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Pain and anxiety associated with bone marrow aspiration and biopsy

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Abstract---Introduction: Bone marrow biopsy (BMB) and aspiration is a fundamental part of the diagnostic workup of various benign and malignant hematological disorders. Improved via several variations and technical modifications ever since its advent in the early nineteenth century, the procedure plays a central role in establishing diagnosis in various hematological and systemic diseases. Materials and Methods: This is a prospective study conducted in the Department of Pathology, Tertiary Care Teaching Hospital over a period of 1 year. Sixty-four patients met the criteria of the study (adults aged ≥ 18 , not having communication barrier or any kind of mental illness) and agreed to take part in the study. To gather the research data, personal information form. It is used to determine the risk group by identifying anxiety and depression, not with the aim of making a diagnosis for the patients who consult to primary care health service and have physical diseases. Anxiety before and pain during the procedure were assessed by patient interview 10 minute before and 10 minute after the procedure, respectively. A numerical rating system (NRS) scale, ranging from 0 (no symptom) to 10 (the worst), was administered to score symptom intensity. In order to explore correlation between anxiety before and pain during the procedure, the incidence of moderate-severe pain (NRS 4-10) in different anxiety severity population was examined. Results: In our study cases were evaluated for analysis. Anxiety was experienced by 64/64 (100%) patients and scored as mild (1-3), moderate (4-6) and severe (7-10) in 35 (54.68%), 25 (39.06%) and 4 (6.25%) of them respectively, median anxiety NRS value was 3 (0-10). Pain was reported in 64/64 (100%) patients and scored as mild (1-3), moderate (4-6) and severe (7-10) in 31 (48.43%), 23 (35.9%) and 10 (15.62%) of them respectively, median pain NRS value was 3 (0-10). By using median anxiety NRS value as cut off, patients were divided into two groups: Low anxiety level (NRS 0-3) group (35 patients, mean anxiety

NRS- 2) or high anxiety level (NRS 4-10) group (29 patients, mean anxiety NRS-4). Mean pain NRS was 3 and 5 in low and high anxiety level group respectively. Moderate or severe pain was recorded in 7/35 (20%) low anxiety level patients and in 13/29 (44.8%) high anxiety level patients, respectively. Conclusion:As a result, pain develops depending on bone marrow aspiration and biopsy; therefore, taking precautions aimed at alleviating pain and evaluation of pain before and after the application within the scope of total maintenance have been suggested.

Keywords--pain, anxiety, bone marrow aspiration.

Introduction

Bone marrow biopsy (BMB) and aspiration is a fundamental part of the diagnostic workup of various benign and malignant hematological disorders. Improved via several variations and technical modifications ever since its advent in the early nineteenth century, the procedure plays a central role in establishing diagnosis in various hematological and systemic diseases. [1] The standard methods of bone marrow sampling and BMB have remained unchanged ever since its standardization in the early 1970s. [2] Despite several breakthroughs in medicine, limited work has been done to develop methods/measures that would better control pain in patients undergoing the procedure. To date, BMB remains a considerably painful procedure, with about half of the patients reporting severe and unbearable pain and discomfort during the procedure. [3]

As modern medicine becomes patient-oriented and tailored to ensure each patient derives maximum benefit from the healthcare system, importance is given to reduce pain associated with medical procedures/interventions. [4] Since there is paucity of data concerning the treatment and prevention of pain during BMBx, strategies to combat this problem have not been systematized. There is no formal consensus on the optimal approach to reduce pain associated with BMBx. [5]

A BMBx is typically performed by a trained physician in a hospital, usually in an out-patient setting. The most common sampling site is the posterior superior iliac spine, followed by the anterior superior iliac crest. In the past, the sternum has also been used as a biopsy site, however, due to the risks of mediastinal injury and complications such as cardiac tamponade, this option is commonly kept as a last resort when sampling is not possible from other sites. [6] Sternal puncture is also commonly used for patients who only require bone marrow aspiration with no need for trephine biopsy. [7] A local anaesthetic agent is administered to reduce sensations and minimize pain at the biopsy site. Some patients may also be given systemic analgesics and anxiolytics/sedatives before the procedure to reduce anxiety. [8]

A needle is inserted through the skin and into the periosteum. With twisting motion and pressure applied, the needle is driven through the bony cortex and into the marrow cavity. Most of the pain and discomfort associated with the procedure comes from the needle piercing through the periosteum. [9] A solid,

cylindrical sample of the marrow is removed as a trephine biopsy, followed by attachment of a syringe and aspiration of marrow fluid. The aspiration may be performed before the biopsy in some cases, depending on the physician practices and institutional policies. The needle is then withdrawn and pressure is applied to stop excessive blood loss from the sampling site. [10]

Materials and Methods

This is a prospective study conducted in the Department of Pathology, Tertiary Care Teaching Hospital over a period of 1 year. Sixty-four patients met the criteria of the study (adults aged ≥ 18 , not having communication barrier or any kind of mental illness) and agreed to take part in the study. To gather the research data, personal information form. It is used to determine the risk group by identifying anxiety and depression, not with the aim of making a diagnosis for the patients who consult to primary care health service and have physical diseases.

