Feasibility and experience of nurse-led ultrasound-guided percutaneous liver biopsy

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Abstract

The demand for collaborative and innovative clinical practitioners to act as leaders in healthcare remains strong as many challenges are faced including rising costs, shortage of professionals, the introduction of new technology and difficulties with access to care. Nurses in advanced nursing practice are well positioned to respond to this, playing a key role in building nursing knowledge, advancing the nursing profession and contributing to sustainable and effective healthcare systems. Percutaneous liver biopsy (PLB) is an essential tool used for diagnosis and management in liver disease, being most commonly performed by consultant gastroenterologists, hepatologists and radiologists. While invasive and with complications PLB is a simple, cost-effective procedure that can be undertaken at the bedside. Our study demonstrates that an advanced nurse practitioner (ANP) with a sound working knowledge of hepatology and familiarity with indications, methods and risks of PLB procedure can be trained to perform ultrasound-guided liver biopsy both safely and effectively.

Introduction

The technique for obtaining liver tissue was first accredited to Paul Erlich over 100 years ago, with the first percutaneous liver biopsy for diagnostic purposes being reported in 1923.¹ By the 1950s, following modifications and improvements in technique liver biopsy had become the 'gold standard' in the management of liver disease.² Recent advances in medical imaging, non-invasive fibrosis markers and drug treatment have had a significant effect on the diagnosis and management of hepatic disease and as a consequence indications for liver biopsy have changed.³ The procedure, however, is still considered to be the most specific test in the

assessment of the nature and severity of liver diseases.⁴ In addition, the low death rate of 0.01–0.17% and the relatively low morbidity of this procedure have meant that liver biopsy has become widely used.⁵ Liver biopsy should be considered in patients when the diagnosis is in question or when the histological knowledge of a specific diagnosis would alter the management plan.⁶

The usual technique for obtaining liver tissue for histological evaluation of diffuse parenchymal liver disease is percutaneous needle biopsy, performed either blind or guided by ultrasound or CT.⁷ There are several studies discussing which clinicians are best placed to perform the procedure as well as focusing on indications for liver biopsy, how the procedure should be performed and frequency of complications after the procedure.^{7–11} There is no consensus as to who should perform liver biopsy and few data as to whether the procedure can be safely performed by other healthcare personnel. Only one published study relates to a non-physician (physician assistant) performing PLB in the Mayo clinic USA.¹²

Methods

Approval was gained at local and national levels for the development of a theoretical and practical training pack relating to nurse-led ultrasound-guided PLB, in accordance with international and national guidelines and local trust policies. Assessment and demonstration of achievement included underpinning theoretical knowledge and observation of procedure, ultrasound technique and the performance of 45 biopsies under direct supervision before independent performance. A consultant radiologist competent in the performance of PLB provided

clinical supervision and dedicated training in PLB including ultrasound technique. In addition, the radiologist was responsible for the decision on suitability of patients for the ANP biopsy list. Patients with coagulopathy (deemed as platelet count <80/international normalised ratio >1.3), hepatic mass lesions or decompensated cirrhosis were excluded from the study.

Informed consent was obtained before each procedure and the optimal intercostal site for retrieval of liver tissue identified by the ANP with the use of bedside ultrasound examination. Local anaesthetic (lido-caine) was administered by the ANP followed by the use of an 18 g automated spring loaded biopsy needle (ACHIEVE) to obtain the sample. Postprocedural care was given in accordance with local trust policy. Data were collected prospectively, including aetiology of liver disease, age and sex of patient, preprocedural haematological and biochemical markers, complications postprocedure, number of passes with needle, sample size and Knodel fibrosis score.

Results

Between November 2004 and March 2010 a total of 216 patients underwent PLB performed by the ANP specialising in hepatology (table 1).

Complications after the procedure

Complications after PLB include pain, bleeding, infection, pneumothorax, puncture of adjacent organs and death.¹³ Within the study the overall complication rate, excluding mild pain was 1.4%. Pain (mild and requiring no intervention) was reported in 11% (n=23). One patient described moderate pain which subsequently settled after the administration of paracetamol. One patient was admitted for overnight observation with significant pain (requiring opiate intervention) with no identification of a postprocedural bleed. One patient had immediate severe right upper quadrant pain and then an identified postprocedural bleed and was admitted for overnight observation, requiring no other clinical intervention. There were no other cases of major complications after the procedure. There were no requirements for blood transfusion or surgical intervention and no patient died undergoing the procedure.

