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Complications of Ultrasonography Guided Percutaneous Renal Biopsy in Children: A Retrospective Study in a Tertiary Hospital in Nepal

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ABSTRACT

Introduction:
Percutaneous renal biopsy is done under ultrasonographic guidance in recent times due to which the diagnostic yield has increased and complications have been severely curtailed. We aimed to retrospectively evaluate the complications following kidney biopsy in children.

Methods:
After obtaining ethical clearance, retrospective evaluation of sixty pediatric renal biopsies done in BPKIHS from October 1, 2018, to September 30, 2020, were included in the study. Biopsies were done by 18G biopsy guns under ultrasound guidance and the complications were evaluated.

Results:
Of sixty patients, 13.33% had gross hematuria, 3.33% had a perirenal hematoma and the biopsy failure rate was 3.3%. None of the patients required blood transfusion and had major complications requiring further intervention.

Conclusions:
Percutaneous renal biopsy under ultrasonographic guidance is a safe procedure with a better success rate.

Keywords: *Biopsy; Hematoma; Ultrasonography*

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INTRODUCTION

The diagnosis of renal pathology has increased in recent years owing to the availability of imaging modalities and laboratory investigations. Though not always necessary, a renal biopsy with histopathological confirmation may be needed time and again to arrive at the final diagnosis, thereby directing the precise management of the patient.

Percutaneous renal biopsy was first reported around 1940 and since then it has been increasingly performed by clinicians to improve diagnostic accuracy.[1] However it was not free of complications. Previously renal biopsy was performed without imaging guidance which often resulted in several complications. The results were inconsistent and the success of the procedure was operator-dependent. In recent years, renal biopsy is usually done under ultrasonographic guidance due to which the diagnostic yield has increased and complications have been severely curtailed. As ultrasound is easily available, easy to handle, portable, inexpensive and above all demarcates the kidney, guiding the biopsy needle under ultrasonic guidance has been considered the safest modality to perform renal biopsy. But still, it's not completely free of complications. In the context of Nepal, doing renal biopsy under ultrasonographic guidance has gained popularity only for a few years in contrast to the developed countries, and very few studies are only reported.

Percutaneous renal biopsy is essential for the diagnosis, prognosis, and management of children with unknown kidney disease.[2] Common indications of renal biopsy include proteinuria, hematuria, acute renal failure and renal injury associated with systemic diseases.[3] But performing a renal biopsy in children is a bit more difficult than in adults as they are usually non-cooperative and significant variation in size and position may be encountered during the growth period.[4] Despite the complications and difficulties, renal biopsy under ultrasound guidance is considered the primary modality in recent days to establish the diagnosis and alter the treatment accordingly.

With the increasing diagnostic modalities, more numbers of renal pathologies are getting detected and various pathologies often need histopathological confirmation for the proper management of the patient. Previously renal biopsy was done blindly by nephrologists and now, with the availability of ultrasonography, renal biopsies are referred to the radiology department time and again. Yet the literature addressing the safety of this procedure in the child population in our setup is hard to find. So this study will address the complications and thus safety regarding USG-guided renal biopsy in our part of the country.

METHODS

After obtaining approval from the institutional review board, the medical record of the patients (age of 16 years or less) who have undergone renal biopsy in the Radiology Department, BPKIHS from October 1, 2018, to September 30, 2020, were considered for the study. A pre-designed structured data collection tool was developed to record the demographic profile and relevant findings. All renal biopsies of patients in the age group of 0-16 years who had undergone biopsy from the lower pole of the kidney using an 18 gauge Bard biopsy gun under direct visualization were included in the study. Participants with incomplete information on medical records were excluded.

Two cores of tissues were obtained: one of them was kept in normal saline for immunofluorescence microscopy and another one in formalin for light microscopy. For patients not cooperating during the procedure, sedation was also performed with an injection of midazolam, and if required Ketamine or Fentanyl was also given in presence of a pediatric nephrologist and anaesthetist if required. Counselling the patient's parents and taking consent from them were done in every case and coagulation profiles were also checked beforehand. The procedure was done as per institute protocol with full aseptic precaution.

An immediate abdominal evaluation was examined to see the presence of an immediate hematoma. A pressure bandage was applied at the site of the biopsy thereafter. Patients were monitored carefully for vital signs and features of any complications. Ultrasound was performed to detect any perirenal hematoma or other complications after 6 hours post-biopsy in all cases. Data was entered in MS Excel and analyzed using SPSS. For descriptive

statistics; mean, and standard deviation, were calculated along with a tabular presentation.

RESULTS

Sixty renal biopsies were performed during the study period with a mean age of 9.55±3.87 years. The mean age among males was 9.29±4.08 years and for females was 9.83±3.67 years. The male to female ratio was 1.1. The number of patients according to the age group is shown in Table1.

Table 1: Patient distribution according to age groups

Age group (years)	Frequency (n)	
	Male	Female
0-4	5	2
5-9	10	13
10-14	14	12
15-16	2	2
Total	31	29

The indications of renal biopsy in our study were: Acute nephritic syndrome 29 (48.3%), nephrotic syndrome (40%), Acute Kidney Injury 4(6.7%), and Acute Kidney Disease 3 (5%).

