Annals of Hematology and Oncology Research

ISSN: 2692-7950

Research Article

Smartphone: A New Tool for Precisely Locating the Posterior Iliac Crest to Obtain Bone Marrow Aspiration and Trephine (Core) Biopsies

*Anwarul Islam**

Department of Medicine, Division of Hematology/Oncology, State University of New York at Buffalo, New York, USA

Abstract

Ultrasound imaging has evolved as a very important tool in medical science. In addition to its varied uses it can also be used to help accurately locate the posterior iliac crest during a Bone Marrow Aspiration (BMA) and Bone Marrow Trephine (core) Biopsy (BMTB). Ultrasound machines are large and bulky and generally not suitable for bedside use. We have used a smartphone and the Philips Lumify app for Android as a mechanism for ultrasound guided visualization of the posterior iliac crest to obtain BMA and BMTB specimens. The technique of using smartphone for image guidance can facilitate the extraction of bone marrow specimens from the posterior iliac crest that is otherwise imprecisely identified by relying on external landmarks and blind needle exploration.

Keywords: Smartphone; Image guidance; Bone marrow aspiration; Bone marrow trephine; Bone marrow core biopsy

Introduction

Bone marrow aspiration and trephine biopsy play an important role in the investigations, diagnosis and management of patients with various hematological and non-hematological conditions [1-5]. However, for decades the standard methods of performing BMA and BMTB in patients with these disorders have remained unchanged despite the fact that the manual palpation and blind exploration of locating the sites for performing these procedures have significant limitations. Most importantly, the latter approach lacks the precision to accurately locate the posterior iliac crest at its center. BMTB is now routinely used in tandem with bone marrow aspiration [6-9] because of the advantage it offers over sole marrow aspiration. The value of BMTB depends on the quality of the specimen that is obtained [10,11]. It is also known that the quality of the BMTB depends not only on the type of instrument that is used [12] but it also depends on the knowledge and proficiency of the operator [13]. However, even in experienced hands and with appropriate needles [14-16] the posterior iliac crest can be missed or hit off-center resulting in a less than desirable biopsy specimen.

In this technique, sound waves are projected on the body parts, which bounce back and are collected by software installed in the smartphone to generate images of the internal organs. Sound waves cannot penetrate bone; hence it is plainly visualized as a clearly identified black image on the smartphone or tablet. This technique can be particularly useful for patients in whom it is difficult to reach the biopsy targets such as obese patients whose iliac crests are buried under layers of adipose tissue and almost impossible to locate by conventional method of palpation. Introduction of such technology into the mainstream of hematology medicine as an imaging modality may eliminate the necessity for elaborate and expensive CT guided BMA and BMTB [17].

Citation: Islam A. Smartphone: A New Tool for Precisely Locating the Posterior Iliac Crest to Obtain Bone Marrow Aspiration and Trephine (Core) Biopsies. Ann Hematol Oncol Res. 2020; 1(2): 1009.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Oct 15th, 2020

***Corresponding author:** Anwarul Islam, Clinical Associate Professor of Medicine, Department of Medicine, Division of Hematology/Oncology, State University of New York at Buffalo, Buffalo General Hospital, Buffalo, New York 14203, USA, Tel: 716-859-2360; E-mail: aislam@buffalo.edu

Materials and Methods

A BMA and BMTB were obtained from patients diagnosed with various hematological conditions using an Android smartphone as a hand-held ultrasound device. A specific controlled study was not considered necessary as the same physician who has routinely executed many BMA and BMTB previous to this study by relying on external landmarks also performed the smartphone procedures. Generally the patients were placed in a right or left lateral decubitus position, with the knees drawn up and back comfortably flexed or in the prone position with a pillow beneath the hips. An ultrasound transmission gel was applied over the right or left lower back which overlies the posterior iliac crest. The posterior iliac crest was then located by using a transducer connected with the smartphone*. With the transducer positioned over the posterior iliac crest, an ink line was made on the skin at the midpoint of each side of the transducer (Figure 1). The lines were then connected to form a "+". The accuracy of the marking was checked by placing the transducer at the "+" in both transverse and longitudinal orientations. Care was taken to ensure that the marking (center of the '+') was directly over the center of the posterior iliac crest where the needle was to be introduced. Once the bone was adequately demonstrated on the smartphone screen (Figure 2) the area was marked with an indelible marker. After marking the area the site was prepared with the use of sterile technique and the patient was draped. The aspiration and trephine biopsy were performed under local anesthesia using a bone marrow aspiration [18] and core retention bone marrow biopsy needles [16].

