

Clinical Study

Does Systematic Preliminar Colour Doppler Study Reduce Kidney Biopsy Complication Incidence?

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While ultrasonography is widely performed prior to biopsy, colour Doppler examination is often used only to discover post-biopsy complications. Aim of this paper was to evaluate the usefulness of colour Doppler examination in planning the optimal site of puncture for renal biopsy. Present analysis includes 561 consecutive percutaneous renal biopsies performed from the same operator. Until August 2000 332 biopsies were performed after a preliminary ultrasonography (Group A). From September 2000, 229 patients underwent even a preliminary colour Doppler study (Group B). Postbioptic bleeding were categorized as minor (gross hematuria or subcapsular perinephric hematoma < 4 cmq of greater diameter) or major (hematoma > 4 cmq of greater diameter; requiring blood transfusion or invasive procedures; leading to acute renal failure, urine tract obstruction, septicemia, or death). Major complications were seen in 2.1% in Group A while in Group B only one case was reported (0.43%). Minor clinically significant complications occur in 7.8% in Group A and in 3.4% of cases of Group B. Colour Doppler reduced drastically the incidence of complications observed before the introduction of routine colour Doppler examination prior to biopsy. In our opinion, these data support the use of preliminary colour Doppler study when a biopsy is planned.

1. Introduction

Percutaneous renal biopsy has become an essential tool in the diagnosis and treatment of patients with renal disease, and although less invasive, it is fraught with potential complications. Introduction of realtime ultrasound and automated biopsy needles increased quality of specimens and dramatically reduced the incidence of biopsy-related accidents [1–4]. Nonetheless, the potential for serious complications still remains. On average, clinically significant complications occur in 7.4% of cases, but also complications rates as high as 19.5% have been reported [1]. Many variability in complication incidence attains certainly to operator experience, but it is our opinion that a part of

this heterogeneity is linked to the attention paid in planning correctly the optimal site of puncture, in order to avoid undesired puncture of anomalous vessels.

While preprocedural ultrasonography is in fact widely used to assess the anatomical landmarks of the kidney and to exclude anatomical conditions considered as absolute contraindications, to date, power and colour Doppler (CD) examination are used less frequently in this setting, if not only to discover postprocedural complications.

In our experience, anomalous perirenal vessels were present in many biopsies complicated by renal bleeding.

In our Department, until August 2000, we performed a total of 332 biopsies, using B-mode ultrasonography, only occasionally integrated by CD study, in planning procedures.

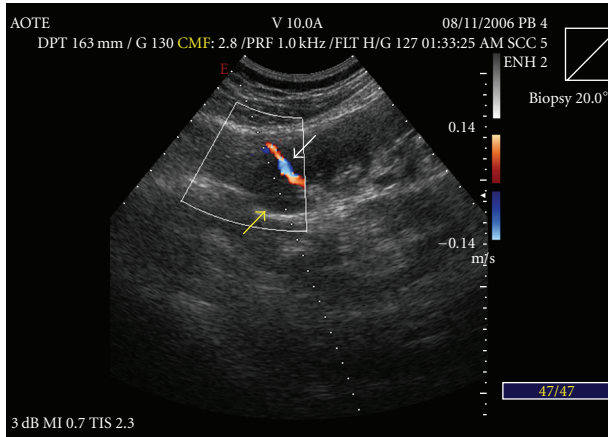


FIGURE 1: Colour Doppler US examination discloses perforant artery (white arrow) at the inferior pole of left kidney (yellow arrow).

From September 2000 all patients underwent a systematic preliminary CD study prior to biopsy.

To investigate if this systematic approach reduced or not complication incidence after procedure, we designed a retrospective analysis of observed complications before and after the systematic introduction of CD study in the preparation of renal biopsy.

2. Subjects and Methods

Present analysis includes 561 consecutive ultrasound-guided percutaneous renal biopsies performed in our department from August 1995 to December 2009 from the same operator.

Until August 2000, a total of 332 biopsies were performed, after a B-mode ultrasonographic study of kidneys. From September 2000 all patients (total 229) underwent a preliminary systematic CD study prior to biopsy. In these patients, vessels in the region of the biopsy were imaged immediately before the procedure using CD ultrasonography. Low pulse repetition frequency were used, between 750 and 1000 Hz.

332 patients biopsied before September 2000 were named Group A. The group of 229 patients systematically CD-studied was named Group B.

Demographical data are listed in Table 1. Major and minor complications were systematically registered in a database. Postbiopsy complications were categorized as either minor (gross hematuria and/or subcapsular perinephric hematoma < 4 cmq of greater diameter) or major (>4 cmq of greater diameter; requiring transfusion of blood products or invasive procedures; leading to acute renal failure, urine tract obstruction, septicemia, or death) [5, 6].