The histopathological diagnosis obtained was as shown in Table 2.

Table 2: Distribution of histopathological diagnosis

Histopathological diagnosis	Frequency (Percentage)
Lupus Nephritis	13 (21.67%)
Minimal change diseases (MCD)	11 (18.33%)
Focal segmental glomerulosclerosis (FSGS)	9 (15%)
Nephritic nephritic	8 (13.33%)
Rapidly Progressive Glomerulonephritis	5 (8.33%)
Henoch Schonlein (HS) Nephritis	3 (5%)
Diffuse segmental Glomerulosclerosis	1 (1.67%)
IGA Nephropathy	3 (5%)
Thrombotic Microangiopathy	1 (1.67%)
Acute Tubular Interstitial Nephritis	3 (5%)
Diffuse Global Glomerulosclerosis	2 (3.33%)
Chronic Glomerulonephritis	1 (1.67%)

Gross hematuria was the commonest complication noted in our study which occurred in 8 (13.33%) participants. Most of them were kept in observation and the hematuria subsided without any active intervention. Out of these, two of them had a perirenal hematoma. Other complications like arteriovenous malformation, pneumothorax, post-biopsy infections, sedation related complications were not found in our study. None of the cases required blood transfusion. Two (3.3%) of the cases were labelled as an unsuccessful biopsy which was reported inadequate sampling due to the presence of medullary tissue rather than glomerular tissue. Both of the cases were biopsied again with the required results.

DISCUSSION

Previously, renal biopsies were used to be done as a blind procedure with frequent complications depending upon the expertise of the operator. The first successful renal biopsy was done in 1944.[1] Thereafter, the biopsies were also performed under fluoroscopic guidance. The breakthrough was the introduction of ultrasound imaging in the early 80s. Ultrasound helped to easily localize the kidneys without the use of contrast and added benefits to patients with no radiation exposure. Moreover, the advancement of ultrasound devices today as real-time imaging allows the operator to directly visualize the kidney during the procedure.[5] With the developing charm of interventional radiology in recent years, there is an increasing number of biopsies performed in the radiology department.

Our study group consists of pediatric participants ranging from two years to 16 years of age with the mean age group in our study at 9.55±3.87 years, implying that most of the biopsies occurred around this time. The most common indication of biopsy in our study was noted to be acute nephritic syndrome followed by nephrotic syndrome. The indications for renal biopsy may differ according to age, ethnic group and geographic location.[6] Several previous studies have shown nephrotic syndrome as the commonest indication.[7,8,9] The most common indication for the kidney biopsy was shown to be proteinuria independent of nephrotic syndrome in a large series audit done by Mallik et al. whereas a study done by Kim et al. depicted asymptomatic

urinary abnormalities as the most common cause.[6,10] The commonest histopathological diagnosis in our study was found to be lupus nephritis followed by MCD and FSGS. Some previous studies in different geographical areas showed FSGS to be the most frequent type of biopsy-proven renal disease. The other frequent histopathological diagnosis was MCD, IgA nephropathy, HS nephritis, MPGN, and acute post-infectious nephropathy.[7,9] The most common primary renal pathology was found to be mesangial proliferative glomerulonephritis and minimal change disease (MCD) according to Roy et al.[11] The prevalence of different renal diseases may vary with the population characteristic and environmental factors but in most the studies, common histopathological diagnoses were almost similar with slightly different proportions.

Several previous studies have also reported gross hematuria as the most common complaint. We also observed gross hematuria in 8 (13.3%) cases. Previously, without ultrasound guidance, gross hematuria was reported to be in 23.3% of cases.[12] The biopsy done with ultrasound guidance showed a lesser incidence of gross hematuria.[9,13] Perirenal hematoma was detected in two cases in our study. A study done by Cakmakci et al. also detected perirenal hematoma in three cases out of 166 cases which regressed spontaneously in all cases.[9] Fortunately, our cases also showed complete regression in all cases in successive follow-ups. No major complications were seen in our study. Blood transfusion was required in two patients and one of them also had to undergo embolization to control bleeding in a study done by Sumboonnanonda et al. in 85 patients.[12] The total frequency of blood transfusion or intervention (surgery or angiography) is as low as 0.9% and 0.2% respectively.[14] Walker PD has also stated that Blood transfusion is required in less than 1% of biopsies.[15]

Failure of biopsy was observed in 2 cases (3.3%) in our study. Both cases were labelled as inadequate samples on histopathology due to the presence of predominantly medullary tissue and inadequate glomerular tissue. Previously, without ultrasound guidance, Dodge et al. reported a success rate of 92% in 205 kidney biopsies performed in children with diffuse renal disease.[16] The failure rate may vary from 2.3% to 4.8% in different studies with ultrasound guidance.[7,10,11] A study by Al Menawy et al. has reported a 100% success rate.[17]

The main limitation of our study is its retrospective design. However, the frequency of complications has reduced in recent times due to real-time direct visualization during a renal biopsy is also supported by several other studies.

CONCLUSION

Most of the complications are minor ones and can be managed without active intervention. Major complications are rarely observed nowadays during renal biopsy. We can conclude that renal biopsy is a safe and efficacious procedure when diagnoses have to be established for further management of the patient.

CONFLICT OF INTEREST

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