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Bleeding complications post ultrasound guided renal biopsy – A single centre experience from Pakistan

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HIGHLIGHTS

- Percutaneous kidney biopsy is a relatively safe procedure.
- Complication rates following the procedure are minimal.
- All nephrology programs must train the trainees in performing biopsies.

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ABSTRACT

Introduction: Renal biopsy is the diagnostic modality of choice for the diagnosis of renal parenchymal diseases. The advent of improved imaging techniques and biopsy needles over the years has increased the safety of the procedure and the ability to obtain adequate renal tissue for diagnosis. However, there is paucity of data in this regard from Pakistan. This study shall help in establishing the local perspective of the frequency of bleeding complications in percutaneous ultrasound guided renal biopsy.

Materials and methods: This is a prospective case series of hospitalized patients from January till December 2015 at Nephrology Department, Aga Khan University Hospital, Karachi, Pakistan. After enrolment, each participant was followed for 24 h after renal biopsy.

Results: A total of 220 patients were included. Mean age was 41.65 ± 8.627 years, 82 (37.2%) were male and 138 (62.8%) were female. Pre and post biopsy haemoglobin, pre and post biopsy haematocrit were 10.92 ± 1.25 and 10.60 ± 1.22, and 30.82 ± 4.73 and 30.49 ± 4.68 respectively. Out of 220 patients, 16 (7.27%) developed major complications and 26 (11.8%) developed minor complications in 24 h after renal biopsy.

Conclusions: Percutaneous kidney biopsy is a relatively safe procedure. Complication rates following the procedure are minimal. It is important that all nephrology programs train the trainees in performing biopsies, so that there is a wider clinical use of this important investigation even in underprivileged & developing countries.

1. Introduction

The percutaneous renal biopsy (PRB) of native kidneys has been an essential tool in the diagnosis and management of renal disease for over 50 years [1]. It is often required to establish histological diagnosis, determine the prognosis and choose appropriate methods of treatment for renal disorders [2]. PRB was first described in the early 1950s by Iversen and Brun [3] and Alwall [4] who performed the biopsies with the patients in sitting position by use of a suction needle and intravenous urography for guidance. An adequate tissue diagnosis was achieved in less than 40% of these early cases [5,6].

Nowadays, ultrasound-guided (USG) PRB with an automated spring-loaded biopsy device has become the standard method for kidney biopsy. With the advent of this technique, the results of renal biopsies have significantly improved with >99% of biopsies being diagnostic [7] and has led to increased safety of the procedure

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with the rate of life-threatening complications decreasing from 0.12 to 0.02% [1]. Sonography enables skin surface marking of lower poles of kidney as well as visualization of the biopsy needle and its path during the procedure [8,9].

SM Korbet in 2002 showed that bleeding complications post-PRB of native kidneys occur on average in 7.4% of biopsies [10] but complication rates as high as 25% [11] to >30% [7,12,13] have been reported in a number of studies despite the use of newer technologies. Waldo B at Rush University Medical Centre, Chicago stated that the post biopsy bleeding complication occurred in 16% of his patients [1].

Most complications are minor and resolve spontaneously. However, up to 7% of biopsies can result in major complications that require further intervention [1,10–12,14]. Whittier et al. found in his study that biopsy-related complications occurred in 98 (13%) patients; minor complications occurred in 50 (6.6%) patients, and major complications occurred in 48 (6.4%) patients [14].

There is limited data available from Pakistan in this regard. The aim of this study is to establish a local perspective of the frequency of bleeding complications (hematoma, haematuria, post biopsy bleeding requiring transfusion, angiography or surgery) in percutaneous ultrasound guided renal biopsy. Based on this data strategies could be made to screen all patients pre and post PRB at regular interval so as to prevent fatal complications.

