Complications of Bone Marrow Aspiration and Biopsy: a New Unexpected Risk

Najlaa Badr Alawadi

ABSTRACT:

BACKGROUND:

Bone marrow examination represents an essential tool for diagnosis and monitoring of haematological and non-haematological disorders. Although some hazards are recognized, bone marrow aspiration and trephine biopsy are generally thought to be safe procedures.

OBJECTIVE:

The aim of this study is to identify the possible complications associated with the bone marrow aspiration and biopsy procedures.

METHODS:

In this study, 2156 cases of bone marrow aspiration with or without trephine biopsy were done in Merjan Teaching Hospital, Babil governorate, Iraq during a five year period from 1st Feb 2006 to 1st Feb 2011. These procedures were done under local anesthesia. The complications associated with these procedures were reported.

RESULTS:

A new previously unreported complication was seen in 2 patients as they developed sudden apnea and loss of consciousness.

The final diagnosis in both patients was acute lymphoblastic leukemia with huge mediastinal widening and they were lying in prone position during the procedure.

Bleeding was seen in 2/2156 (0.09%) cases. Prolonged pain was documented in one case. No infection was reported.

CONCLUSION:

Bone marrow examination is generally safe, however apnea and loss of consciousness can occur in patients with a huge mediastinal mass compressing trachea and/or major chest vessels when the procedure is done in prone position.

KEY WORDS: Bone marrow aspiration.

INTRODUCTION:

Bone marrow aspiration and trephine biopsy have an important role in the investigation and diagnosis of haematological and non-haematological malignancies and various other diseases[1,2,3].

They are also important in the management of these conditions particularly in the follow-up evaluation of patients undergoing chemotherapy, bone marrow transplantation and other forms of medical treatment[4,5]. Bone marrow biopsy is superior to aspiration for the assessment of the marrow cellularity, fibrosis, vascularization and architecture, site and extent of malignant infiltrates[6,7].

The procedure usually involves aspiration of bone marrow from the sternum (using the Salah and Klima sternal biopsy needle or a sternal puncture needle)[8] or from the posterior iliac crest by using a sternal puncture needle, or with longer needles specially designed to obtain plasma suspended (liquid) marrow[9]. The bone marrow trephine biopsy specimens are usually obtained from the posterior iliac crest with a Jamshidi needle[10] ,an Islam needle[11] or similar needle[12] (e.g. Core-Lock bone marrow biopsy system). The specimens are fixed in acetic acid-zinc-formalin fixative and decalcified in 10% formic acid 5% formaldehyde then processed to paraffin-wax embedding. Sections are cut by experienced histotechnologist and stained with hematoxylin and eosin, Giemsa or reticulin stain[13]. Recently, standardized polymerase chain reaction-based molecular techniques and mRNA in situ hybridization studies have been successfully applied on bone marrow

Department of Pathology and Forensic Medicine, College of Medicine, Babil University, Iraq.
Senior Hematologist, Oncology Department, Merjan Teaching Hospital, Babil, Iraq.

biopsy[13,14]. Excellent morphology with good antigen, DNA and RNA preservation is offered by the Hammersmith Protocol [14].

Generally bone marrow aspiration and trephine biopsy are considered safe procedures as complications are rare and mostly simple.

The aim of this study is to identify the possible complications associated with the bone marrow aspiration and biopsy procedures.

MATERIALS AND METHODS:

This is a retrospective study in which 2156 cases of bone marrow aspiration with or without trephine biopsy were done in Merjan Teaching Hospital, Babil governorate , Iraq during a five year period from 1st Feb 2006 to 1st Feb 2011. These procedures were done under local anesthesia using lidocain 2% solution with infiltration of skin, subcutaneous tissue and bone cortex. Bone marrow aspiration only was done in 1578 of cases while the remaining 578 cases had combined aspiration and biopsy procedures.

Same maneuver and instruments were used for all patients. They were in prone position facing the examination table, sternal puncture needle and Jamshidi needle were used to take samples from posterior superior iliac spine.

RESULTS:

In this study, the bleeding was seen in 2/2156 (0.09%) cases; both of them were stopped with pressure applied on puncture site for 5 minutes. first case was diagnosed as immune thrombocytopenic purpura with platelets count of 5000/cmm and second case was diagnosed as acute pro-myelocytic leukemia (AML-M3) with disseminated intravascular coagulation (DIC). Infection wasn't reported in this study. Prolonged pain after the end of procedure was seen in one case with pain continued for 24 hours post-procedure.

Two patients (0.09%) developed sudden apnea and loss of consciousness. In both of them; the total time spent from injection of local anesthesia till the end of procedure was short, about 8-10 minutes. The patients during that time were lying in prone position. The final diagnosis in both patients was acute lymphoblastic leukemia with huge mediastinal widening. Chest X-ray and CT scan done later on showed severe pressure on trachea and major vessels by huge mediastinal lymphadenopathy (figure 1).

