

20.8 Percutaneous Renal Transplant Biopsy

The biopsy of transplanted kidney is usually easier to perform, since the graft is more superficial and easier to reach.

The graft is located on the anterior part of the lower abdomen, in the pelvis. It lays over the ilio-

psoas muscle and it is retroperitoneal (in case of multiple transplants, its position may be intraperitoneal).

The patient is in supine position, and the biopsy is performed after B-mode and color Doppler ultrasound study.

About the preparation of the patient, there is no difference from the biopsy of native kidney. The chosen spot is usually the upper pole of the graft, to reduce major vascular complications (damaging principal vessels of the kidney, very close to the lower pole).

In case of suspect of rejection, biopsy of different spots of the kidney is necessary, since inflammatory lesions may have a heterogeneous distribution.

20.9 Monitoring

The observation time of the patient after renal biopsy must be at least 12 h (33% of complications occur after 8 h), although monitoring the patient for more than 24 h would be safer since the complication rate within 24 h is about 91% [7].

During this period, the patient must remain enticed. In case of low back pain, abdominal pain, or sudden pressure drop it is necessary to repeat immediately a blood count and, when possible, a Doppler ultrasound and a CT scan.

Hourly monitoring of blood pressure is needed during the 6-h period after the procedure.

A check of the hemoglobin value should be performed after 4–6 h and after 24 h the renal biopsy.

A color Doppler study must be performed on the following day. The patient should be resting at home for 7 days, averting car trips and physical activity for 2 weeks.

A study involving a remarkable number of patients found that 91% of major complications occurred within 12 h of PRB, with 7.4% occurring between 12 and 24 h and 1.85% occurring after 24 h [12].

Discharging uncomplicated outpatients after a 24-h observation period after renal biopsy would be the safest choice.

20.10 Complications

Few systematic data exist to estimate the complication rate of kidney biopsy, although recently many studies have been focusing on invasive procedures (e.g., thoracentesis, central venous catheter insertion, and liver biopsy).

When evaluating whether to perform a renal biopsy, benefit/risk ratio should be weighed out.

The standard procedure for kidney biopsy involves the use of ultrasounds and an automated spring-loaded biopsy device that may be associated with lower rates of procedural complications.

Bleeding complications include asymptomatic hematomas (Fig. 20.7a, b) detected only by

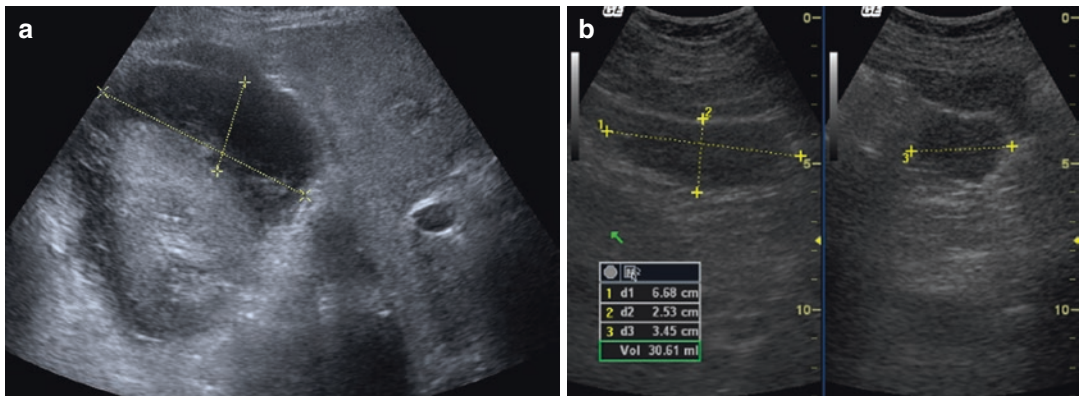

Fig. 20.7 Post-biopsy complications: hematomas could be symptomatic (**a**) or asymptomatic (**b**)

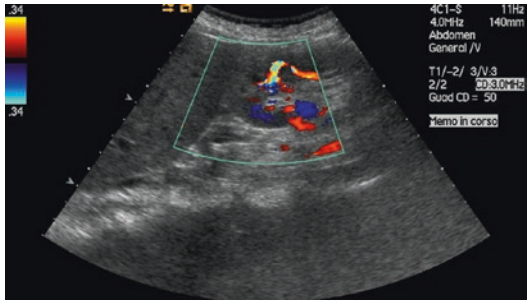

Fig. 20.8 Post-biopsy complications. FAV is often small and does not require angiographic intervention

post-biopsy ultrasound study, macroscopic hematuria, blood loss requiring erythrocyte transfusion, arteriovenous fistula (Fig. 20.8), and, rarely, complications that require angiographic intervention or nephrectomy.