Sample size

The mean sample size of liver tissue adequate for assessment (n=213) was 18 mm. Three samples were deemed too small for adequate assessment measured at 10 mm, 10 mm and 7 mm. While not routinely collected, complete portal tract data were available on 117 patients showing the mean amount of portal tracts to be 9.

Number of passes

A total of seven (3%) procedures required a second pass of the biopsy needle to obtain an adequate sample.

Table 1 Baseline data and histological diagnoses (n=216)

Mean age	51 (18–77)	Number
Sex	Male	123
	Female	93
Histological diagnosis	NASH/NAFLD	85
	HCV	56
	AIH/PSC/PBC	33
	ALD	30
	GH	5
	HBV	1
	α1-Antitrypsin	1
	Drug-induced liver injury	1
	Non-specific hepatitis	1
	Samples unsuitable for assessment	3

AIH, autoimmune hepatitis; ALD, alcoholic liver disease; GH, genetic haemochromatosis; HBV, hepatitis B virus; HCV, hepatitis C virus; NAFLD, non-alcoholic fatty liver disease; NASH, non-alcoholic steatohepatitis; PBC, primary biliary cirrhosis; PSC, primary sclerosing cholangitis.

Fibrosis score

Mean fibrosis score was 2 (knodel) with 31 patients (14.5%) having established cirrhosis.

Discussion

The main cause of mortality after liver biopsy is intra-peritoneal haemorrhage, with major bleeding reported in up to 4.5% of liver biopsies and rates varying depending on where the liver biopsy was performed.^{14 15} In the Mayo clinic the mortality from fatal haemorrhage was 0.11%.¹⁶ McGill reported significant haemorrhage occurring in 0.35–0.5% of all procedures.² Various predictors of bleeding have been identified; coagulopathy, multiple passes, cirrhosis and presence of tumour but it is worth noting however that most bleeding cases occur with an international normalised ratio of <1.3.¹⁷ The rate of significant haemorrhage in the study was 0.46%. This was associated with a drop in haemoglobin of >2 g/l and identification of a large haematoma with the use of CT. No further intervention was required to maintain patient safety other than overnight observation.

Morbidity rates vary, but 5.9% has been quoted for those with minor complications postprocedure.¹⁸ Differences in published papers relate to lack of a clear definition of minor and major symptoms.¹⁹ Pain, including mild discomfort, is the most common complication of PLB and has been noted to occur in up to 84% of patients.⁶ Moderate and severe pain occurs in 3% and 1.5%, respectively.¹⁸ Complication rates after PLB may be influenced by factors such as the use of ultrasonography to guide placement of the biopsy needle, the type of needle used and the skill and experience of the operator.¹²

It has been difficult to prove that ultrasound guidance is better than blind approaches because complications of PLB are relatively uncommon.² The effect of imaging preprocedure in reducing complication

rates remains controversial. Observation with ultrasound should reduce the risk of puncturing adjacent organs and increase adequate sampling with accurate localisation of the liver. This localisation may lead to a decreased risk of bleeding when associated with the need for a reduced number of passes to the liver.²⁰ Ultrasound is generally readily available, safe and cost-effective, being particularly useful where the liver may be difficult to visualise—for example, in obese patients.²¹ Its use is therefore recommended²² but it should be noted that this technique affects the training for PLB and clinicians need to be proficient in this area. The question has been posed therefore as to whether radiologists are best placed to perform the procedure. There is no distinct recommendation for ultrasound training for those not specialising in radiology and the number of proposed supervised ultrasound markings for liver biopsy ranges between 20 (American board) and 300 (European board). Proficiency should include the detection of anatomical variation such as Chilaiditi syndrome, detection of adjacent organs, diagnosis of dilated intrahepatic ducts and ascites and the appearances of liver lesions.

