NEPHROLOGY

Nephrology **18** (2013) 36–40

Original Article

Safety and feasibility of outpatient percutaneous native kidney biopsy in the developing world: Experience in a large tertiary care centre in Eastern India

VISHAL GOLAY, DIPANKAR SARKAR, PUNNOOSE THOMAS, MAYURI TRIVEDI, AMETASHVER SINGH, ARPITA ROYCHOWDHARY, SANJAY DASGUPTA and RAJENDRA PANDEY

Department of Nephrology, Institute of Postgraduate Medical Education and Research, Kolkata,West Bengal, India

KEY WORDS:
complications, haematuria, native kidney biopsy, outpatient, ultrasound guided.

Correspondence:
Dr Vishal Golay, Department of Nephrology, Institute of Postgraduate Medical Education and Research, 244, AJC Bose Road, Kolkata, West Bengal, India, PIN-700020. Email: drvgolay@gmail.com

Accepted for publication 2 October 2012.
Accepted manuscript online 8 October 2012.

doi:10.1111/j.1440-1797.2012.01663.x

SUMMARY AT A GLANCE

Golay and colleagues reported a prospective observational study on outpatients with percutaneous renal biopsies. They compared the efficacy and safety of percutaneous renal biopsies in outpatients and overnight inpatients and suggested percutaneous renal biopsies could be safely performed in outpatients with low risks.

ABSTRACT:

Aim: **Optimal time of observation following percutaneous biopsy has not been clearly established. Outpatient biopsy protocol was established in our centre for low risk patients and we assessed its efficacy and safety.**

Methods: **Patients fulfilling the low risk profile underwent a real time ultrasound-guided percutaneous native kidney biopsy. They were observed for 6 h and any complication was recorded. Ultrasound and hematocrit was done only in those patients with complications. Patients were contacted on telephone after 24 h and in case of any emergency.**

Results: **A total of 403 native kidney biopsies were performed from June 2011 to June 2012 of which 115 (28.5%) were on an outpatient basis. This was a 41.4% increase in the number of biopsies compared to the same period in the previous year. Fifteen patients (13.04%) had macroscopic haematuria within 2, 4 and 6 h in eight (53.33%), six (40%) and one (6.67%) patient, respectively. One of them had haematuria on follow-up phone call resolving without intervention. Only two (1.74%) patients developed significant bleeding with a drop in haematocrit needing overnight observation, with one requiring blood transfusion (with perinephric haematoma not requiring intervention). Complication rates were also similar in the 288 patients who had at least an overnight inpatient observation post-biopsy. There was no biopsy related mortality.**

Conclusions: **Percutaneous native kidney biopsies can be safely performed on an outpatient basis in selected low risk patients. This approach increases the number of procedures, decreases the waiting periods and can have potential cost savings making it an attractive option in the developing world.**

INTRODUCTION

Kidney biopsy is a very important investigation in the evaluation of patients with renal diseases. Since the first description of percutaneous native kidney biopsy (NKB) in 1951 by Poul Iversen and Claus Brun,[1] the procedure has become much safer due to many developments. The most important being introduction of spring loaded biopsy guns and the use of ultrasound (USG) for guidance.[2] These developments have significantly improved the safety as well as the yield of biopsy. Nevertheless, it is an invasive procedure and is associated with many complications, the most dreaded one being haemorrhage. Significant macroscopic haematuria has been variably reported from 0.3–14.5% but a recent meta-analysis showed that the overall rate was 3.5% with 0.9% requiring blood transfusions.[3] Thus, NKB is a relatively safe procedure with life-threatening complications occurring in <0.1% of biopsies.[4–7]

Timely detection of complications is necessary for intervention but the optimal time of observation post-biopsy is not clear. Due to the occurrence of delayed bleeding complications in many reports,[6,8] nephrologists generally perform

kidney biopsy as an inpatient procedure. Patients are generally observed for a period of at least 24 h as an observation period of ≤8 h risks missing ≥33% of complications.[8] However, there is also the need for cost savings as well as demand for a greater number of procedures due to which a shorter duration of observation is proposed in view of the relative safety of the procedure. Studies, both in the adult as well as paediatric nephrology practice have shown that shorter observation times of ≤6–8 h is safe with no procedure related deaths in the published literature.[9–13]

In addition, nephrologists in developing countries face the problem of poor follow up and poor access to health care due to which outpatient (OPD)-NKB are not generally performed. To address this issue, we performed NKB on an OPD basis for low risk patients and assessed the safety as well as efficacy of this approach.