The 1st patient was male aged 24 years. His apnea was discovered early with rapid turn of him to supine position and start urgent cardiopulmonary resuscitation (CPR) with chest thumb and mouth to mouth breathing, He regain consciousness shortly within 15-20 seconds. The 2nd patient was a boy aged 7 years. His apnea was discovered somewhat late after about 30-40 seconds where he found breathless, cyanosed and unconscious. CPR started urgently followed by mechanical ventilation for 3 days with high dose of steroids and antibiotics. The patient regained consciousness without neurological deficit or other complications.

No pressure was applied on the patient's chest during the aspiration procedure in both patients especially the boy as only his arms and legs were fixed to restrict his movement during procedure.

In this study, 457 of cases were diagnosed as acute lymphoblastic leukemia, 98 as lymphoma involving bone marrow, 72 as lymphoma not involving marrow, 8 as hairy cell leukemia and 2 as splenic lymphoma with villous lymphocytes. Mediastinal masses are mostly seen in these lymphoproliferative diseases. This means that the incidence of this complication in lymphoproliferative diseases is 0.31% (2/637).

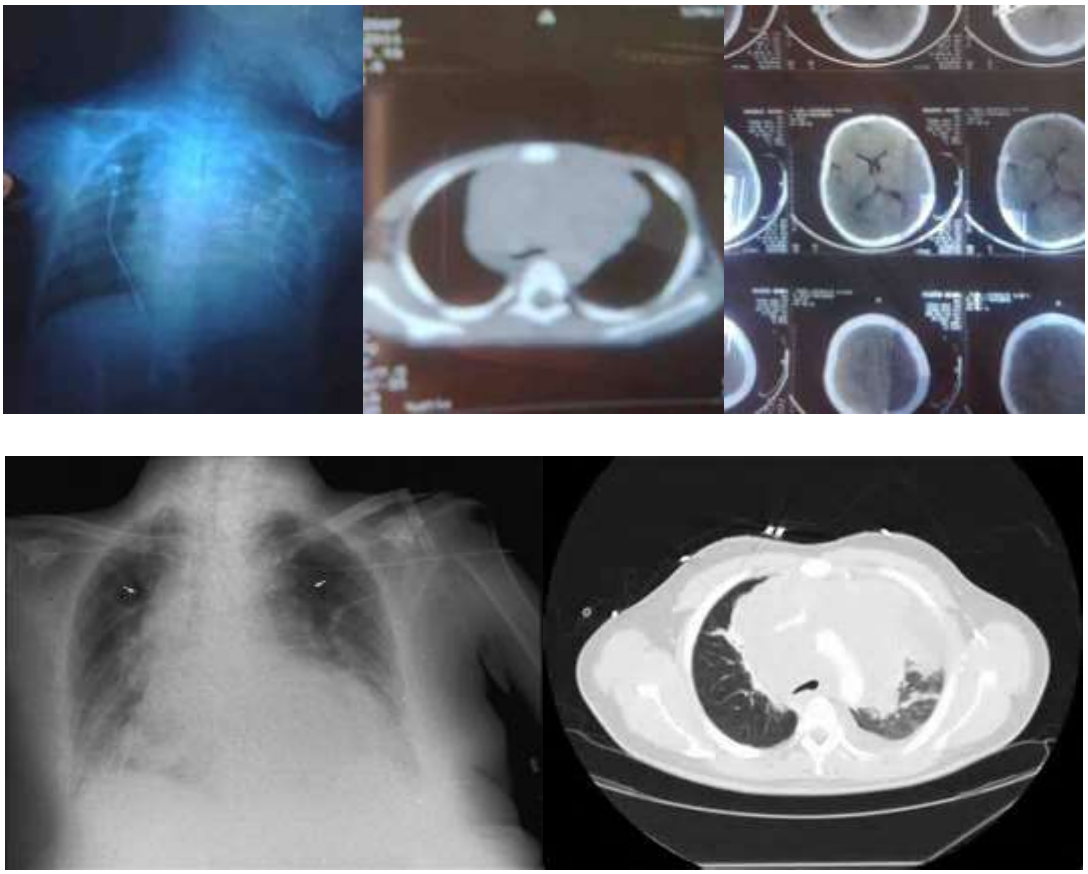

Figure 1: Chest X ray and CT show superior mediastinal mass with severe pressure on trachea and great vessels. CT brain shows absence of brain involvement.

