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BRIEF REPORT

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Percutaneous renal biopsy in children: survey of pediatric nephrologists in Japan

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Abstract Between 1996 and 1997, 2,045 percutaneous renal biopsies were performed on native kidneys in 2,013 patients in pediatric nephrology units in Japan. Of these, 50.8% were performed by automated needle biopsy gun under ultrasound guidance, and the standard biopsy needle, Tru-cut needle or Vim-Silverman needle, under fluoroscopic guidance was used in 12.4% and 12.3% of the biopsies, respectively. Adequate renal tissue for histological diagnosis was obtained in 98.7% of cases, and the success rates for the techniques were not significantly different. The overall complication rate was 5.8%; gross hematuria occurred in 2.7% and large perirenal hematoma in 0.9% of cases. These complication rates were higher when a standard needle under fluoroscopic guidance was used compared with an automated needle under ultrasound guidance. We conclude that pediatric nephrologists in Japan perform percutaneous renal biopsies safely, partly due to technical improvements, such as the automated needle or ultrasound guidance.

Key words Percutaneous renal biopsy · Biopsy gun · Complications

Introduction

Percutaneous renal biopsy has been an important tool in the diagnostic and prognostic evaluation of kidney disease in children. However, with this procedure there is a risk of several kinds of complications, such as gross hematuria, perirenal hematoma, arteriovenous fistulae, infection, damage to adjacent organs, or loss of the kidney. Therefore, the decision to perform a renal biopsy must be made in the light of the relative risks and benefits. To obtain information about the diagnostic efficacy and complications of current percutaneous renal biopsies in native kidneys, we conducted a detailed survey of pediatric nephrologists in Japan. The data provided information on the current status of percutaneous renal biopsies in children with kidney disease.

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Methods

A survey using a questionnaire was conducted to assess all patients who underwent renal biopsy by members of the Japanese Society for Pediatric Nephrologists between 1 September 1996 and 31 August 1997. The questionnaire included the number of biopsies and patients, age, methods of sedation and anesthesia, positioning of patients, choice of which side to biopsy, localization of the target kidney and guidance, types of biopsy needles, term of bed rest or hospitalization after biopsy, procedure of ultrasonographic examination after biopsy, accuracy of technique, and complications. Patients who underwent biopsy of a transplanted kidney were excluded in this survey.

Gross hematuria was defined as a newly developed macroscopic hematuria after renal biopsy, and recovery was defined as return to urinary levels of pre-biopsy status.

Statistical significance was evaluated using the Wilcoxon rank sum test for nonparametric data for between-group comparisons. Values were expressed as mean±SE. Differences of $P<0.05$ were regarded as significant.

Results

Patients

Between September 1996 and August 1997, 2,045 renal biopsies on native kidneys were performed in 2,013 patients from 1 to 25 years of age in 160 pediatric nephrology centers in Japan. All adolescents were observed from childhood and the procedures were repeat biopsies.

Pre-biopsy procedure

Sedation and anesthesia

Most physicians or pediatric nephrologists have reported the use of sedation or general anesthesia. Atropin sulfate,

pethidine hydrochloride, pentazocine, and/or hydroxyzine pamonate were given intramuscularly in one syringe 1 h before the biopsy. Patients younger than 6 years of age, or those who were not cooperative, were anesthetized with ketamine, diazepam, or thiamylal sodium. Local anesthesia was performed with 1% lidocaine.

Positioning

The prone position was used by 97.5% of the centers and the sitting position by 2.5%.

Choice of which side to biopsy

The left kidney was biopsied in 46.2%, the right kidney in 48.8%, and 5% were biopsied alternately.

Localization of the target kidney and guidance

Ultrasound was used by 65.6%, fluoroscopy after intravenous injection by contrast material was used by 25%, a mixture of ultrasound and fluoroscopy by 8%, and localization by superficial anatomical landmarks, the 'blind technique,' by 1.3%.

Biopsy procedure

Biopsy needle

Among 2,045 percutaneous renal biopsies of native kidneys, 1,237 (60.5%) were performed by biopsy gun and 300 (14.7%) by Vim-Silverman needle. The remaining 508 (24.8%) were performed by 'disposable needles,' of which 398 (78.0%) employed the Tru-cut needle, 43 (8.5%) biopsy needle, 41 (8.1%) monopty, 11 (2.2%) Ace-cut needle, 10 (1.9%) Top-aspiration needle, and 5 (0.9%) the Sure-cut needle.

Guidance and biopsy needle

In 50.8% of patients, renal biopsy was performed by biopsy gun under ultrasound guidance. Tru-cut needle or Vim-Silverman needle with fluoroscopic guidance was used in 12.4% or 12.3% of cases, respectively. Biopsy gun with fluoroscopic guidance was employed in 9.7%, and Tru-cut needle with ultrasound guidance in 7.0%. The remaining biopsies utilized monopty, biopsy needle, Ace-cut needle, or Sure-cut needle with ultrasound or fluoroscopic guidance (Table 1).