2. Subjects and methods

This is a prospective case series of patients hospitalized in the Nephrology Department of an academic tertiary care hospital in Karachi, Pakistan from January till December 2015. Proposal was approved by Ethical review committee of Aga Khan University Hospital Karachi, Pakistan. Inclusion criteria were 1) patients undergoing renal biopsy for acute kidney injury, nephrotic syndrome, acute nephritic syndrome or rapidly progressive glomerulonephritis 2) Age 20 years–60 years. Exclusion criteria were 1) patients not willing to participate, 2) International normalized ratio >1.3, 3) Platelets<50000 cells/mm^3, 4) Uncontrolled hypertension (BP > 160 mmHg systolic and >90 mmHg diastolic, 5) Antiplatelet use (such as Aspirin and Clopidogrel) within seven days before biopsy, 6)Solitary kidney proven by ultrasound, 7) Patients with hydronephrosis, cyst, perinephric abscess proven by ultrasound, 8) Small sized kidneys (<9 cm proven by ultrasound) 9) Patients with acute exacerbation of chronic obstructive pulmonary disease, chronic liver disease, cardiac failure and stroke (as these patients are not able to comply with the procedure and other limitations).

The biopsy procedure and its risks & benefits were explained to the patients. Informed consent was taken from patient or attendant next of kin. Anonymity of the patients and confidentiality of the data was maintained throughout this study. Following informed consent, consecutive patients who underwent renal biopsy were enrolled in the study.

Complete blood count, prothrombin time, partial thromboplastin time and blood pressure were checked and ensured to be within normal limits on the morning of the biopsy procedure. All biopsies were performed under real-time ultrasound guidance by a single nephrologist. The biopsy was carried out with patients in prone position. The skin was prepped with antiseptic solution and draped to maintain sterility. A sterile cover was also placed over the ultrasound probe, and the lower pole of the kidney was visualized. Lidocaine was given for local anaesthesia. An automated biopsy gun (Bard Monopty gun) with 14 gauge biopsy needle was used. Once the needle was close to the renal capsule, the gun was fired with the patient holding his or her breath. The biopsy needle was then retrieved and the specimen was placed in a media container for histopathology. 2 cores of kidney tissue were obtained. The patient's blood pressure, cardiac rhythm, and pulse oximetry were monitored throughout the procedure. Immediate post biopsy ultrasound was done to check for perinephric hematoma.

The patients were instructed to lie flat on bed on their back for 4–6 h post procedure and then further rest in bed for 24 h for observation post-procedure. Patients were monitored closely after biopsy for gross haematuria and flank pain. Blood pressure and heart rate were monitored post biopsy every 15 min in the first hour, every 30 min in the second hour and then hourly for the next 4 h. Patients demographics like age, sex, haematuria, fall in haematocrit/haemoglobin, formation of subcapsular perinephric hematoma, need for blood transfusion post biopsy or an invasive procedure (angiography, nephrectomy) were recorded on a preformed Performa.

Post Renal biopsy complications can be categorized as minor & major complications. Minor complications included 1)Gross haematuria (red or smoky-brown urine visible with naked eye) which did not require intervention such as blood transfusion or angiography. 2)Perinephric Hematoma <5 cm in size on ultrasound imaging that did not need any intervention such as nephrectomy, angiography or blood transfusion [7]. Major complications included 1)Gross haematuria or perinephric hematoma with a fall in haematocrit ≥10% from pre-biopsy level that require packed red blood cell transfusion, angiography or surgery or caused 2) Hypotension that require higher level of nursing care or need for Intravenous fluid or vasopressor support [10,15].

Non Probability consecutive sampling technique was used. The sample size was calculated using the WHO software. By taking the least prevalence of 6.4% [14], margin of error = 3.5% and confidence level 'C.I' = 95%, the required sample size came out to be 188 patients. For reporting this prospective case series, we have followed PROCESS guidelines [16].

3. Statistical analysis

Data was analysed on SPSS Version 16. Mean and standard deviations were calculated for the quantitative variables like age of the patient, pre and post-biopsy haemoglobin and haematocrit. Frequencies and percentages were calculated for the qualitative variables gender, major and minor complications. Effect modifiers will be controlled through stratification of age, gender, pre and post biopsy haemoglobin and haematocrit to see the effect of these on the outcome variable. Post stratification chi square test will be applied. p-value of ≤0.05 will be taken as significant.