A rare complication is the page kidney, caused by a large hematoma in the perinephric or subcapsular space resulting in extrinsic compression of the involved kidney, renal ischemia, activation of the renin-angiotensin-aldosterone system, and systemic hypertension [13].

Early ultrasonography performed immediately after the procedure and 1 h after the biopsy was clinically helpful in predicting the risk of major bleeding complications [14, 15].

On the other hand, a systematic use of color Doppler ultrasonography in monitoring patients after a renal biopsy is crucial for an early diagnosis of post-procedural arterio-venous fistula [16].

There is no consensus, among different studies, about the incidence of complications associated with kidney biopsy and their possible predictors, because of the presence of some biases (e.g., definition of complication, patient enrollment, procedural technique, and monitoring protocols) [7, 8].

The occurrence of post renal-biopsy bleeding complications has been systematically evaluated in a cohort of 471 patients who underwent real-time ultrasound-guided automated percutaneous renal biopsy in our single center [8].

The incidence of post renal-biopsy bleeding complications detected by systematic ultrasound and clinical examination was relatively high (34.1%), although bleeding complications were generally not relevant; only 1.2% required interventions for major complications (two cases of arterio-venous fistulas and four large hematomas). Two out of six patients required blood transfusions for relevant hemoglobin reduction and cardiovascular instability, hypotension, and tachycardia. Three patients underwent angiographic evaluation of the bleeding and Gelfoam trans-arterial catheter embolization of the lesion; one only patient underwent a surgical nephrectomy.

Clinical symptoms (discomfort or lumbar pain) were present in only a small part (2.5%) of the cohort. After evaluating several demographic, clinical, laboratory, and needle-related indicators, only gender, age, and baseline partial thromboplastin time were found to be significantly predictive of the risk of post-bioptic bleeding. This risk was greater in women and patients with higher baseline partial thromboplastin times, while, paradoxically, in older patients the risk of post-biopsy bleeding complications was significantly lower [8].

However, a phase IV randomized controlled trial on 162 patients has shown that treatment with desmopressin acetate decreases the risk of bleeding after a renal biopsy and reduces hematoma size in patients without coagulation defects [17]. Desmopressin is a synthetic derivative of vasopressin that exerts its hemostatic effects by increasing the levels of von Willebrand factor and factor VIII.

Post-biopsy bleeding was significantly less common in desmopressin-treated patients than in placebo-treated patients (13.7% vs. 30.5%, respectively). Among the 36 patients who experienced bleeding, the median hematoma size was 208 mm^2 versus 380 mm^2 in patients receiving desmopressin and placebo, respectively. Mean hospitalization duration was 1 day shorter in desmopressin-administered group than in the control one, which led to considerable cost savings. No other differences were found between the two groups in terms of secondary outcome results. The treatment caused no serious adverse events, and there were only mild side effects in three patients (a transient and nonrelevant tachycardia).

In a recent systematic review and meta-analysis, the authors aimed to evaluate the incidence of hemorrhagic complications (macroscopic hematuria and need for erythrocyte transfusion) after ultrasound-guided biopsy with automated spring-loaded biopsy device, in order to identify potential risk factors for bleeding complications [18]. Including 34 publications for the analysis was an important limitation of the review; only one of these was a randomized controlled trial, 13 studies were prospective, and 20 were retrospective. The rate of macroscopic hematuria was 3.5% and erythrocyte transfusion was 0.9%.

Significantly higher rates of transfusion were seen when using 14-gauge needles, serum creatinine level >2.0 mg/dL, female gender, acute kidney injury, mean age of 40 years or older, and mean systolic blood pressure greater than 130 mm Hg.

In conclusion, the risk of hemorrhagic complications is relatively low when the renal biopsy is ultrasound guided and performed with automated biopsy needles. However, in order to improve patient safety, the use of large-gauge needles (14 gauge) should be discouraged.

Since the prognostic value of potential risk factors is debatable, the search for more sensitive tests to assess coagulation disorders and better identify patient and procedural characteristics requires more studies in order to perform biopsy safely.

Finally, the use of desmopressin should be considered, since the only randomized controlled trial included in this review demonstrates the risk reduction of bleeding complication. This drug should be administered cautiously in patients with high thromboembolic risk.

20.11 Conclusion

The advent of ultrasound methods in interventional procedures has drastically reduced complications, especially when performing renal biopsy. This procedure, if performed by trained physicians, has a high success rate and few complications. Renal biopsy is essential for diagnosis and prognosis and nephrologists should train their fellows in order to perform renal biopsy safely.

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