Colour-coded Doppler sonography in monitoring native kidney biopsies

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Abstract. Two hundred and one patients had biopsies of their native kidneys with ultrasound-guided needle technique. They were evaluated on the second post-biopsy day with colour-coded Doppler sonography. Ten patients out of these 201 were found to have an arteriovenous fistula, which remained asymptomatic for the whole follow-up period (follow-ups ranged from 2 to 31 months). Four of these 10 patients developed a perirenal haematoma as well and five macroscopic haematuria.

Our study shows that the systematic use of colour-coded Doppler sonography after renal biopsy facilitates diagnosis of arteriovenous renal fistula.

Key words: arteriovenous fistula; echo Doppler; renal biopsy

Introduction

Arteriovenous fistulae (AVF) are known complications of renal biopsies. However, their true incidence is not known, due to the lack of systematic monitoring of biopsied patients with sensitive techniques.

In arteriographic studies the incidence of AVF was 15-18% [1]; studies in animals show higher frequency (up to 70%) [2]. Ultrasound diagnosis of AVF is not easy: conventional greyscale sonographic imaging shows morphological abnormalities only in chronic AVF, i.e. enlargement and tortuosity of the vessels leading to and from the fistula, but in most acute AVF B-mode ultrasound examination is negative. Duplex Doppler and colour-coded Doppler sonography (CCDS) are necessary to detect the haemodynamic consequences of the pathological AV communication.

In clinical practice the diagnosis is seldom made because the condition is usually asymptomatic: macroscopic haematuria due to AVF is reported in only 0.5% of cases [3]. AVF can have a benign evolution, with spontaneous regression in few months. Ninety five percent disappear within 2 years [4]; the rest may persist without causing symptoms. An adverse course with aneurysmic transformation or development of progressive renal failure (in single kidneys) is rare [5].

AVF have been evaluated by CCDS especially in renal grafts [6–10]. On the contrary only anecdotal evaluations with CCDS have been reported after biopsy of the native kidney [11,12].

Herein we present data on a large series of biopsied patients systematically monitored with CCDS.

Subjects and methods

Renal biopsy

The protocol for preparation of patients for renal biopsy included coagulation study (platelet count, prothrombin time, partial thromboplastin time, bleeding time (evaluated with the Simplate IIR, Organon Teknika, Durham, NC, USA), clotting time); blood pressure control (BP < 160/90 mmHg); pre-anaesthesia with atropine (0.5 mg) and promethazine (50 mg).

Biopsy was performed with real-time ultrasound control (Figure 1), employing 3.5 MHz convex probe with coaxial guidance device for needles. Surecut 15-gauge needles (TSK Laboratory, Japan) were employed. Biopsy was performed manually. One or two bioptic cylinders were obtained with a maximum of four attempts at biopsy.

During the biopsy the patient was positioned lying face downwards with abdominal compression. The patient was maintained in this position for the next 2 h, perfused with 2 l saline solution and forbidden to stand up for 2 days. CCDS was performed before and 2 days after the biopsy. When AVF was detected, CCDS was repeated 1 month, 2 months, 6 months, 1 year, and 2 years after the biopsy.

Colour-coded doppler sonography (Figure 2)

In our Centre this technique has been employed systematically since January 1991 for monitoring kidney biopsies. Sonolayer SSA 270 device with 3.75 MHz convex probe is used. CCDS features which allow the detection of AVF consist of a blue and red image which results from random colour assignment to vibrating non-vascular tissue adjacent to AVF [13–16]. Placing the duplex Doppler cursor on the
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Fig. 1. Real-time ultrasound-guided needle biopsy using a probe with coaxial guidance device for needles.

fistula, peculiar spectral analysis can be obtained, consisting of high-velocity jet with evidence for gross turbulence manifesting an irregular waveform [14].

These features had to be present only in the CCDS made after and not before the biopsy.

Regional dynamic scintigraphy

Regional dynamic scintigraphy was performed in 6 patients as a non-invasive examination for identifying hypoperfused areas in the renal parenchymae peripheral to AVF.

A dynamic $^{99}$Tc-MAG3 study included 180 sequential images at 10-s intervals starting at 5 s post-injection of 111 MBq of the radiotracer. During the parenchymal phase of the scintigraphic study (i.e. 1–2 min after the start), the activity over the lowest third of the kidney was evaluated and compared with that of the middle third of the same kidney. A difference of activity, expressed as counts/pixel, higher than 5% was considered significant.

Statistical analysis

The Yate's corrected chi-square test was performed for analysing the difference between patients with and without AVF for each clinical parameter considered in the study.