Reports have suggested that a sample size of at least 2 cm of liver tissue is required for adequate assessment and also importantly a minimum number of complete portal tracts.²³ In practice, the use of smaller samples, with fewer numbers of portal tracts, are common.^{13–24} While these standards might have been set within the literature, in practice, the use of fewer samples and a smaller number of portal tracts is common. Poynard *et al*²⁵ concluded that 84% of biopsy samples obtained by an experienced practitioner were <2 cm. In addition, Cholongitas *et al*²⁶ in a systematic review found average length and number of portal tracts below published requirements in over 50% of cases. Gunneson's data¹² proved an overall mean sample size of 3.2 cm which is considerably higher than in this and other studies.^{25–27} Sample size is affected by the type of biopsy needle used, varying in gauge and mechanism (cutting, suction, automated). The authors conclude that the large samples were most likely due to the use of a large 14 g suction needle (Jamshidi). The diagnostic yield of liver tissue can be increased with the number of passes taken. This, however, might increase the complication rate.²⁸

Over the period of the study the ANP performed an average of 40 PLB procedures a year. This figure may seem low and initially training was hindered by unavailability of either student or mentor, or resources such as bed availability. The ANP has the capacity to perform two PLB procedures a week and non-attendance of patients occurs. In addition, a 16-month period of maternity leave has been undertaken.

Continued clinical supervision and support is paramount to success of this expansion of role, particularly in light of the associated complications with the procedure. Regular clinical governance is maintained and the ANP has provided clinical supervision to

other centres wishing to set up such a service whereby those working as nurse specialists can undertake PLB. Underpinning the success of advanced nursing practice is this continued clinical supervision and support from other members of the multidisciplinary team.

With no national comparisons this study was developed in conjunction with a number of departments in order to ensure patient safety and for the practitioner to fully understand accountability and lines of responsibility. It should be noted that the ANP has significant experience in the management of hepatological patients, supported by an MSc in advanced nursing practice and non-medical prescribing status. ANPs build on their expertise in a specialist area, using sophisticated knowledge and skills to provide effective care with a high degree of autonomy to an identified population. Trends in the delivery of healthcare are providing nurses with opportunities to expand current roles and create new ones. Advanced nurse practitioners have the education, clinical expertise, leadership skills and understanding of organisations, health policy and decision-making to play an important role now and in the future. This depth and breadth of knowledge draws on a wide range of strategies to meet the needs of individuals, families, groups, communities and populations and to improve access to, and quality of, care.

In addition to supporting the concept that a non-medical practitioner can perform liver biopsy successfully and safely, the study was envisaged as a holistic approach to the patient experience. Anecdotal evidence suggests patients respond well to having the ANP undertake the procedure and report a reduction in anxiety levels when having seen the ANP in clinic before being counselled about the required intervention. The same practitioner in addition often then gives the results to patients. It would be useful for future studies to consider patient experience and satisfaction.

Conclusion

Liver biopsy remains a fundamental tool in the management of patients with liver disease and its use is recommended until better methods are fully developed and validated. This study demonstrates that the biopsy procedure can be safely performed by an appropriately trained ANP. Complication rates were low in comparison with international results and the majority of samples deemed adequate for assessment by the histopathologist.

Contributors EAF accepts full responsibility for the finished article, had access to all data and controlled the decision to publish. The article was written in full by EAF. The training for percutaneous liver biopsy (PLB) was fully administered by GM who also proof read the article with one comment about the biopsy type of needle. HSH supported theoretical training of PLB and also proof read the article with some comments.

Competing interests None.