2.1. Biopsy Preparation. To minimize the risk of bleeding, prothrombin time, partial thromboplastin time, bleeding time (Ivy), and fibrinogen were measured, using standard methods, two hours prior to biopsy. Renal biopsy was not performed if there were any abnormalities not liable to

correction. Salicylate, ticlopidine, and NSAIDs were withdrawn for at least 7 days before biopsy. Use of heparin was prohibited two days before biopsy. In case of arterial hypertension under treatment, biopsy was performed only when normotensive range was achieved (less than 140/90 mm/Hg). Patients with renal cortex width < 10 mm and/or < 90 mm of kidney longitudinal diameter were not considered suitable for renal biopsy. All biopsies were performed using realtime ultrasound-fixed guidance (3.5 MHz convex probe, Technos MP; Esaote, Italy), and 16-gauge automated spring-loaded gun. In all cases the lower pole of kidney was used for biopsy, mainly at left side. Only in cases in which cysts, small cortex, peri-renal vessels were detected in this location, the right kidney was biopsied. In Group B, the presence of medium-size arteries/veins at lower pole of left kidney was an indication to perform biopsy on right kidney.

Single orthotopic kidneys (anatomically or functionally) were not biopsied. One experienced nephrologist (AG) performed all the biopsies.

Biopsy was performed in prone position with patients lying with the abdomen on a firm pillow. The lower pole of the kidney was located by ultrasound. The most appropriate needle-skin angle was selected by adjusting the puncturing adaptor (usually 20°; see Figure 1). After disinfection of the skin, lidocaine (1%) was applied locally under ultrasound control along the needle insertion tract. A small incision of the skin was made to facilitate the introduction of the biopsy needle. Under US imaging guidance the needle was advanced at an angle of 20° until the capsule of the lower kidney pole had been reached. Patients were asked to hold their breath, the biopsy device was unlocked and tissue obtained. The sampling time was <1 s. Length of the obtained biopsy specimens was usually 18–20 mm and at least two samples were taken. Following the biopsy, patients lay in bed on their backs for a 24-hour observation time. During this time, both clinical (gross hematuria, flank pain, and hypotension) and imaging test (2-D realtime sonography, CD sonography, and power Doppler sonography) were performed in order to evaluate the presence and sizes of potential bleedings. Blood pressure and pulse were monitored hourly. The next morning, patients were mobilized after ultrasound examination had ruled out major haematomas.

Statistical analysis was performed through Statistica 5.0 (StatSoft Inc.), using Fisher's exact test. Statistical significance was set at $P < 0.05$.

3. Results

In all cases specimens showed sufficient material. Mean number of glomeruli was 11 (range 7–43) per biopsy. Histological analysis, including conventional light and immunofluorescence microscopy, could be performed by the pathologist in 100% of cases. All complications registered during the study are reported in Table 2.

In Group A an arteriovenous fistula was observed in one patient, and spontaneously resolved 18 months after procedure. In Group B no fistulas were detected.

Only in Group A two patients requested blood transfusion for postprocedural acute anemization. One of this

TABLE 1: Demographic data and diagnostic categories in 514 consecutive percutaneous renal biopsies.

	Group A	Group B	P (A versus B)
Patients	332	229	—
Gender (m/f)	188/144	132/97	NS
Median age (years)	44.6	47.8	NS
Patients presenting with ARF	47 (14.1%)	31 (13.5%)	NS
Patients with creatinine > 5 mg/dL	45 (13.5%)	34 (14.8%)	NS
Nephrotic syndrome	126 (37.9%)	85 (37.1%)	NS
Diabetes	29 (8.7%)	21 (9.17%)	NS
Urinary abnormalities	38 (11.4%)	26 (11.3%)	NS
Hematuria	47 (14.1%)	32 (13.9%)	NS

TABLE 2: Major and minor postbiopsy complications.

	Group A	Group B	P
Major complications			
Arteriovenous fistula	1	0	—
Acute anemization requiring blood transfusion	2	0	—
Perirenal hematoma > 4 cmq	3	1	—
Parenchymal bleeding requesting angiography	1	0	—
Total (%)	2.1	0.43	<0.05
Minor complications			
Gross hematuria	16	5	<0.05
Small hematoma < 4 cmq	10	3	<0.05
Total (%)	7.8	3.4	<0.005

two requested an angiographic procedure to stop bleeding, through Gianturco method.

Three major hematomas (>4 cmq) were observed in Group A, while only one in Group B. In none of these cases surgical procedures were indicated after urological consulting.

Minor clinically significant complications occur in 7.8% of cases in Group A and in 3.4% of cases of Group B. Microhematuria was highly frequent but it was not intended as a complication.

Prebiopic CD evaluation showed anomalous vessels at the lower pole of the right kidney in 15 patients and at the lower pole of left kidney in 19 patients, respectively, as shown in Table 3. In 15 of 19 patients with anomalous vessels at the left kidney, it was impossible to identify an alternative trajectory for the needle (Figures 1 and 2) and biopsy was carried out on the right kidney. In the other 4 cases was sufficient to accurately study the trajectory. Only one patient in Group A underwent right kidney biopsy, showing a large inferior pole simple cyst.

