Percutaneous renal biopsy

Introduction

Percutaneous renal biopsy allows a small sample of kidney tissue to be obtained via a relatively minor procedure. Subsequent histological analysis of this tissue can help with making the diagnosis, providing prognostic information and guiding the management of many renal diseases, both in native and transplanted kidneys. In fact many renal conditions are classified on the basis of the histopathological appearances seen in biopsy samples (*Figures 1* and *2*). The diagnostic potential of a renal biopsy has also increased with advances in immunofluorescence and electron microscopy.

There is no doubt that a biopsy is extremely useful. Nevertheless, the morbidity and occasional mortality associated with this procedure requires careful evaluation of the risk:benefit ratio for each patient. In some cases where there are anatomical variations or bleeding disorders, the transjugular route or an open surgical biopsy can also be considered.

Figure 1. Normal glomerulus – haematoxylin and eosin stain (x 400).

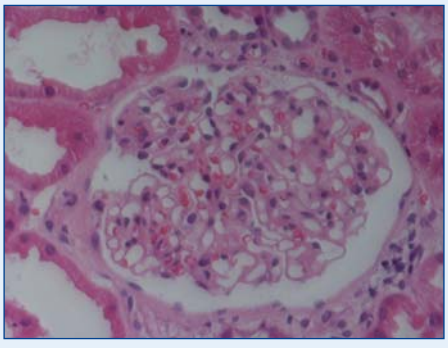
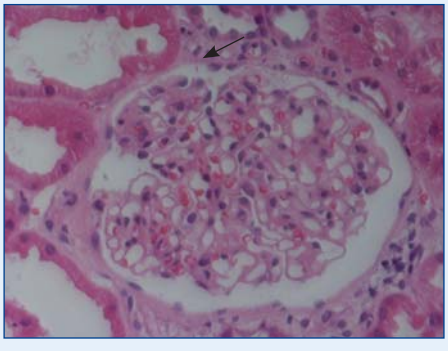


Figure 2. Abnormal glomerulus. Silver stain showing mesangio-capillary glomerulonephritis type I and a crescent.



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Indications

The indications for renal biopsies vary among clinicians. This is determined in part by the presenting history and clinical features. The differences in biopsy rates seen across centres are not driven by any different spectrum of diseases, but by opinions about how the procedure will alter management. In transplant units, transplant biopsies far exceed native biopsies. In up to 60% of cases the biopsy result will impact patient management (Cohen et al, 1989; Pfister et al, 1999). The decision for a patient to undergo a renal biopsy should ideally be made by a nephrologist.

Less controversial indications for renal biopsy include (Fuiano et al, 2000):

1. Unexplained or unresolving acute kidney injury
2. Acute nephritic syndrome
3. Significant proteinuria (>1 g/24 hours) with or without haematuria unless there is a history of diabetes mellitus and associated complications, e.g. retinopathy
4. To define renal involvement in systemic conditions, e.g. systemic lupus erythematosus
5. Progressive chronic kidney disease where it is felt that it may alter management or provide useful prognostic information
6. Renal transplant dysfunction in the absence of obstruction or infection.

Contraindications

1. Obstructed system
2. Polycystic or horseshoe kidney
3. Renal masses, such as tumours, should only be biopsied by a radiologist under direct vision, by ultrasound, computed tomography scanning or by open surgical biopsy
4. Solitary (or solitary functioning) kidney – except for transplants
5. Uncontrolled hypertension or coagulation defects – aim to correct before biopsy
6. Chronic renal failure and bilaterally small, shrunken kidneys (<8 cm). There is an increased risk of bleeding and a reduced chance of useful diagnostic information being obtained
7. Acute pyelonephritis – there is a risk of developing a perinephric abscess.

Pre-biopsy evaluation

A renal ultrasound should be obtained beforehand to rule out obstruction, assess kidney size, and define the presence of any anatomical abnormalities.

In hypertensive patients, adequate control should be achieved using antihypertensive agents. In the elective setting a blood pressure of 140/90 mmHg or below is generally considered acceptable.

Laboratory investigations that should be ordered before a biopsy include a full blood count, coagulation screen, group and save, and renal function. Bleeding time is not routinely carried out in all centres, although it may be the best indicator of haemostasis in patients with significant renal dysfunction. The bleeding time takes into account platelet function, which can be altered in uraemia. Desmopressin increases factor VIII activity in uraemic patients and is administered (0.3 mg/kg body weight) before biopsy in patients with significant renal dysfunction (e.g. creatinine >200 mmol/litre), although there are no trials confirming that its use reduces the risk or severity of bleeding.

Antiplatelet agents should ideally be discontinued 7–10 days before the procedure and any coagulation disorders corrected.

Written informed consent needs to be obtained, ideally via a two-stage process. The patient should specifically be asked about any possible allergies to local anaesthetic agents or skin cleaning solutions.

Technique

The procedure should only be carried out by a clinician with adequate experience or under the supervision of such a person.

Peripheral venous access should be obtained and the patient should empty his/her bladder before the procedure. A

trolley with all necessary equipment is then prepared (*Table 1*).

The procedure is usually performed with the patient in the prone position. A pillow or rolled sheet is placed under the abdomen to compress the upper abdomen and lower ribs. If the patient is pregnant or very obese, the biopsy can be performed in the seated or lateral decubitus position.