4. Results

A series of 220 patients, enrolled from January till December 2015 who met the inclusion criteria & underwent PRB. Females were 138 (62.8%) & males were 82 (37.2%). Mean age was 41.65 ± 8.627 years. Mean pre and post biopsy haemoglobin were 10.92 ± 1.25 and 10.60 ± 1.22 respectively. Mean pre and post biopsy haematocrit were 30.82 ± 4.73 and 30.49 ± 4.68 respectively.

Table 1
Post Renal Biopsy Percentages of Major and Minor Complications n = 42.

	n	%
Minor complications	**n = 26**	
Gross hematuria	22	84%
Hematoma(<5 cm)	4	15%
Major complications	**n = 16**	
Hematoma requiring blood transfusion	14	87.5%
Hypotension	2	12.5%
Chemoembolization	0	0

Complications post renal biopsy occurred in 19.1% patients. 7.4% patients developed major complications & 11.7% patients developed minor complications as shown in (Table 1). Out of 7.4% patients who developed major complications, 12.5% suffered from hypotension with SBP< 90 mmHg requiring intravenous fluids & 87% developed hematoma >5 cm requiring RBC transfusion, however nephrectomy/surgical intervention or chemoembolization were not needed. Minor complications included gross haematuria in 84% patients & perinephric hematoma (<5 cm) in 15% patients. No intervention was needed in either of these patients.

The mean pre-biopsy haemoglobin in patients who developed minor complications was 10.55 ± 1.14 mg/dL and 10.93 ± 1.21 mg/dL in patients who developed major complications. Similarly the mean pre-biopsy haematocrit was 28.86 ± 4.63 in patients who developed minor complications while 33.29 ± 3.05 in patients who developed major complications. The comparison of haematocrit and haemoglobin in patients with and without complications is shown in Table 2.

5. Discussion

Percutaneous renal biopsy (PRB) is an integral part of the clinical practice of nephrology. It is essential for the diagnosis of glomerular, vascular, and tubulointerstitial diseases of the kidney, providing information that is valuable in prognosis and patient management. PRB can be fraught with severe complications that may result in loss of kidney and rarely, even death. Selection of patients plays a crucial role in avoiding complications. Prior to the procedure, it is imperative to evaluate the patient for history of bleeding diathesis, recent non-steriodal anti-inflammatory drug (NSAID) use, hypertension control, recent pyelonephritis or skin infections near biopsy site and the ability to comply with instructions during biopsy. Pre-biopsy laboratory tests should include complete blood count including platelets, prothrombin time, activated partial thromboplastin time & international normalized ratio.

The overall complication rate in our study was 19.1% compared to Khurraum et al. [17] from Rawalpindi, Pakistan (2016) where 35% patients had a fall in haemoglobin of 1 gm/dl, 12% had gross haematuria and 82% patients had microscopic haematuria. In our study gross haematuria occurred in 10% patients.

When comparing to international studies, such as one done by Chung S et al. [18] from Korea in 2014, the gross haematuria was observed in 9.8% patients, which was comparable to ours with the incidence of self-limiting gross haematuria being 10%.

Whittier et al. [14] from America, in his study in 2004, performed PRB of native kidneys of 750 adult patients. The complications occurred in 98 (13%) patients; minor complications occurred in 50 (6.6%) patients, and major complications occurred in 48 (6.4%) patients [14].

Eiro et al. in Japan, 2005 found that the most common complication was hematoma (37.8%). Macrohaematuria was observed in 7.4% patients. Other complications included pain (6.9%), loss of blood (4.3%), and renal dysfunction (increase of serum creatinine more than 0.2 mg/dl, 2.2%). Although there were no severe complications such as loss of blood requiring a blood transfusion, loss of kidney function, or death, 10 patients had an extended rest period in bed because of moderate complications [12]. Contrary to this, in our study the most common complication was self-limiting gross haematuria (10%) & hematoma occurred in occurred in 6.36% patients. Thus, with time the complication rate post renal biopsy has decreased significantly.