Results

We have carried out ultrasound guided BMA and BMTB using an

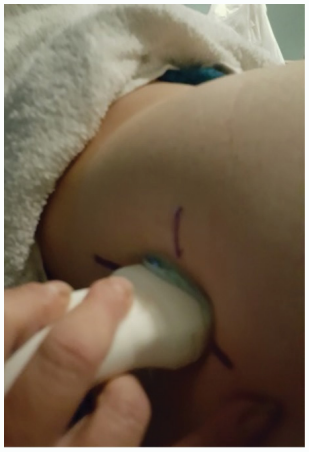

Figure 1: An illustration of the positioning of a transducer over the posterior ilial region for sonographic localization of the posterior iliac crest while the smartphone is being held by an assistant. The center of the discussed '+' (covered by the transducer) lies directly over the center of the posterior iliac crest through which the needle will be introduced into the bone to obtain the bone marrow aspiration and trephine (core) biopsy.

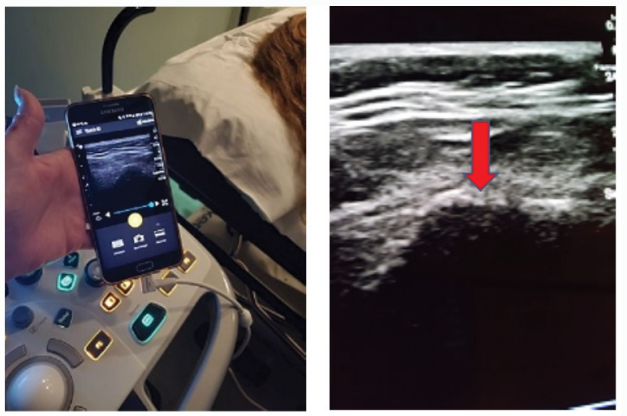

Figure 2: (A) A photograph of the smartphone that presents the sonographic on-screen image of the posterior iliac crest. The image which appears as dark black area is identifiable but is limited in definition at the current photographic magnification. (B) A photograph of the reflective hyperechoic bone cortex (arrow) of the posterior iliac crest as seen on the screen of the smartphone but at higher magnification.

Android smartphone in ten adult patients with various hematological conditions. An adequate and satisfactory BMA and BMTB specimen was obtained from each patient. There were no inadequate or unsatisfactory specimens [19]. The ease of the ultrasound technique and its successful clinical results were immediately apparent. The technique was found to be simple and very useful in precisely locating the posterior iliac crest and placement of the needle into the center of the posterior iliac crest. This assisted in obtaining excellent hematologic samples at each attempt. The patients tolerated the procedure well.

Discussion

Traditionally, hematologists perform bone marrow aspiration and trephine biopsy relying heavily on external anatomical landmarks by palpation which is known as blind aspiration and biopsy. This technique has an inherent problem as the site (posterior iliac crest) may be missed resulting in an inadequate or unsatisfactory specimens. This new technology of using smartphone as a tool for image guidance allows the safe and accurate passage of the needle into the marrow cavity and helps obtain adequate BMA and BMTB while avoiding damage to important surrounding structures [20,21].

We illustrate for the first time that the technique of bone marrow aspiration and biopsy using smartphone as a tool for sonographic guidance to precisely locate and enter the posterior iliac crest with a bone marrow aspiration and biopsy needle. Sonographic evaluation and guidance for bone marrow aspiration and biopsy offer several advantages over the traditional approach. The posterior ilium can be easily located, and the needle can be directed at a correct angle toward the posterior iliac crest with ultrasound guidance.

It is known that a higher rate of inadequate or unsatisfactory biopsy specimens are obtained by less-well-trained hematologists; however, the fault also lies in the fact that, particularly in obese patients, it is rather difficult to locate the posterior iliac crest by the conventional blind method of aspiration and biopsy. This technique of image-guided BMTB with the help of a smartphone improves our ability to precisely locate the posterior iliac crest and thus may help even a less-familiar hematologist to obtain an adequate trephine biopsy specimen. Ultrasound guided bone marrow biopsy is also preferable to CT (Computed Tomography) guided bone marrow biopsy as favored by interventional radiologists as it avoids exposure to ionizing radiation to patients and operators, even though it can be very minimal. It is also cost-effective.

With the introduction of this new smartphone technology, we hope and believe that it will bring a new era in the field of bone marrow aspiration and biopsy technique. It is recognized that many hematologists are uncomfortable with performing these procedures as much as the patients dread undergoing them [22]. This is particularly so because of the uncertainty of making contact with the posterior iliac crest in its center and at a correct angle thereby not able to obtain an adequate sample of bone marrow aspiration and biopsy at every attempt or injuring the surrounding tissue.