DISCUSSION:

In general, bone marrow aspiration and biopsy are safe procedures and can be done in outpatient clinics under local anesthesia, but nevertheless simple complications can occur. In 2001, a patient died as a result of retroperitoneal haemorrhage after an aspirate and a trephine biopsy from the posterior iliac crest[15].

In this study, a new first time ever reported complication was seen in two cases. Sudden apnea and reduction in cardiac output with cyanosis and near death were seen in those two patients. After investigations, huge mediastinal masses were found in both cases compressing trachea and major vessels in superior mediastinum. The diagnosis was acute lymphoblastic leukemia in both.

The most likely explanation for this could be a pressure effect of mediastinal masses on trachea and/or great vessels causing asphyxia and/or reduced cardiac output with subsequent brain hypoxia and loss of consciousness. Prone position of the patients and keeping them for longer time in this position after injecting local anesthesia waiting it to start action are possible inducing factors.

Although both patients had bone marrow aspiration only, biopsy is surely associated with a higher risk as a longer time is needed.

It seems that the risk of this complication is related to the patient's position, hence lateral position may alleviate that risk.

Professor DJ Bain reported adverse events in of (16 patients)(0.08%) of bone marrow procedures done during 2003 in UK. Eleven patients had hemorrhages, no one of them was fatal, but 3 were judged as serious hemorrhages. Two patients had infection, 2 had persistent pain and 1 had serous leak. He stated that "previous data have suggested more likely adverse events with less experienced operators". At that time, he said

that "Haematologists need to be aware of the various ways of minimizing risks and of dealing with adverse events when they occur"[15,16].
Recommendations to avoid this risk:

1. Lateral position is safer than prone position.
2. If prone position is otherwise indicated, chest X ray should be done to exclude mediastinal widening.

Further studies are required to assess the exact risk in all patients with mediastinal masses and correlates that risk with degree of pressure upon trachea and/or great vessels on CT chest.

CONCLUSION:

Complications associated with bone marrow aspiration and biopsy are rare; however sudden apnea and loss of consciousness can occur when the procedure is done in patients with huge mediastinal mass and in prone position.

REFERENCES:

1. Brynes RK, McKenna RW, Sundberg RD. Bone marrow aspiration and trephine biopsy an approach to a through study. Am J Clin Pathol 1978:70753-59.
2. Ellman L. Bone marrow biopsy in the evaluation of lymphoma, carcinoma and granulomatous disorders. Am J Med 1976:601-7.
3. Islam A, Hebderson ES. The role of bone marrow biopsy in hematological disorders with special reference to plastic embedded material. Haematol Rev Commun 1990: 410-12.
4. Van den Berg H, Kluin PM, Vossen JM. Early reconstitution of hematopoiesis after bone marrow transplantation: a prospective Histopathological study of bone marrow biopsy specimens. J Clin Pathol 1990:43365-69.
5. Liso V, Albano F, Pastore D et al. Bone marrow aspirate on the 14th day of induction treatment as a prognostic tool in de novo adult acute myeloid leukemia. Haematologica 2000:851285-90.
6. Wilkins BS, Clark DM. Making the most of bone marrow trephine biopsy. Histopathology. 2009 ; 55:631-40.
7. Hamid GA, Hanbala N. Comparison of bone marrow aspiration and bone marrow biopsy in neoplastic diseases. Gulf J Oncolog. 2009:41-44.
8. Islam A. A new sternal puncture needle. J Clin Pathol 1991. 44690-44691.
9. Islam A. A new bone marrow aspiration needle to overcome the sampling errors inherent in the technique of bone marrow aspiration. J Clin Pathol 1983:36954-58.
10. Jamshidi K, Windschitl HE, Swaim WR. A new biopsy needle for bone marrow. Scand J Haematol 1971:869.
11. Islam A. A new bone marrow biopsy needle with core securing device. J Clin Pathol 1982:35359-66.
12. Goldenberg AS, Tiesinga JJ. Clinical experience with a new specimen capturing bone marrow biopsy needle. Am J Haematol 2006:68189-93.
13. Naresh KN, Lampert I, Hasserjian R, Lykidis D, Elderfield K, Horncastle D et al. Optimal processing of bone marrow trephine biopsy: the Hammersmith Protocol. J Clin Pathol. 2006 ;59:903-11.
14. Fend F, Tzankov A, Bink K, Seidl S, Quintanilla-Martinez L, Kremer M et al. Modern techniques for the diagnostic evaluation of the trephine bone marrow biopsy: methodological aspects and applications. Prog Histochem Cytochem. 2008;42:203-52. Epub2008 Jan 4.
15. Bain BJ. Bone marrow biopsy morbidity: review of 2003. J Clin Pathol. 2005; 58:406-8.
16. Bain BJ. Bone marrow biopsy morbidity and mortality: 2002 data. Clin Lab Haematol 2004;26: 315-18.