In recent studies it is observed that transfusion rates were higher when serum creatinine levels were ≥2 mg/dL compared to studies who reported lower mean creatinine levels [19,20].Our study showed similar results as shown in Table 2. Similarly another factor associated with increased bleeding rate was the needle gauge. Use of 14 gauge needle has been reported to be associated with higher bleeding complications and we happened to use the 14 guage needle too [19].

Waldo et al. in 2009, in his study observed clinically apparent complications in 16% patients post-PRB (8% minor not requiring any intervention and 8% major requiring intervention).Clinically significant hematoma requiring intervention occurred in 7.4% patients & hypotension was observed in 1.2% patients. Hematoma formation in our study requiring transfusion occurred in 6.36% patients which was comparable with the results in this study, however, hypotension occurred in significantly less number of patients (0.9%) in our study.

The study of Manno et al. cohort from Italy, in 2004 showed post renal biopsy bleeding in 34.1%. 33.3% hematomas, 0.4% gross haematuria and 0.4% arteriovenous fistula. Major complications requiring blood transfusion, angiography & nephrectomy were seen in 1.2% patients.

Another study from Pakistan which shows the safety of CT guided renal biopsy included 100 patients. The incidence of gross haematuria, hematoma formation and need for transfusion was 3%, 3% & 2% respectively.[17] This study indeed shows a better safety profile of CT guided renal biopsy, yet the high cost of CT guided biopsy as compared to ultrasound guided renal biopsy will out do the benefit of CT guided biopsy over ultrasound guided renal biopsy. The ultrasound guided renal biopsy has been reported to be a safe & cost effective procedure in international as well as our study.

Ultrasound guided percutaneous renal biopsy is a safe and accurate method in the hands of trained and experienced personnel and can be safely performed as an out-patient procedure. Complication rates following the procedure are minimal and have been decreasing over a period of time especially with careful pre-biospy screening methods including evaluation of any underlying bleeding problems. Along with the safety profile of this procedure, it is also cost effective & should be used in developing countries for

Table 2
Comparison of patients with and without complications n = 220.

	Complications				p-value
	Without Complications		With Complications		
	Mean	Standard Deviation	Mean	Standard Deviation	
Age	42	9	40	8	0.230
Systolic BP	132.4	17.20	134.2	18.01	0.180
Pre biopsy hemoglobin	10.97	0.27	10.69	1.16	0.210
Post biopsy hemoglobin	10.73	1.20	10.03	1.15	0.002
Prebiopsy haematocrit	30.88	4.77	30.58	4.59	0.298
Postbiopsy haematocrit	30.88	4.77	28.83	3.88	0.018
Creatinine	1.89	0.49	5.25	2.34	<0.001

diagnosis of renal diseases. It is important that all nephrology programmes train the trainees in performing biopsies, so that there is a wider clinical use of this important investigation.

6. Limitations

There are certain limitations of our study. 1) It is a single centre study. 2) USG PRB is an operator dependent procedure hence its complication rates may vary with the expertise of the nephrologist performing it.

7. Conclusions

Percutaneous kidney biopsy is one of the most important investigations in clinical nephrology and is a relatively safe procedure because of the development of many advances such as USG and automated biopsy needles. Complication rates following the procedure are minimal and have been decreasing over a period of time. It is important that all nephrology programs train the trainees in performing biopsies, so that there is a wider clinical use of this important investigation.

Ethical approval

Ethical approval taken from Ethical Review Committee at Aga Khan University Hospital.

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Author contribution

Dr. Rabeea Azmat(RA) has made contributions to conception and design, interpretation of data, drafting the manuscript and revising it critically for important intellectual content.Dr. Abdul Basit Siddiqui(AS) has made contributions to acquisition and, interpretation of data and drafting the manuscript. Dr.M. Tahir Rizwan Khan (TK) has made contributions to interpretation of data and drafting the manuscript. Dr.Shiyam Sunder(SS) has made contributions to interpretation of data; and in revising the manuscript Dr. Waqar Kashif (WK) has made contributions to conception and design and drafting the manuscript.

Conflicts of interest

The Authors declare no conflict of interest.

Guarantor

Rabeea Azmat.

Consent

Informed consent was taken from all of the patients included in this study.

Registration of research studies

Not applicable.

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