Fast-track, ambulatory ultrasound-guided Tru-Cut liver biopsy is feasible and cost-efficient

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ABSTRACT

INTRODUCTION: Most institutions perform percutaneous liver biopsy with a post-biopsy patient observation period lasting up to eight hours, which is resource-demanding. This study aimed to evaluate the safety of liver biopsy performed in a fast-track setup with an only one-hour post-biopsy observation time.

METHODS: Patients referred to our institution underwent fast-track ultrasound-guided 18-gauge Tru-Cut liver biopsy procedures. Each single biopsy procedure was followed by a post-procedure observational period of one hour and an additional focused assessment with sonography for trauma before patient discharge. All patients underwent a clinical follow-up programme at revisit in order to register any delayed onset of major complications.

RESULTS: Out of 200 completed biopsy procedures, two major complications were registered post biopsy and they were treated appropriately. All patients were safely discharged from our institution. No fatality or long-term complications were found during this study.

CONCLUSION: The fast-track approach reported herein is a feasible option when adequate patient information is given. Besides the obvious, positive effect on patient logistics and departmental throughput, this approach may also reduce diagnostic work-up time and bring financial benefits. Therefore, we encourage the use of this approach in institutions comparable to our own.

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Despite recent advances in medical imaging, percutaneous coarse-needle liver biopsy remains the gold standard for diagnosis of focal liver lesions [1]. However, liver biopsy is associated with a risk of potentially serious complications such as bleeding [2]. The latest European guideline (2004) from the British Society of Gastroenterology recommends that this procedure shall be performed on an in-patient basis or an out-patient basis with a six-hour post-biopsy observation period [3]. Following this recommendation makes the procedure both expensive and time-consuming. Recent recommendations (2009) from the United States suggest that this observation time may be reduced to four or two hours [4]. Supported by previous studies with a short observation time [5-7], we considered that ultrasound (US)-guided Tru-Cut liver biopsy performed under appropriate conditions could be safely performed as a fast-track ambulatory procedure with an observation time of one hour. In contrast to previous studies [5-7], we added a Focused Assessment with Sonography for Trauma (FAST) scan before discharge of the patient in order to detect any acute major and clinically important complications [2, 8]. Included in our algorithm was a short-term (2-3 weeks) patient revisit follow-up to register any delayed onset of major complications.

The benefits of this fact-track approach may include shorter waiting lists, reduced overall costs and a shorter procedure-related time for the individual patient [5, 7].

The aim of this study was to evaluate the major complications and thereby to discuss the cost-efficiency of this algorithm.

Minor complications including mild post-biopsy pain at the puncture site are common and self-limiting, and they were therefore not included in the scope of this study [9].

METHODS

This is a quality assurance study approved by the head of the institution and The Danish Data Protection Agency. Due to its retrospective nature, this study was exempt from approval by the local ethics committee. All included patients provided their informed consent prior to the liver biopsy procedure. The indications for these biopsies were diagnostics of primary and secondary liver cancer or cancer receptor determination from known liver metastasis. Liver parenchyma biopsy was not conducted in our institution (Department of Surgery).

All fast-track biopsy procedures were performed on an out-patient basis by a team of three US interventionists, all performing at an expert level [10]. Prior to the procedure, medical records and blood samples available were reviewed by a US interventionist to exclude any contraindication such as: coagulation disorders, recent use of anticoagulants, lack of fasting, a platelet count < 40,000/µl, an international normalised ratio (INR) > 1.5 or a partial thromboplastin time (PTT) > 40. A patient-site coagulation test was performed using a portable device (CoaguChek XS Plus, Roche Ltd.) providing INR and PTT levels if no recent coagulation status was available. The patient and his or her companion or relatives were

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TABLE 1

Histological report with relation to demography (gender and age).

Histological report	Patient cases, n[c]	Gender, M/F, n	Age, yrs, median (IQR)
Normal histology	17	7/10	67 (60-71)
Benign liver condition[a]	20	5/15	58 (41-68)
Biopsy not representative	16	7/9	73 (60-79)
Adenocarcinoma from pancreatic cancer	31	10/21	70 (60-78)
Adenocarcinoma from colon-rectal cancer	43	22/21	67 (59-77)
Adenocarcinoma from breast cancer	26	0/26	59 (52-65)
Liver metastasis from other cancer	21	11/10	71 (63-75)
Primary liver cancer[b]	26	18/8	64 (57-75)
Total	200	80/120	66 (57-74)

F = female; IQR = interquartile range; M = male.
a) Regenerative nodules, focal nodular hyperplasia, haemangioma, necrosis, cirrhosis.
b) Cholangiocarcinoma, hepatocellular carcinoma.
c) 18 of 182 included patients underwent the procedure twice at different points in time; these patients were regarded as separate patient cases.

TABLE 2

The number of Tru-Cut punctures performed in the study with relation to patients with major complication.