Results

From January 1991 to April 1993, 201 renal needle biopsies were performed in our Centre.

Overall complications were 75 (37.3%), including asymptomatic complications as documented by sonography, e.g. perirenal and intrarenal haematoma, macroscopic haematuria, ureteral colic for clots, loin pain, vasovagal hypotension, and AVF. Four major complications were observed (1.99% of patients and 5.3% of complications). Major complications were loin pain, ureteral clots or transfusion requirement for Hb < 6 g/dl.

Intrarenal AVF were found in 10 of the 201 patients biopsied in this period (5%). AVF represented 13.3%
of complications. AVF were associated with perirenal haematoma in five patients and haematuria in four. Statistical analysis showed a significant increase in the number of haematuria episodes and of total complications other than AVF in patients who developed AVF in comparison to the other patients (Table 1). There was no difference concerning age, percentage of hypertensive patients, histological signs of vascular damage, and presence of renal failure between the two groups.

The age of the patients who developed AVF ranged from 18 to 65 years (mean age 47.5 ± 17 years). Six patients were hypertensive and took anti-hypertensive medication at the time of renal biopsy.

Serum creatinine ranged from 0.8 to 5.3 mg% (mean 2.7 ± 1.5 mg%). Five patients, who already had renal failure at the time of biopsy, had transient worsening of their renal function. Only one patient had a significant but transient increase in blood pressure. Embolization or surgical intervention was not required.

Histological diagnosis of the 10 cases varied: six were glomerulonephritis (4 IgA glomerulonephritis, 1 focal and segmental glomerulosclerosis, and 1 mesangial glomerulonephritis). One case had interstitial nephritis, two vasculitis and one 'thin-membrane nephropathy'. Arteriolar damage was evident in five patients.

Arteriography was performed in only one case (case 2) in order to look for multiple aneurysms because of vasculitis. Arteriography confirmed the presence of AVF.

In only one patient regional dynamic scintigraphy with 99mTc-MAG3 showed a modest but significant decrease in segmental renal function related to AVF.

During follow-up AVF was no longer detectable in two patients (in one it had disappeared after 1 month and in the other after 1 year of follow-up). AVF was still present in the other patients (follow-up ranging from 2 to 31 months).

Discussion

Using colour-coded Doppler sonography we were able to detect 10 AV fistulae amongst 201 patients who underwent biopsy of their native kidneys. Such a high rate of AV fistulae shows that past reports were probably considerable underestimates, particularly since AV fistulae are rarely symptomatic.

We suggest the routine use of CCDS, a method with documented high sensitivity for the recognition of arteriovenous fistulae [13] to monitor patients after routine biopsy.

In all our cases AV fistulae were asymptomatic and an incidental finding. Invasive treatment including surgery was not required. Nevertheless it may be useful to make the diagnosis because of the rare case with a delayed adverse course [5] including delayed aneurysmal transformation.

Patients who developed AV fistulae had more frequently other complications, e.g. perirenal haematomata, macrohaematuria, etc. (Table 1). It is unknown whether this reflects greater biopsy-related trauma in patients who developed AV fistulae or whether patients who developed AV fistulae had an unrecognized bleeding tendency.

Our analysis shows that colour-coded Doppler sonography provides a safe, non-invasive, sensitive tool for the early diagnosis of post-biopsy AV fistula.

References


<table>
<thead>
<tr>
<th>Number of patients</th>
<th>With AVF</th>
<th>Without AVF</th>
<th>Total</th>
<th>Significance (Yates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>10</td>
<td>191</td>
<td>201</td>
<td></td>
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<tr>
<td>Total complications other than AVF</td>
<td>9</td>
<td>56</td>
<td>65</td>
<td>P&lt;0.001</td>
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<td>Major complications</td>
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<td>4</td>
<td>4</td>
<td>n.s.</td>
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<tr>
<td>Haematoma</td>
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<td>13</td>
<td>14</td>
<td>P&lt;0.07</td>
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<td>Haematuria</td>
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<tr>
<td>Other complications</td>
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<td>3</td>
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<td>Hypertension</td>
<td>0</td>
<td>85</td>
<td>91</td>
<td>n.s.</td>
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<td>5</td>
<td>100</td>
<td>105</td>
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<td>Renal failure (Crea1.210inonine1.5 mg%)</td>
<td>7</td>
<td>90</td>
<td>97</td>
<td>n.s.</td>
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<td>Age (&gt;60 years old)</td>
<td>3</td>
<td>64</td>
<td>67</td>
<td>n.s.</td>
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