METHODS

The study was a prospective observational study carried out in the Nephrology Unit of a large tertiary care centre in Eastern India. Patients who did not have any contraindications for a NKB[14] were selected for an OPD biopsy if they fulfilled the low-risk profile according to the protocol set by our unit. This included: age between 10–60 years, educated at least up to the primary level, access to a mobile phone, residence within 2 h of our centre, BMI ≤ 30 kg/m^2, blood pressure (BP) < 150/100 mmHg, serum creatinine ≤3 mg/dL, platelet count >150 000/mm^3 with normal coagulation profile and not on anticoagulants or antiplatelet agents. Patients residing in distant locations not wanting an admission were also included if they agreed to stay near our centre for at least a day. We also excluded patients with a clinical diagnosis of acute nephritic syndrome from an OPD-NKB. Patients not fulfilling these criteria underwent a NKB with at least a 24 hour inpatient observation. The study was approved by the Institute Ethics Committee and an informed consent was obtained from all patients before the procedure.

The procedure

All the patients were called in for the procedure at 09.00 hours. A set of baseline investigations were ordered to be done the day before the procedure and BP, pulse rate, bleeding time and clotting time were measured immediately before the procedure. Biopsies were performed by either the attending physician or nephrology residents under supervision. All biopsies were done under real-time USG guidance in the biopsy suite using the Bard Max-Core Disposable Core Biopsy Instrument (Bard Biopsy Systems, Tempe, AZ, USA). A 16GX16cm size instrument was used for adults ≥18 years old and a smaller 18GX16cm instrument was used for those <18 years. At least two cores were obtained and samples sent for light microscopy and immunofluorescence microscopy in all cases and for electron microscopy in select cases or where it could be afforded by the patient.

Observation following biopsy

Ultrasound screening for complications was done immediately after the procedure and patients were observed in the biopsy suite for at least 6 h. BP and pulse rate was measured every 30 min and all voided urine was visually inspected for macroscopic haematuria. Patients having macroscopic haematuria, fall in the BP or tachycardia or complaining of persistent pain had a haematocrit and USG done. Patients with haemodynamic instability and fall in haematocrit (≥5%) or USG showing the presence of a large haematoma (causing haemodynamic instability, compressing the renal parenchyma or severe loin pain) or other kidney/life threatening complications were admitted for observation/intervention. Those having only macroscopic haematuria were observed until urine was visibly clear. Patients were instructed to lie supine for 24 h after discharge and were contacted by phone after 24 h to enquire about haematuria and general well being and were instructed to return after 3–4 days in the OPD. A telephone number was also given to contact in case of any emergency.

Statistical analysis

Descriptive data are presented as mean ± standard deviation (SD). Independent *t*-test and paired *t*-test were used for continuous data wherever applicable and Fisher exact test/χ^2 test was used for categorical data. Multivariate logistic regression was used to predict the association of independent baseline factors (age, sex, serum creatinine, blood pressure, number of biopsy passes) for the development of macroscopic haematuria after renal biopsy. *P*-value of <0.05 was considered significant.