	Procedures		Patients with major complications, n
	n	%	
Tru-Cut punctures, n			
1	128	64.0	0
2	54	27.0	1
3	17	8.5	1
4	1	0.5	0
Total	200	100.0	2

informed both orally and in writing about possible complications and emergency procedures.

US-guided Tru-Cut 18G (1.2 mm) with a core-biopsy cutting needle (MEDAX Italy, compatible with Bard Magnum automatic biopsy gun) was performed under local anaesthesia (Lidocaine). The biopsy gun was adjusted to extract a specimen length of (up to) 20 mm. Continuous US visualisation of the needle during the entire procedure was maintained, and the number of specimens was decided on the basis of the quality of the tissue sample macroscopically evaluated by the US interventionist. The specimen was immediately fixated in formalin for transfer to the Department of Pathology for histological evaluation.

The insertion site was covered by a simple plaster after manual compression, and the patient was advised to continue fasting and to remain sitting or resting in a supine position calmly in the observation area for one hour. The one-hour post-biopsy observation was followed by a FAST scan combined with a clinical evaluation including vital signs (blood pressure, pulse rate and appearance or colour). The patient was then discharged without further observation, provided that no complications were detected by the FAST scan and no new-onset complaints were observed during the clinical evaluation. Moderate or severe pain that required further therapy or observation was registered. Patients with mild pain were discharged without delay with optional paracetamol tablets.

Major complications were registered in accordance with the definitions used in the Society of Interventional Radiology (SIR) classification [11], in which therapy requiring hospitalisation (< 48 hours), major therapy requiring hospitalisation (> 48 hours), permanent adverse sequelae and death are major complications graded C, D, E and F, respectively.

The patients underwent follow-up at their hospital revisits. During these revisits, information about any major complications was collected. The revisit usually occurred for one of the following reasons: 1) consultation concerning the biopsy result, 2) elective admission for chemotherapy/surgery or 3) additional elective examination. The investigators contacted and interviewed those patients who had not revisited the hospital after 30 days.

Trial registration: not relevant.

RESULTS

The present study included a total of 182 referred patients who completed 200 consecutive US-guided 18G Tru-Cut liver biopsy procedures performed during a four-year period (from January 2010 through December 2013) at our institution. Eighteen of the included patients underwent the biopsy procedure twice at different time points (either due to a non-representative biopsy sample or a follow-up biopsy in relation to disease progression). We considered these patients as separate patient (biopsy) cases. A total of 80 male and 120 female patient cases with a median age of 66 years (interquartile range: 57-74 years) were enrolled in this study. Prior to the biopsy procedure, 171 of the included patient case (153 patients) had already been diagnosed with a cancer disease. The histological evaluation of the biopsies revealed 121 cases with liver metastasis, of which colorectal, pancreatic and breast cancer were the most frequently diagnosed cancer diseases. The detailed histological results are depicted in **Table 1**. In addition, the number of insertions per procedure is shown in **Table 2**. Two thirds of the 200 biopsy procedures were completed in a single puncture, and less than 10% required three or more needle punctures.

All 200 patient cases completed the one-hour post-procedure observation and post-biopsy FAST scan. All 200 patient cases also completed the revisit follow-ups, of which 65% were completed at a biopsy report consul-

tation 11 days later and 33% were completed at admission for chemotherapy two weeks later. The remaining 2% of the patient cases were contacted in person 30 days after the biopsy procedure. The national patient records were also reviewed to register any biopsy-related re-admission events that occurred in the period between the biopsy procedure and the revisit follow-up, during which nine patients, apart from major complication cases, contacted the hospital due to biopsy-related pain. They were readmitted for clinical examination including FAST scan and observed for a few hours before discharge without any treatment.

Two major complications were registered in a total of 200 procedures. Both complications were due to post-biopsy bleedings with non-fatal outcomes. One patient case was treated with saline infusion (SIR C). The other case required more demanding therapies and had a longer hospitalisation (SIR D). The patient cases are described in the following.

Case 143 (INR = 1.1): A 56-year-old female with ovarian cancer underwent a procedure that involved two needle punctures due to partial fragmentation of the first biopsy sample. No bleeding was visible on the FAST scan one hour post procedure. The patient experienced pain in the left lower abdominal region the next morning and was therefore readmitted, and a computed tomography (CT) showed a minor intra-peritoneal bleeding of approximately 200 ml. The patient was hospitalised for two days of observation during which she was treated with saline infusion only, and after which she was discharged in a stable clinical condition. Eight days later, she returned for a consultation relating to the biopsy result and was in good condition.