Post-biopsy care

In 125 centers (78%), patients required strict bed rest overnight after the biopsy, while the recovery time ranged from 3 to 5 h in 14% of the centers. In the absence of complications, the patients were allowed to go to the toilet the following morning. Most patients (67%) remained in the hospital for at least 4–8 days. In 10 centers (6%), patients were discharged within 3 days, but no center allowed discharge within 24 h of the biopsy. In 27% of the centers, patients were discharged from 9 to 12 days after the biopsy without complications.

Ultrasonographic examinations after biopsy were carried out in 93 centers (58.2%). Among them, 40 (43%) performed these examinations only once within 6 h, on the 1st–2nd day, or the 3rd–5th day. Furthermore, 45 (48%) centers performed them twice, within 3 h and on the 1st–3rd day, or at 12–25 h and on the 7th–9th day. Three examinations were performed in 7 centers.

Accuracy of technique

Of the biopsy specimens, 98.7% contained more than 10 glomeruli, the amount defined to be adequate for diagnosis. The successful rate under ultrasound guidance was 99.0±1.63%, whereas that under fluoroscopic guidance

Table 1 Technique and successful biopsies in 2,045 percutaneous renal biopsies

Guide	Technique	No. of biopsies	Successful biopsies
	Biopsy gun	1039 (50.8%)	1032 (99.3%)
	Tru-cut needle	144 (7.0%)	141 (97.9%)
	Vim-Silverman needle	42 (2.1%)	42 (100%)
	Monopty	41 (2.0%)	39 (95.1%)
Ultrasound	Biopsy needle	26 (1.3%)	26 (100%)
	Ace-cut needle	11 (0.54%)	11 (100%)
	Top-aspiration needle	10 (0.48%)	10 (100%)
	Sure-cut needle	4 (0.19%)	4 (100%)
	Tru-cut needle	254 (12.4%)	249 (98.0%)
	Vim-Silverman needle	251 (12.3%)	246 (98.0%)
Fluoroscopic	Biopsy gun	198 (9.7%)	196 (98.9%)
	Biopsy needle	17 (0.83%)	16 (94.1%)
	Sure-cut needle	1 (0.05%)	1 (100%)
Blind	Vim-Silverman needle	7 (0.34%)	7 (100%)
Total		2045	2020 (98.7%)

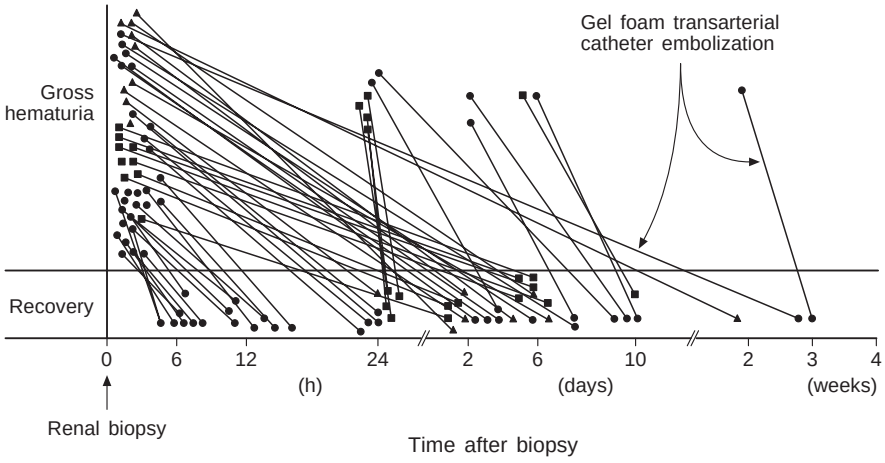

Fig. 1 Course of gross hematuria in 57 patients after percutaneous renal biopsies (● biopsy gun, ▲ Vim-Silverman needle, ■ others)

Table 2 Summary of complications in 2,045 percutaneous renal biopsies

Complications	No. of biopsies
1. Gross hematuria	57 (2.7%)
2. Perirenal hematoma[a]	20 (0.98%)
3. Infection	19 (0.93%)
4. Damage to adjacent organs	16 (0.78%)
Liver	6
Intestine	5
Muscle or lymphonodus	5
5. Arteriovenous fistula	1 (0.05%)
6. Intrarenal cyst	1 (0.05%)
7. Others	6 (0.29%)
Drug allergy	5
Liver dysfunction due to unknown origin	1
Total	120 (5.8%)

[a] Greater than one-third of hemilateral renal size

or blind was 97.8±1.99%. No significant differences were observed among biopsy needles (Table 1).