The systolic blood pressure (SKB), diastolic blood pressure (DKB), heart rate, and respiration of the patients were also evaluated. The blood pressures of the patients were measured by a standard mercury reference sphygmomanometer. The interview was conducted in the waiting hall 30–60 min before BMAB. During the interview, socio-demographic characteristics and characteristics regarding the disease form, anxiety, and depression state before BMAB were evaluated. Furthermore, patients were questioned on their previous biopsy experiences.

BMAB application protocol: The most commonly used method for these applications is narcotizing the region where the local anaesthetics have to be administered. Local anaesthetics are weak bases; they block sodium channels and prevent the action potential from sprawling along the nerve fibers. The effect of the local anaesthetic depends on several factors like the type becoming blood stained of the region where injection has been done. The application of aspiration is removing the bone marrow with the help of an injector by entering with a special sternum or crista iliaca posterior needle, and it is mostly performed for the diagnosis of leukaemia. The sample collected is put on the glass, stained with some special dyes, similar to that used in peripheral smear, and examined under the microscope. Only 5 cc of 2% priloc as the sternum anaesthetic was administered to the patients during the aspiration and 5 min after it, the application had been done.

For the bone marrow biopsy, mostly crista iliaca posterior superior is preferred. In this study, 10 cc of 2% priloc was administered to the patients who would undergo both biopsy and aspiration, and the application had been done 5 min later. For biopsy patients, an 8-Gc-marked Matex biopsy needle was used. After the biopsy, the removed piece of bone was placed in formaldehyde. Afterwards, a sample was taken by entering the marrow material again at a 45-degree angle. All these aforementioned procedures were performed by an educated specialist doctor were all carried out by a medical specialist. The interview was conducted 30 minutes after BMAB. The pain severity, anxiety, and depression state of the patients were evaluated.

Anxiety before and pain during the procedure were assessed by patient interview 10 minute before and 10 minute after the procedure, respectively. A numerical rating system (NRS) scale, ranging from 0 (no symptom) to 10 (the worst), was administered to score symptom intensity. In order to explore correlation between anxiety before and pain during the procedure, the incidence of moderate-severe pain (NRS 4-10) in different anxiety severity population was examined.

Statistical analysis

Statistical data was analyzed with the SPSS 20 program using percentages and correlation regression analysis. $P < 0.05$ was considered statistically significant. Statistical analysis was performed using Pearson's chi-square test.

Results

Table 1: Distribution of Gender and age

Total number	N (%)
Age (Mean±SD)	51.45 (16.21)
Gender	
Female	38 [59.3]
Male	26 [40.7]

Table 2: Distribution of Diseases

Disease category	
Acute leukaemia	8 (12.5)
Chronic leukaemia	14 (21.8)
Lymphoma	11 (17.1)
Multiple myeloma	16 (25.0)
Myelodysplastic syndrome	9 (14)
Other hematologic disease	6 (9.3)

Table 3: Distribution of Site of bone marrow aspiration

Site of bone marrow aspiration	
Posterior iliac crest	48 (75)
Sternum	16 (25)

Table 4: Distribution of Type of bone marrow aspiration

Type of bone marrow aspiration	
Aspiration	12 (18.7)
Biopsy	9 (14.0)
Both aspiration and biopsy	39 (67.2)

Table 5: Distribution of Indication of bone marrow aspiration

Indication	
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Diagnostic/staging	35 (54.6)
Remission status	29 (45.4)

Table 5: Distribution of Previous biopsies or aspirate

Previous biopsies or aspirates	
No previous bone marrow aspiration	44 (68.7)
>1 times	20 (31.3)

Table 6: Anxiety incidence, severity and their correlation

Anxiety	N (%)
Mild (NRS 1-3)	35/64 (54.68%)
Moderate (NRS 4-6)	25/64 (39.06%)
Severe (NRS 7-10)	4/64 (6.25%)
Total	64/64 (100%)

In table 6, 64 cases were evaluated for analysis. Anxiety was experienced by 64/64 (100%) patients and scored as mild (1-3), moderate (4-6) and severe (7-10) in 35 (54.68%), 25 (39.06%) and 4 (6.25%) of them respectively, median anxiety NRS value was 3 (0-10).

Table 7: Anxiety and pain: incidence, severity and their correlation

Pain	N (%)
Mild (NRS 1-3)	31/64 (48.43%)
Moderate (NRS 4-6)	23/64 (35.93%)
Severe (NRS 7-10)	10/64 (15.62%)
Low-anxiety level group (NRS 0-4; mean=1.22)	High-anxiety level group (NRS 5-10; mean=6.55)
Total	64/64 (100%)

In table 7, Pain was reported in 64/64 (100%) patients and scored as mild (1-3), moderate (4-6) and severe (7-10) in 31 (48.43%), 23 (35.9%) and 10 (15.62%) of them respectively, median pain NRS value was 3 (0-10).