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References

1. Kuntz E, Kuntz HD. Hepatology textbook and atlas. Third edition. Germany: Springer 2004.
2. McGill DB. Liver biopsy: when, how, by whom, and where? *Curr Gastroenterol Rep* 2001;3:19–23.
3. Neuberger JM, Lucey MR. Living-related liver donation: the inevitable donor deaths highlighted the need for greater transparency. *Transplantation* 2004;77:489–90.
4. Kalambokis G, Manousou P, Vibhakorn S, *et al.* Transjugular liver biopsy—indications, adequacy, quality of specimens, and complications—a systematic review. *J Hepatol* 2007;47:284–94.
5. Sherlock S, Dooley J. Diseases of the liver and biliary system. 10th edition. London: Blackwell scientific 1997.
6. Rockey DC, Caldwell SH, Goodman ZD, *et al.* Liver biopsy. *Hepatology* 2009;49:1017–44.
7. Griffiths A, Viala CH, Olynyk JK. Liver biopsy in the 21st century: where and why? *Med J Aust* 2002;176:52–3.
8. Anguaco TL, Lal SK, Banaad-Omiotek GD, *et al.* Current liver biopsy practices for suspected parenchymal liver diseases in the United States: the evolving role of radiologists. *Am J Gastroenterol* 2002;97:1468–71.
9. Douds AC, Joseph AE, Finlayson C, *et al.* Is day case liver biopsy underutilised? *Gut* 1995;37:574–5.
10. Farrell RJ, Smiddy PF, Pilkington RM, *et al.* Guided versus blind liver biopsy for chronic hepatitis C: clinical benefits and costs. *J Hepatol* 1999;30:580–7.
11. Gilmore IT, Burroughs A, Murray-Lyon IM, *et al.* Indications, methods, and outcomes of percutaneous liver biopsy in England and Wales: an audit by the British Society of Gastroenterology and the Royal College of Physicians of London. *Gut* 1995;36:437–41.
12. Gunneson TJ, Menon KV, Wiesner RH, *et al.* Ultrasound-assisted percutaneous liver biopsy performed by a physician assistant. *Am J Gastroenterol* 2002;97:1472–5.
13. Bravo AA, Sheth SG, Chopra S. Liver biopsy. *N Engl J Med* 2001;344:495–500.
14. Piccinino F, Sagnelli E, Pasquale G, *et al.* Complications following percutaneous liver biopsy. A multicentre retrospective study on 68,276 biopsies. *J Hepatol* 1986;2:165–73.
15. Sanai FM, Keeffe EB. Liver biopsy for histological assessment: The case against. *Saudi J Gastroenterol* 2010;16:124–32.
16. Sue M, Caldwell SH, Dickson RC, *et al.* Variation between centers in technique and guidelines for liver biopsy. *Liver* 1996;16:267–70.
17. Ewe K. Bleeding after liver biopsy does not correlate with indices of peripheral coagulation. *Dig Dis Sci* 1981;26:388–93.
18. Perrault J, McGill DB, Ott BJ, *et al.* Liver biopsy: complications in 1000 inpatients and outpatients. *Gastroenterology* 1978;74:103–6.
19. Grant A, Neuberger J. Guidelines on the use of liver biopsy in clinical practice. British Society of Gastroenterology. *Gut* 1999;45:IV1–IV11.
20. Stotland BR, Lichtenstein GR. Liver biopsy complications and routine ultrasound. *Am J Gastroenterol* 1996;91:1295–6.
21. Lebrech D. Various approaches to obtaining liver tissue—choosing the biopsy technique. *J Hepatol* 1996;25:20–4.
22. Lightdale CJ, Das L. Difficult liver biopsies: only for radiologists? *Am J Gastroenterol* 1997;92:364–5.
23. Schlichting P, Hølund B, Poulsen H. Liver biopsy in chronic aggressive hepatitis. Diagnostic reproducibility in relation to size of specimen. *Scand J Gastroenterol* 1983;18:27–32.
24. Bedossa P, Dargère D, Paradis V. Sampling variability of liver fibrosis in chronic hepatitis C. *Hepatology* 2003;38:1449–57.
25. Poynard T, Imbert-Bismut F, Munteanu M, *et al.* Overview of the diagnostic value of biochemical markers of liver fibrosis (FibroTest, HCV FibroSure) and necrosis (ActiTest) in patients with chronic hepatitis C. *Comp Hepatol* 2004;3:8.
26. Cholongitas E, Senzolo M, Standish R, *et al.* A systematic review of the quality of liver biopsy specimens. *Am J Clin Pathol* 2006;125:710–21.
27. Colloredo G, Guido M, Sonzogni A, *et al.* Impact of liver biopsy size on histological evaluation of chronic viral hepatitis: the smaller the sample, the milder the disease. *J Hepatol* 2003;39:239–44.
28. Vautier G, Scott B, Jenkins D. Liver biopsy: blind or guided? *BMJ* 1994;309:1455–6.