*Instead of a smart phone, a tablet can also be used which in fact gives a bigger picture, but the tablet is bulky and one has to buy the tablet while most physicians carry a smartphone and Lumify app is free.

Novelty

The technique of doing bone marrow biopsy by relying blindly on palpation of external landmarks is imprecise and leads to failure of obtaining adequate biopsies. Smartphone for image guidance can facilitate the extraction of bone marrow specimens from the posterior iliac crest.

For the first time we have used a smartphone as an ultrasound imaging device to accurately locate the posterior iliac crest for performing bone marrow aspiration and bone marrow trephine biopsy.

The technique was found to be simple and very useful in precisely locating the posterior iliac crest and placement of the needle into the center of the posterior iliac crest. This assisted in obtaining excellent hematologic samples at each attempt.

References

1. McFarland W, Dameshek W. Biopsy of bone marrow with the Vim-Silverman needle. JAMA. 1958; 166(12):1464-66.

2. Ellman L. Bone marrow biopsy in the evaluation of lymphoma, carcinoma and granulomatous disorders. Am J Med. 1976;60(1):1-7.

3. Burke JS. The value of the bone marrow biopsy in the diagnosis of hairy cell leukaemia. Am J Clin Pathol. 1978;70(6):876-84.

4. Brunning RD, Bloomfield CD, McKenna RW. Bilateral trephine bone marrow biopsies in lymphoma and other neoplastic disease. Ann Int Med. 1975;82(3):365-6.

5. Parapia LA. Trepanning or trephines: a history of bone marrow biopsy. Br J Haematol. 2007;139(1):14-19.

6. Brynes RK, McKenna RW, Sundberg RD. Bone marrow aspiration and trephine biopsy an approach to a through study. Am J Clin Pathol. 1978;70(5):753-9.

7. Islam A. Indications for and value of bone marrow trephine biopsy in haematological disorders (invited annotation). Haematology. 1996;1(2):167-72.

8. Moid F, DePalma L. Comparison of relative value of bone marrow aspirates and bone marrow trephine biopsies in the diagnosis of solid tumor metastasis and Hodgkin's lymphoma – Institutional experience and literature review. Arch Pathol Lab Med. 2005;129(4):497-501.

9. Chandra S, Chandra H. Comparison of bone marrow aspirate cytology, touch imprint cytology and trephine biopsy for bone marrow evaluation. Hematol Rep. 2011;3e22.

10. Campbell JK, Matthews JP, Seymour JF. Optimum trephine length in the assessment of bone marrow involvement in patients with diffuse large cell lymphoma. Ann Oncol. 2003;14(2):273-6.

11. Islam A, Catovsky D, Goldman JM. Value of long core biopsy in detection of discrete bone marrow lesions. Case Reports. 1979;1(8121):878.

12. Jacobs P. Choice of needle for bone marrow trephine biopsies. Haematol Rev. 1995;9:163-8.

13. Rudzki Z, Partyla T, Okon K, Stachura J. Adequacy of trephine bone marrow biopsies: the doctor and the patient make a difference. Pol J Pathology. 2005;56(4):187-95.

14. Islam A. A new bone marrow biopsy needle with core securing device. J Clin Pathol. 1982:35(3):359-66.

15. Islam A. A new single use bone marrow biopsy needle. Biomed Instrum Technol. 2005;39(5):391-6.

16. Islam A. A New Single-Use Bone Marrow Biopsy Needle With Core Retention. Biomed J Sci & Tech Res. 2019.

17. Badiola CM, Scappaticci F, Brahaj D. CT Guided Bone Marrow Aspiration and Core Biopsy. Open J Radiol. 2012;2(2):55-6.

18. Islam A. A new bone marrow aspiration needle to overcome the sampling errors inheren t in the technique of bone marrow aspiration. J Clin Pathol. 1983;36:954-8.

19. Islam A. Bone Marrow Solid Core Biopsy Needle: A Critical Assessment of the Utility, Benefits and Limitations of the Instruments Employed in Current Day Haematology and Oncology. J Clin Pathol. 2017; 71(6):1-8.

20. Bain BJ. Bone marrow biopsy morbidity and mortality. Br J Haematol. 2003;121(6):949-51.

21. Sarigianni M, Vlachaki E, Chissan S, Klonizakis F, Vetsiou E, Anastasiadou KI. Haematoma caused by bone marrow aspiration and trephine biopsy. Hematol Rep. 2011;3(3):e25.

22. Symington K, Martinez F. Bone marrow procedures move into the 21st century. Oncology News International 2010;19(9):1-3.