Case 167 (INR = 1.2): A 91-year-old female with disseminated malignant melanoma and multiple partly cystic metastases in both liver lobes underwent US-guided liver biopsy. The biopsy specimens were fragmented; three punctures were done to achieve appropriate samples. Approximately one hour after the biopsy, the patient felt dizzy. A FAST scan revealed a 15 mm rim of fluid between the liver and the abdominal wall, and her systolic blood pressure (SBP) was 90 mmHg. This was interpreted as ongoing bleeding and the patient was transferred immediately to the intensive care unit. Acute laparoscopy was performed due to rapidly dropping haemoglobin levels and SBP. A 1.5 l haematoma around the liver was evacuated, but no ongoing bleeding from the three biopsy sites on the surface of liver was present. There were no other injuries in the abdominal cavity. The surgeons applied fibrinogen patches (Tachosil, Nycomed Danmark A/S, Roskilde, Denmark) to the biopsy sites to prevent further bleeding. The patient recovered successfully and was discharged from the hospital three days after the operation. Seven days later, she returned for consultation concerning her biopsy result and was in good condition.

A female patient undergoing an ultrasound-guided Tru-Cut needle liver biopsy at our department.

DISCUSSION

In our opinion, the single most important benefit from the fast-track biopsy algorithm is a positive impact on the patient logistics and diagnostic process, because a bottleneck caused by limited room for post-procedure patient observation will be avoided through a fast-track regimen. With this approach there is no delay between the decision to take the biopsy and the biopsy. Previously in our department, performing a Tru-Cut histology biopsy would require scheduling of a new appointment as well as admission for post-procedure observation. With the fast-track approach, we avoid rescheduling for this appointment and typically save 2-7 days, which may contribute to a more rapid diagnosis and subsequent treatment. Furthermore, the fast-track approach will be associated with a financial gain if the patient needs less observation in hospital, provided the complication rate remains unchanged.

During our four-year study period, no fatality or permanent adverse sequelae occurred in relation to this fast-track approach. However, we registered two non-fatal post-procedure bleedings, categorised as C and D, respectively, in the SIR classification [11]. The SIR classification allows for uniform reporting of complications that can be compared across future studies. The definitions of major complications in previous studies differ [1, 12-16] making mutual complication rates incomparable. Overall, post-biopsy haemorrhage is the most frequently observed major complication. However, the major complication rates were low (0.5-1.7) in most studies, which is consistent with our findings (1.0).

Major post-biopsy haemorrhage is rare and predominantly occurs within the first six hours according to an earlier, but larger study [2]. A recent study with more

than 3,000 US-guided biopsies showed that the vast majority of major complications occurred within the first hour [6]. We performed all the liver biopsies with US-guidance. Compared to blind biopsy, the US-guided biopsy reduces the risk of accidental puncture of adjacent organs during the procedure [2, 7, 8, 17]. In addition, according to previous studies, the post-biopsy FAST scan added to our routine post-procedure algorithm has the potential of detecting ongoing major bleedings [2, 8]. In the present study, this FAST scan fulfilled the main purpose and detected all cases of major ongoing bleeding. We are, however, aware of its limitation in detecting latent bleeding that takes time to accumulate, which was exactly what we observed in one case of latent minor intra-peritoneal (200 ml) bleeding (Case 143). The patient was readmitted to the hospital the next morning due to increasing pain and received the proper treatments. In these latent bleeding cases, the only feasible solution is appropriate patient information and education, because even with 4-8 hours of observation after the biopsy, these complications may still be impossible to detect. In the actual case reported herein, symptom onset did not occur until 19 hours post biopsy. In accordance with this observation, biopsy patients are advised to remain within one hour's travel distance from their family practitioner or from hospital for the first 24 hours after their biopsy.

We are limited by the relatively small sample size. Therefore, the risk factors associated with major complication and justification of post-biopsy FAST scan could not be evaluated statistically. The strength of our study was 100% data completeness, and no cases of major complication had therefore been overlooked. In addition, the fast-track algorithm has a potential financial benefit compared with the conventional algorithm performed on an in-patient basis with 4-8 hours of hospitalisation. We did not calculate the actual cost saving in our population, but an Australian study estimated that the cost of hospitalisation and FAST scan were 806 USD and 79 USD, respectively, per procedure [5]. Based on their estimations, the financial aspect of this fast-track approach could, indeed, be relevant and attractive for Danish institutions. To the best of our knowledge, the major institutions in Denmark still perform these liver biopsies on an in-patient basis with 4-6 hours of hospitalisation. We believe that the use of this fast-track algorithm is feasible and beneficial in institutions comparable to our own. The positive clinical impact in our institution is convincing, and our fast-track biopsy algorithm will continue.

CONCLUSION

The fast-track, US-guided 18G Tru-Cut biopsy algorithm described herein is a safe and feasible option when adequate patient information is given. This approach is of major benefit to the patient and the clinical department owing to the substantial reduction in diagnostic work-up time and the increase in patient throughput. As a positive side-effect, our approach is associated with a financial benefit.

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