RESULTS

During a 12 month period from June 2011 until June 2012, a total of 403 NKB were performed, out of which 115 (28.5%) biopsies were performed on an outpatient basis. The demographic, clinical and laboratory profile of these 115 patients, along with the 288 patients who underwent an inpatient biopsy are summarized in Table 1. Both the groups had similar haemoglobin and haematocrit values. The patients undergoing an inpatient observation were younger but the difference was not significant ($P = 0.07$). A greater number of males underwent an outpatient NKB mainly due to societal factors operant in the developing world wherein males can more easily follow up as compared to females. Patients undergoing inpatient NKB also had more severe forms of renal disease with significantly higher serum creatinine values ($P = 0.01$). Even though both diastolic and systolic BP was significantly higher among inpatients, the overall number of hypertensive patients was similar ($P = 0.49$). Outpatient NKB took significantly lesser time to biopsy from advice (5.23 ± 2.76 days) as compared to patients undergoing inpatient NKB (6.96 ± 3.73 days) ($P < 0.001$). This difference was significant even in patients who had nephrotic syndrome (5.32 ± 2.51 days vs. 6.49 ± 3.69 days, $P = 0.015$), where the patient profiles were similar in both groups.

The outcomes of the procedure and complications of the 115 patients undergoing an outpatient NKB are noted in Table 2. Fifteen (13.04%) patients developed macroscopic

Table 1 Clinical and laboratory profile of the study population (*n* = 403)

Variable	Outpatient biopsy group (*n* = 115)	Inpatient biopsy group (*n* = 288)	*P*-value
Age (years)	31.42 ± 16.5	28.40 ± 14.79	0.07†
Sex, Males (%)	59.13	47.91	<0.001‡
Number of days to biopsy	5.23 ± 2.76	6.96 ± 3.73	<0.001†
Hypertension, *n*	31 (26.96%)	90 (31.25%)	0.49‡
Systolic BP (mmHg)	128.54 ± 12.88	132.82 ± 15.02	0.009†
Diastolic BP (mmHg)	79.58 ± 10.79	83.28 ± 13.27	0.01†
BMI (kg/m^2)	20.9 ± 3.9	23.55 ± 4.59	0.009†
Clinical Indications for biopsy, *n*			
1. Nephrotic syndrome	72 (62.60%)	166 (57.63%)	
2. Rapidly progressive renal failure	22 (19.13%)	67 (23.26%)	
3. Asymptomatic urinary abnormalities	17 (14.78%)	25 (8.68%)	
4. CKD of unknown aetiology	4 (3.5%)	14 (4.86%)	
5. AKI/acute glomerulonephritis	0	16 (5.55%)	
Serum creatinine (mg/dL)	1.46 ± 0.81	2.21 ± 2.51	0.01†
Platelet count (× 1000 per mm^3)	225.5 ± 64.4	234.7 ± 91.04	0.56†
Haemoglobin (prebiopsy) (g/dL)	11.24 ± 2.19	10.91 ± 2.50	0.44†
Haematocrit (prebiopsy) (%)	35.56 ± 5.89	34.18 ± 5.29	0.27†

†Independent *t*-test. ‡χ^2 test.

Table 2 Procedure outcomes and complications in patients undergoing outpatient and inpatient biopsies

Variables	Outpatient biopsies (*n* = 115)	Inpatient biopsies (*n* = 288)	*P*-value
Kidney size on USG (cm)	9.57 ± 0.91	9.64 ± 0.95	0.62
Number of biopsy passes	2.28 ± 0.54	2.24 ± 0.51	0.48†
Number of glomeruli	27.87 ± 11.31	29.71 ± 12.18	0.35†
Adequacy of kidney biopsy	100%	100%	
Macroscopic haematuria, *n*	15 (13.04%)	33 (11.4%)	0.73‡
• without drop in haematocrit	13 (11.3%)	25 (8.68%)	0.45‡
• with haematocrit drop	2 (1.74%)	8 (2.78%)	0.73§
Observation extended to 8 h, *n*	4 (3.47%)	NA	
Late haematuria after 6 h, *n*	1 (0.87%)	0	
Blood transfusion, *n*	1 (0.87%)	2 (0.69%)	NS§
Perinephric haematoma	1 (0.87%)	0	
Vascular intervention, *n*	0	0	
Death, *n*	0	0	