By using median anxiety NRS value as cut off, patients were divided into two groups : Low anxiety level (NRS 0-3) group (35 patients, mean anxiety NRS- 2) or high anxiety level (NRS 4-10) group (29 patients, mean anxiety NRS-4). Mean pain NRS was 3 and 5 in low and high anxiety level group respectively.

Table 8: Distribution of Moderate and severe pain

Moderate and severe pain in low anxiety	Moderate to severe pain in high anxiety group N (%)	
07/35 (20.0%)	13/29 (44.8%)	p< 0.03

Moderate or severe pain was recorded in 7/35 (20%) low anxiety level patients and in 13/29 (44.8%) high anxiety level patients, respectively in table 8. Anticipatory anxiety holds a strong predictor of procedure related pain.*

Discussion

In our study, the level of agreement for rated pain by patients and health-care professionals during BMA was graded as fair. In a prior study by Kuball et al. (2004) the level of agreement between patients and physicians was graded as moderate. [11] We were unable to further assess underlying causes of these discrepancies and we have speculated that they may be due to differences in patient populations and/or health-care professionals. The rating for intensity of pain during BMA among patients versus health-care professionals was graded moderate. Importantly, in accord with the literature (Kuball et al., 2004), the occurrence of severe pain (>54 mm on VAS), present in 32% of the patients, was recognized by the physicians only in one third of the affected patients. [12]

Indeed, underestimation of severe pain, including procedural pain, appears to be common in a variety of patient care settings (Curtiss, 2001). [13] Prior studies have suggested that underestimation of severe pain could depend on RNs' and physicians' working experience, where those with longer experience have been found to underestimate the pain more frequently than do those with less experience (Marquie et al., 2003). [14] As pointed out previously, a difference with regard to ratings of pain among patients and health-care professionals might depend on that the two groups relate to different experience when scoring pain (Levin et al., 1998). [15]

We found better agreement for the rated occurrence of pain between patients and health-care professionals when, e.g., the BMA took more than 15 min, suggesting that staff might expect a longer BMA to be more painful since such BMAs may often be associated with procedure-related problems. Another proposed factor that influences the evaluation of rated pain among patients and health-care professionals is that health-care professionals sometimes believe some patients to exaggerate the severity of their pain while they sometimes believe that other patients act as they have to endure some pain (Idvall, 2002) and therefore ignore its intensity. [16]

The posterior superior iliac spine is the preferred site of BMB due to its surface prominence, safety and convenience. A BMB procedure from the posterior superior iliac spine usually takes 10 minutes, but the procedure may take up to 30 minutes depending on other sites of biopsy (and hence their respective convenience), experience of the physician and co-operation of the patient. [17] The patient is discharged after a brief period of observation following the procedure to ensure no immediate complications follow. Additional observation time and post-procedural care is needed for patients who received systemic sedation prior to the biopsy. Despite its highly invasive and painful nature, complications are exceptionally rare and BMB is generally considered a safe and low risk procedure. [18]

Several factors have been studied to assess likelihood of pain and discomfort during BMB. These include basic demographic factors such as age, gender, body-mass index (BMI) and ethnicity of the patient. There are no definitive correlations between the age, gender and ethnicity of the patient and pain during the BMB. [19] When concerning BMI, some studies have concluded that it plays a minimal role in association with pain, whereas others have demonstrated it to be an important factor influencing pain. [20] Patients with a high BMI may have a thick layer of skin and subcutaneous tissue, making it difficult to feel the surface prominences of the posterior and anterior superior iliac crests, making the biopsy a difficult and possibly prolonged procedure requiring multiple punctures to gain access to the appropriate site. In obese patients, these sites may be inaccessible for a biopsy. [21] Consequently, these patients undergo sternal puncture, which is reported to be the most painful site for marrow sampling and also holds a greater likelihood of complications. This may be one plausible explanation how BMI plays a role in determining pain associated with BMB. [22]

Some pain-influencing factors are associated with the procedure itself. Reports have demonstrated a correlation of pain with the duration of BMB and the difficulty of obtaining an adequate sample. Patients have generally reported lower levels of pain and discomfort when the BMB is performed by an experienced physician and the procedure lasts for around or less than 10 minutes. Experienced physicians take less time to conduct a BMB. [23] Experienced physicians are also easily able to overcome technical difficulties encountered during the procedure and are able to obtain a satisfactory sample in the first attempt, eliminating the need for multiple attempts and hence reducing overall pain. [24] However, there are studies which question this notion and advocate that the effect of physician experience and physician technique on pain intensity in BMB is minimal. [25]

Conclusion

Past experience with marrow sampling is another important factor. Patients undergoing a difficult BMB, and hence more pain, develop anticipatory anxiety which leads to fear and emotional distress, making future biopsies equally or even more painful. These patients are likely to report higher scores of pain in subsequent biopsies; hence it is important for the physician to make every effort to make the procedure as least painful as possible. This is especially important for patients with haematological malignancies who require repeated marrow sampling for assessing treatment response and prognostication. Patient knowledge and anticipation is also a noteworthy factor, as some studies have demonstrated that patients who are given incomplete information regarding BMBx, expected pain and adverse effects reported higher scores of pain.

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