Anomalous interlobar vessels were observed in 9/229 pts while inferior pole arteries in 6 patients. Lower pole perforant arteries was reported in 5 patients. Only one patient showed capsular vessels while two patients had paralumbar plexus. Cumulatively 23 pts (about 10% of whole Group B) showed vascular abnormalities potentially at risk of postprocedural bleeding.

TABLE 3: Vascular abnormalities at the colour doppler ultrasonographic examination before biopsy.

	Right kidney	Left kidney
Lower pole perforant arteries	3	2
Inferior pole arteries	3	3
Capsular vessels	—	1
Paralumbar plexus	1	1
Anomalous interlobar vessels	4	5

4. Discussion

Several authors [7–10] reported a drastic decrease in the incidence of complications after renal biopsy when procedure is guided by ultrasonography. Systematic use of colour Doppler ultrasonography in monitoring patients after a kidney biopsy, is crucial for an early diagnosis of postbiopsy AV fistula [11]. Perhaps if the importance of colour Doppler ultrasonography in postprocedural evaluation [11–13] is clear and commonly accepted, its usefulness in preparing a biopsy is yet to be appreciated.

This study, for the first time, showed a systematic, preparatory use of CD reduced postbiopsy complications incidence, in the same unit and from the same operator. It is to be underlined that during the time course of this study, the operator experience in biopsy practice grew, probably influencing in some part the results of this study. Perhaps it

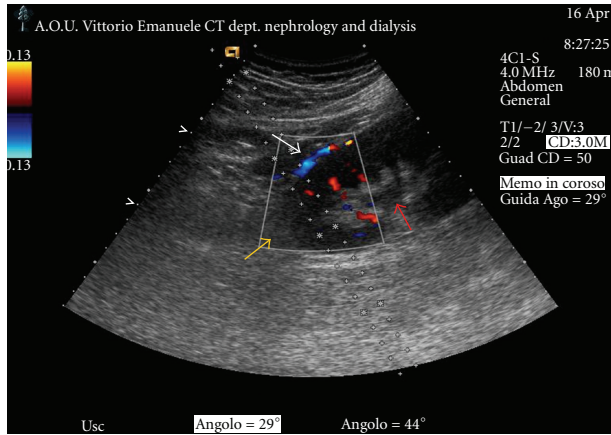


FIGURE 2: Colour Doppler US examination shows anomalous capsular venous vessel (white arrow) at the inferior pole left kidney (yellow arrow). Red arrow shows renal hilus.

is obvious that this study has all limitations of a retrospective analysis. On the other hand it appears acceptable that preliminary CD study helped operators to identify the safest needle trajectory to the kidney, in some cases indicating to prefer right organ for biopsy, even in absence of other ultrasonographic indications to avoid left kidney puncture.

Data registered in our clinic before the default use of CD study showed an incidence of major and minor complications absolutely in line with those reported in the literature [4–8]. The introduction of systematic CD study in biopsy planning literally broke down both incidences.

CD module is largely available in most of ultrasonographers in use in biopsy-providing units. It does not require the exposition to ionizing radiations and does not expose patient to any kind of risk. Perhaps it is an inexpensive tool, in term of money, and its systematic use requests little effort to the nephrologist in term of time. Its systematic use can reduce complications, and then costs, frequently as high as dramatic from an ethical point of view. In other words it is an easy, useful hand and sure tool in percutaneous renal biopsy.

On the other hand CD technique is highly operator-dependent, requesting experience and skill to warrant affordable reliefs.

It is then to be underlined that CD module has to be used when the nephrologist plans a biopsy, to design ideal needle trajectory, and it is turned off when needle starts its descent to the kidney. In this phase, obviously, CD could be only a confounding factor for the operator, often used to vibrate needle to make it visible on ultrasonographic screen.

This study opens a window on a new aspect in planning kidney biopsies: the presence of anomalous vessels potentially on the trajectory of biopsy needle. The systematic study of kidneys showed in fact anomalous vessels in about 10% of patients, giving a potential explanation to the observed reduction in complications rate in CD-studied patients. It is our opinion that this aspect could have more consideration in planning the better strategy for kidney biopsy. Our data show clearly as the same operator, in the same setting, could obtain better results and drastically reduce complications

only enriching preliminary study with CD. It is obvious to remind to the reader as vascular structures, particularly in case of small ones, can slip from the attention even of a well-skilled operator using only B-mode ultrasonography. CD can help him to better clarify their nature and to identify potential sources of risk in his strategy to biopsy.

On the basis of our data, clinically significant postbiopsy haematomas could potentially be related to small anomalous vessels at the lower pole of kidneys. These insidious peculiarities are, in our experience, relatively frequent. Experienced nephrologist, planning a site of puncture for biopsy, has to take care of them and design a strategy to reach renal cortex without undesired experiences.

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