†Independent *t*-test. ‡χ^2 test. §Fisher's exact test. NA, not applicable; NS, not significant.

haematuria post-biopsy, out of which 13 did not have a drop in haematocrit/BP and had no complication noted on USG. Four of them needed observation for 8 h for haematuria to subside. There was one patient who had recurrence of macroscopic haematuria after 18 h, which was detected on follow up phone call and the patient was followed up in the OPD and haematuria subsided without the need for any intervention. None of the patients had pain necessitating parenteral analgesics. There was no significant difference between the pre- and post-biopsy haematocrit of patients who had macroscopic haematuria ($P = 0.183$). There was also no difference between adults and those below 18 years of age in the rate of development of macroscopic haematuria. This can also be extrapolated to the similar complication rates using an 18G versus a 16G biopsy needle.

There was no significant difference between age, sex, BMI, serum creatinine, blood pressure, haemoglobin, platelet count and number of tissue cores taken between patients who developed macroscopic haematuria and those who did not (Table 3). Logistic regression analysis failed to show any independent predictor for the development of macroscopic haematuria among the variables that were analyzed (sex, age, serum creatinine, blood pressure and number of cores of tissue taken). Regression analysis was also done for the entire 403 patients undergoing NKB for these same variables, which again failed to show any independent predictor for the development of macroscopic haematuria.

Procedure outcomes and complications in the remaining 288 patients who had an observation period of at least 24 h were similar to the outpatient group (Table 2). Macroscopic haematuria was seen in 33 (11.4%) patients, 100% of which occurred within the first 6 h. Blood transfusion was given in two patients and one patient developed a urinary tract infection. Four patients were on warfarin therapy and 20 were on

Table 3 Characteristics of patients undergoing outpatient biopsy

Characteristics	Patients with macroscopic haematuria (n = 15)	Patients without macroscopic haematuria (n = 100)	P-value
Age (years)	30.2 ± 8.02	31.6 ± 16.35	0.76†
Sex (males, %)	53.33%	46.67%	0.78‡
BMI (kg/m^2)	22.6 ± 3.71	21.4 ± 4.52	0.35†
Serum creatinine (mg/dL)	1.25 ± 0.53	1.52 ± 0.88	0.28†
Hypertension, n	6 (40%)	26 (26%)	0.35‡
Systolic BP (mmHg)	133.33 ± 13.97	127.82 ± 12.63	0.12†
Diastolic BP (mmHg)	83.07 ± 8.31	79.06 ± 11.05	0.18†
Prebiopsy haemoglobin (g/dL)	11.44 ± 2.21	11.12 ± 2.28	0.66†
Prebiopsy platelet count (X1000 per mm^3)	255.6 ± 66.4	216.7 ± 61.54	0.09†
Number of biopsy passes	2.40 ± 0.63	2.27 ± 0.53	0.38†

†Independent t-test. ‡Fisher exact test.

antiplatelet agents, which were stopped a week before admission and biopsy was done after normalization of coagulation parameters. It was only restarted after a week of biopsy. There was no biopsy related mortality in this group.

During the same duration in the previous year, a total of 285 NKB were performed in our centre. Thus, there was a 41.4% increase in the total number of biopsies after we started doing biopsies on an outpatient basis.

For assessment of probable costs involved in both outpatient and inpatient NKB, we compared 50 patients of nephrotic syndrome in each group. Even in this comparable cohort of patients, the mean number of hospital visits including the visit for biopsy was 2.26 ± 0.44 (total of 113 visits) in the outpatient NKB and number of visits including the admission visit was 3 ± 0.87 (total of 153 visits) in the inpatient NKB group ($P < 0.001$). The inpatient admission duration was 3.14 ± 0.56 days (total of 160 days).