Complications

Gross hematuria occurred in 57 patients (2.7% of biopsies), and in 46 of these it was noted at the first voiding. In the remaining 11 patients, it was detected 1–6 days after biopsy. In the former 46 patients, 19 (33% of patients) exhibited persistent gross hematuria after 48 h; in 7 of the remaining 11 patients gross hematuria persisted for 4–21 days. Two patients required gel foam transarterial catheter embolization to resolve the gross hematuria (Fig. 1). Perirenal hematoma was noted in 337 of 2,045 biopsies (16%). Among these, large hematomas, which were greater than one-third the hemilateral renal size and caused persistent and/or severe pain, were observed in 20 patients (0.98%). Damage to an adjacent organ such as the liver, intestine, or lymphonodus was seen in 16 patients (0.78%). Infection was noted in 19 patients (0.93%); fever in all patients, and abdominal pain in 7 patients. Among the 7 patients with abdominal pain, 3 showed both gross hematuria and perirenal hematoma. One patient developed an arteriovenous fistula and another patient, intrarenal cyst formation. Other events considered complications included drug allergy or liver dysfunction due to sedation. There were no cases of loss of kidney or death (Table 2).

Technique and complications

Among the 1,237 patients in whom a biopsy gun was used, 34 patients (2.7%) showed gross hematuria. Gross hematuria was observed in 9 (3%) of 300 patients with the use of the Vim-Silverman needle and in 14 (2.7%) of 500 patients with other needles, such as Tru-cut, monopty, biopsy needle, Top-aspiration needle, Ace-cut needle, or Sure-cut needle (Table 1). In addition, the incidence of gross hematuria or hematoma was higher in patients in whom a standard needle was used, in particular the Vim-Silverman needle, under fluoroscopic guidance compared with an automated needle, biopsy gun, under ultrasound guidance (3.18% vs. 2.7%, 1.9% vs. 0.9%).

Discussion

In this survey of pediatric nephrologists from 160 centers in Japan, percutaneous renal biopsy was performed in 2,045 patients between September 1996 and August 1997. Adequate renal tissue for histological diagnosis was obtained in 98.7% of cases, and serious complications requiring special management or prolonged hospitalization occurred in 2.5%. These values were much better than those of pediatric nephrologists outside Japan (93.2±5.05%, 4.72±3.51%) [1–10].

Since the introduction of percutaneous renal biopsy in children [11], various methods have been proposed to improve the safety and efficacy. Our findings showed that percutaneous renal biopsies using an automated needle biopsy gun under ultrasound guidance are employed by nearly half of Japanese pediatric nephrologists. The

biopsy gun is being increasingly used to obtain renal tissue for the following reasons: (1) easy control of needle pathway, (2) deep breath holding to assist in localization is unnecessary, (3) less lateral movement of the needle, (4) it is a simple and easy technique to learn. In addition, ultrasound guidance allows exact positioning of the needle tip on the surface of the kidney, as well as determination of the parenchymal depth and the anticipated path of the needle. This may contribute to the favorable results in pediatric nephrology in Japan.

Among several kinds of complications after renal biopsy, macroscopic hematuria and perirenal hematoma are the most common. In this series, the incidence of gross hematuria or large hematoma was higher in patients with the use of a standard needle, in particular the Vim-Silverman needle, under fluoroscopic guidance, compared with an automated needle, biopsy gun, under ultrasound guidance, although there was no significant difference. Similar findings were obtained in an adult series by Burstein et al. [12] and a pediatric series by Davis et al. [10]. Infection due to biopsy is uncommon, but occurred in 19 patients (0.93%), with a similar incidence to large hematoma. We did not obtain sufficient clinical data to explain these findings. However, all patients were completely cured by administration of antibiotics. Care must be taken to reduce the complication rate.

Based on the low complication rate or cost effectiveness, several investigators [9, 10, 13] have recommended day care or 1-night-stays for renal biopsy. We found no examples in this survey. Pediatric nephrologists in Japan do not fully embrace this procedure, because of the lack of objective and unbiased data regarding its safety. In addition, hospital charges are not a burden due to the health insurance system in Japan. In 57 patients with gross hematuria, 11 presented with gross hematuria over 24 h or later after biopsy. In 7 of these cases, hematuria persisted for over 7 days, despite strict bed rest and initial normal hemostatic findings. One of these patients was successfully treated by gel form transarterial catheter embolization. We recommend that patients be carefully monitored overnight for possible sequelae.

In this survey of pediatric percutaneous renal biopsies in Japan, pediatric nephrologists used a variety of needles and devices. Standard needle Tru-cut needle or Vim-Silverman needle under fluoroscopic guidance appeared to be less common, being replaced by the automated needle biopsy gun under ultrasound guidance. This may contribute to reduced operator error. Furthermore, post-biopsy observation was performed carefully. This, together with technical improvement, likely resulted in the decrease in serious complications after biopsy. These findings may be helpful for pediatric nephrologists to successfully perform renal biopsy, and to obtain informed consent for renal biopsy from patients and their parents.

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