Under real-time ultrasound guidance, the native kidneys are visualized. The lower pole of the left kidney is usually biopsied as this is furthest from the major vessels and most easily accessible. The kidneys moves up and down with respiration, and the biopsy is undertaken when the patient holds his/her breath in inspiration.

Using ultrasound guidance, an appropriate point on the skin above the kidney is marked. The surrounding area is cleaned and drapes applied to obtain a sterile field. Local anaesthetic is injected subcutaneously, and subsequently deeper along a track towards the kidney. Ideally the spinal needle is used to infiltrate anaesthetic just above the capsule.

A small skin incision is made to facilitate the passage of the biopsy needle. The needle tip is then passed under direct vision to the renal capsule and the biopsy is taken from the lower pole. The sample obtained is checked under a dissecting microscope to confirm the presence of cortical tissue.

The aim of the biopsy is to get two cores of renal cortex which is the amount required to allow appropriate histological analysis. The gauge of the needles used can vary, with larger gauge needles obtaining more tissue but at the expense of increasing the risk of complications. The introduction of fully automated needles (often termed biopsy guns) has allowed smaller gauge needles to be used without an increase in inadequate sampling. Most centres now use 16-gauge needles.

For renal transplant biopsies, the patient is placed in a supine position as the transplant is usually placed in the right or left iliac fossa. Either the upper or lower pole can be biopsied.

Table 1. Equipment

Ultrasound machine with concave probe
Local anaesthetic, e.g. 1 or 2% lignocaine
10 ml syringe
21 and 25 gauge needles
19 gauge spinal needle
Sterile ultrasound gel
Scalpel
Probe sheath
10 ml 0.9% saline
14 or 16 gauge biopsy needle or automated gun
Skin cleaning solution, e.g. chlorhexidine
Gauze
Sterile drape, gown and gloves

Post-biopsy care

For both native and transplant biopsies, the patient should remain supine for 4–6 hours. The length of time for bed rest varies from centre to centre. As bleeding is the main risk, vital signs are closely monitored. For native biopsies, the kidney, which is a retroperitoneal organ, will be compressed by overlying bowel. This will reduce the risk of bleeding. There is no such compressive mechanism for transplants. At 6 hours if the patient passes urine with no macroscopic haematuria, the observations remain stable and there is no significant pain, the patient can safely mobilize. In the authors' centre patients are discharged on the same day, while in other centres, patients are kept in overnight.

Complications

Bleeding

The kidney receives 20–25% of the cardiac output, so bleeding is the major complication. Post-biopsy scanning has shown that the vast majority of patients develop a peri-renal haematoma, which is usually asymptomatic.

Historically, the quoted risks from a biopsy are described in *Table 2*. Ideally an operator should quote risks based on audited local practice. Eiro et al (2005) reported that most complications occur with the first 24 hours.

Over time there has been a reduction in the need for surgery and rate of death following a renal biopsy (Mendelssohn and Cole, 1995). This is in part a result of the introduction of real time ultrasound guidance and automated needles. The need for surgery has been reduced with increased availability of angiography and embolization of bleeding vessels.

Haemorrhage is more likely to occur in patients with uncontrolled hypertension, hereditary or acquired coagulation disorders, renal amyloid, polyarteritis nodosa and those taking anticoagulants or antiplatelet agents.

Macroscopic haematuria can lead to colic and obstruction as a result of clot formation. Urinary catheterization may be required.

If there is significant blood loss, a blood transfusion may be necessary.

Page kidney

A subcapsular haematoma causes pressure-induced ischaemia. This leads to chronic hypertension as a result of persistent activation of the renin–angiotensin system. This can be corrected by evacuating the haematoma.

Arteriovenous fistulas

In such cases a fistula forms as a result of damage to walls of an adjacent artery and vein. These are normally clinically silent and resolve spontaneously over 1–2 years. Symptomatic fistulas cause haematuria, hypotension and high-output cardiac failure. These are now rare. Diagnosis can be established with colour Doppler ultrasonography (Harrison et al, 1994). If fistulas remain symptomatic or there is significant graft dysfunction they

Table 2. Biopsy complications and historical incidence

Risks	Incidence (%)
Transient microscopic haematuria	Almost 100%
Transient macroscopic haematuria	10
Drop in haemoglobin requiring transfusion	1
Renal angiogram and embolization	0.1
Partial nephrectomy	0.01
Nephrectomy	<0.01

can be embolized. However, embolization can only be undertaken at larger calibre intrarenal arteries. This can lead to loss of a significant proportion of kidney tissue.

Peri-renal infection

This has been reported in up to 0.2% of cases (Parrish, 1992). This is most often seen in the presence of active parenchymal renal infection (pyelonephritis).

Rarely, puncture of other organs such as spleen, liver or pancreas may occur.

Conclusions

Percutaneous renal biopsies are a useful aid in management of renal disease. They should be undertaken by skilled operators. Complications can be minimized by appropriate pre- and post-biopsy care. BJHM

Conflict of interest: none.

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KEY POINTS

- Renal biopsy can provide useful information for the diagnosis and management of renal disease.
- The decision to biopsy requires assessment of the risk:benefit ratio in each individual case and is ideally made by a nephrologist.
- The main risks are of bleeding complications which can be minimized with careful preoperative assessment.
- Advances including the use of real-time ultrasound, automated needles and interventional radiology have reduced the risks of major complications.