DISCUSSION

Our study is perhaps one of the only few studies from a developing country that addresses the issue of NKB on an OPD basis and demonstrates its safety. There was no change in the number of nephrologists doing biopsies or any other change in the setting of biopsy in our centre. This makes us conclude that the main reason for the 41.4% increase in the number of total biopsies could be due to the fact that biopsies done on an outpatient basis took significantly less time to biopsy. Moreover, a short observation time also results in cost savings. Maripuri *et al*. have reported that the overall cost was much lower for outpatient biopsies compared to inpatient observation even when the additional costs accounted for the treatment of complications or possible death was considered.[15] Although we did not collect the exact expenditures incurred in either the outpatient or inpatient NKD in our study, expenditures are obviously more in inpatient NKB. In the 50 patients of nephrotic syndrome in each group, where there was no possibility of procedural delays, the number of hospital visits until inpatient admission after decision for biopsy was significantly greater. This group also had additional expenditures due to admission, which was for a mean duration of 3.14 ± 0.56 days.

The time to biopsy in the inpatient group was longer and this could be due to the fact that patients with nephritic syndromes were generally admitted for biopsy and they constitute those patients who require stabilization before a safe biopsy. However, when we compared patients with nephrotic syndrome in each group, the time to biopsy was still significantly more in the inpatient group.

In our study, the rate of macroscopic haematuria in patients undergoing outpatient biopsy was 13.04%. The occurrence of this complication is variably reported in literature between 0.3% and 14.5%.[3] New data from the Norwegian Kidney Biopsy Registry show that this complication may still be lower with macroscopic haematuria reported in 1.9% of the patients; 0.9% of patients needing blood transfusion and 0.2% of patients needing surgical intervention/catheterization.[16] Haematoma rate when post-biopsy USG is performed routinely is 17%, whereas studies using USG only to evaluate post-biopsy symptoms demonstrate a haematoma rate of 5%. Angiographic intervention rate is only 0.6%.[3] In our study, we encountered only one (0.87%) perinephric haematoma and none of our patients needed any angiographic intervention.

Even though many factors were believed to predict macroscopic haematuria, a recent meta-analysis of 34 studies with a total of 9474 patients failed to show predictability of many variables including needle gauge, number of needle passes, female sex, baseline serum creatinine level, systolic blood pressure, haemoglobin level, patient age and indication for renal biopsy. However, a higher blood transfusion requirement was seen when a 14G needle was used for biopsy compared to 16G and 18 needles, in patients with higher serum creatinine values, in biopsies done for acute kidney injury, lower baseline haemoglobin and also in older patients and hypertensives.[3] Whittier *et al*. had also reported

that biopsies in patients with a serum creatinine ≥5.0 mg/dL were 2.3 times more likely to have a complication after renal biopsy.[8] We also failed to demonstrate the relationship between some of these variables and the occurrence of macroscopic hematuria. But we had excluded patient serum creatinine ≥3 mg/dL from undergoing outpatient NKB in our study. Even in the group of patients who had an inpatient observation with higher creatinine values, the complication rates were similar.

It has been seen in some studies that 20–33% of haemorrhagic complications occurred beyond the first 8 h after the kidney biopsy.[6,8] However, a substantial portion of the biopsies in these studies were performed manually using larger 14G needles. Thus, these data cannot be extrapolated to practice because studies have demonstrated that ultrasound guided renal biopsies are safer.[17] Also, smaller and automated needles have been reported to have lesser complication rates.[18] On the contrary, in our experience of a total of 403 native kidney biopsies (115 outpatient and 288 inpatient), all 48 (11.91%, $n = 403$) cases of macroscopic haematuria were detected within the first 6 h. There was only one case of recurrence of haematuria beyond this time. There are also many studies both in children and in adults that have shown no additional risks with a shorter observation time of 6–8 h.[9–13]

In our study, with NKB using real time USG guidance and automated biopsy guns and in select group patients with low risk profile, we did not encounter any life-threatening complication or additional intervention requirement. This approach can thus be selectively and safely applied even in developing countries. It can significantly increase the number of procedures to cater for the ever growing need for specialized care and thus decrease waiting periods, potentially resulting in cost savings too. Since we also observed that the complication rates were similar in both the group of patients undergoing outpatient as well as an inpatient biopsy, despite the differences in the risk profile, it seems that the number of patients on outpatient biopsy can be further expanded.

ACKNOWLEDGEMENTS

We thank all the residents and nursing staff taking care of the patients who were included in this study.

REFERENCES

1. Iversen P, Brun C. Aspiration Biopsy of the kidney. *Am. J. Med.* 1951; **11**: 324–30.
2. Donovan KL, Thomas DM, Wheeler DC, Macdougall IC, Williams JD. Experience with a new method for percutaneous renal biopsy. *Nephrol. Dial. Transplant.* 1991; **6**: 731–3.
3. Corapi KM, Chen JLT, Balk EM, Gordon CE. Bleeding complication of native kidney biopsy: A systematic review and meta-analysis. *Am. J. Kidney Dis.* 2012; **60**: 62–73.
4. Korbet SM. Percutaneous renal biopsy. *Semin. Nephrol.* 2002; **22**: 254–67.
5. Burstein DM, Schwartz MM, Korbet SM. Percutaneous renal biopsy with the use of real-time ultrasound. *Am. J. Nephrol.* 1991; **11**: 195–200.
6. Marwah DS, Korbet SM. Timing of complications in percutaneous renal biopsy: What is the optimal period of observation? *Am. J. Kidney Dis.* 1996; **28**: 47–52.
7. Mendelssohn DC, Cole EH. Outcomes of percutaneous kidney biopsy, including those of solitary native kidneys. *Am. J. Kidney Dis.* 1995; **26**: 580–85.
8. Whittier WL, Korbet SM. Timing of complications in percutaneous renal biopsy. *J. Am. Soc. Nephrol.* 2004; **15**: 142–7.
9. Mahajan V, Suri D, Saxena A, Nada R. Should ultrasound guided percutaneous renal biopsy in children be done in a day care setting? *Indian J. Nephrol.* 2010; **20**: 21–4.
10. Simckes AM, Blowey DL, Gyves KM. Success and safety of same-day kidney biopsy in children and adolescents. *Pediatr. Nephrol.* 2000; **14**: 946–52.
11. McMahon GM, McGovern ME, Bijol V *et al*. Development of an outpatient native kidney biopsy service in low-risk patients: A multidisciplinary approach. *Am. J. Nephrol.* 2012; **35**: 321–6.
12. Lin WC, Yang Y, Wen YK, Chang CC. Outpatient versus inpatient renal biopsy: A retrospective study. *Clin. Nephrol.* 2006; **66**: 17–24.
13. Maya ID, Allon M. Percutaneous renal biopsy: Outpatient observation without hospitalization is safe. *Semin. Dial.* 2009; **22**: 458–61.
14. Salama AD, Cook T. The renal biopsy. In: Taal MW, Chertow GM, Marsden PA, Skorecki K, Yu ASL, Brenner BM (eds). *Brenner & Rector's The Kidney*, 9th edn. Philadelphia: Saunders, 2012; 1006–14.
15. Maripuri S, Penson DF, Ikizler TA, Cavanaugh KL. Outpatient versus inpatient observation after percutaneous native kidney biopsy: A cost minimization study. *Am. J. Nephrol.* 2011; **34**: 64–70.
16. Tondel C, Vikse BE, Bostad L, Svarstad E. Safety and Complications of Percutaneous Kidney Biopsies in 715 children and 8573 Adults in Norway 1988-2010. *Clin J Am Soc Nephrol* 2012; **7** (10): 1591–7.
17. Maya ID, Maddela P, Barker J, Allon M. Percutaneous renal biopsy: Comparison of blind and real-time ultrasound-guided technique. *Semin. Dial.* 2007; **20**: 355–8.
18. Cozens NJ, Murchison JT, Allan PL, Winney RJ. Conventional 15 G needle technique for renal biopsy compared with ultrasound-guided spring-loaded 18 G needle biopsy. *Br. J. Radiol.* 1992; **65**: 594–7.