COMPARATIVE EVALUATION OF BONE MARROW ASPIRATION AND BONE MARROW BIOPSY IN HAEMATOLOGICAL CONDITIONS

Netra Sajjan¹, Michelle Mathias², Jayaprakash Shetty³

¹Assistant Professor, Department of Pathology, ESIMC, Gulbarga.

²Professor, Department of Pathology, KSHEMA, Mangalore.

³Professor and HOD, Department of Pathology, KSHEMA, Mangalore.

ABSTRACT

CONTEXT

Due to diagnostic difficulties by peripheral smear alone, evaluation of the bone marrow is required for confirmation of a suspected clinical diagnosis.

AIMS

To study and to correlate the bone marrow aspiration with biopsy findings.

METHODS AND MATERIAL

A total number of 100 cases were evaluated. Bone marrow aspiration slides were stained with Leishman stain and biopsy sections were stained with haematoxylin and eosin after decalcification.

STATISTICAL ANALYSIS

Chi square test to evaluate sensitivity, specificity, positive and negative predictive value. P values obtained after completion of 100 cases and Kappa value determined to know the strength of agreement between bone marrow aspiration and biopsy diagnosis.

RESULTS

Of the 100 cases studied, the age of the patient ranged from 4-78 years with male-to-female ratio being 1.3:1. The most common condition was anaemia (47%) and the most common haematological malignancy was multiple myeloma (13%). In our institution, the incidence of multiple myeloma was found to be higher than leukemia. There was a positive correlation of 85.8%, sensitivity of bone marrow aspiration was found to be 88.5% and Negative Predictive Value (NPV) was 94.4%. The p value of 0.001 was statistically significant and the Kappa value of 0.91 shows an excellent agreement between aspiration and biopsy diagnosis.

CONCLUSIONS

Aspiration helps to know the better morphology of the cells and biopsy to assess the cellularity, pattern of distribution of cells. Biopsy is also useful when aspiration is inadequate due to faulty technique. Hence, combined evaluation helps in accurate diagnosis and management.

KEYWORDS

Bone Marrow, Aspiration, Biopsy, Diagnosis.

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INTRODUCTION

Peripheral smear examination do not always provide enough information for diagnosis of hematological disease.¹ In such cases evaluation of bone marrow is required. It is an important diagnostic tool for various neoplastic and non-neoplastic haematological diseases.² Bone marrow aspiration is carried out mainly for the cytological assessment of bone marrow cells.³ Bone marrow biopsy is not necessarily a marrow substitute by aspiration and smear, but is an advantageous complementary procedure.

Here larger amounts of marrow can be examined, cellularity assessed, architectural patterns analyzed and non-haematopoietic cells can also be examined. The most effective way of studying the cellular morphology of the haematopoietic cells is by bone marrow aspiration.⁴ If aspiration is found to be inadequate, imprints should be taken from the biopsy specimen.⁵ Since aspiration and biopsy are complementary to each other, both the samples are obtained routinely.

We conducted this study to evaluate the spectrum and to correlate bone marrow aspiration and bone marrow biopsy findings in haematological disorders. Also to know the strength of agreement between bone marrow aspiration and biopsy.

MATERIALS AND METHODS

We evaluated a total number of 100 cases from June 2012 to June 2014, where both bone marrow aspiration and biopsy was done. Non-haematological malignancies were excluded in our study.

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Corresponding Author:

Dr. Netra Sajjan,
H.NO 1-1495/G-14,
Opp Appas House,
Godutai Nagar, Gulbarga.
E-mail: sajjan.netra@gmail.com
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Clinical details of the patient were obtained from the OP/IP case sheets. Informed consent was taken. Posterior superior iliac spine is the most suitable and safe site for both aspiration and biopsy, although anterior superior iliac spine and sternum are occasionally used.

For children less than 2 years anteromedial surface of tibia is preferred. The patients were explained about the procedure, strict asepsis maintained. The skin, subcutaneous tissue and periosteum were infiltrated with 2ml of 2% Xylocaine as local anaesthetic. Aspiration samples were obtained using Salah's needle and stained with Leishman stain. Trephine biopsy was obtained using Jamshidi needle and the biopsy specimen was fixed in 10% formalin overnight and decalcified with 10% formic acid and 8% hydrochloric acid for 24 hours. After routine processing, biopsy sections were stained with Haematoxylin and Eosin stain.

Chi square test to evaluate sensitivity, specificity, positive and negative predictive value. P value was obtained after completion of 100 cases and Kappa value determined to know the strength of agreement between bone marrow aspiration and biopsy diagnosis. Bone marrow aspiration diagnosis was correlated with the biopsy diagnosis and the efficacy of aspiration was estimated by using methodology of Galen and Gambino.

RESULTS

Of the 100 cases studied, the most common haematological condition in our study was anaemia (47%) and the most common haematological malignancy was multiple myeloma (13%). In our institution the incidence of multiple myeloma was found to be higher than leukemia. Other disorders include Myeloid hyperplasia (4%), Acute leukemia (3%),

Lymphoproliferative disorder (4%), Myelodysplastic syndrome (3%), Myeloproliferative neoplasm (2%), Immune thrombocytopenic purpura (2%), normal (11%), inadequate (9%), Hypereosinophilic syndrome and Aplastic anaemia (1% each). The age of the patient ranged from 4 to 78 years with the mean age of 50.05 years. The maximum number of cases were observed in the age group of 41-50 years (29%). Male-to-female sex ratio was 1.2:1 (57 males and 43 females).

There was a correlation of 78.5% between bone marrow aspiration and biopsy among the haematological malignancies (Table 1). The overall diagnostic accuracy of bone marrow aspiration in diagnosing haematological malignancy was 85% and the diagnostic accuracy of bone marrow biopsy was 95.1%. There was a positive correlation of 85.8% between bone marrow aspiration and biopsy diagnosis in our study. The diagnostic accuracy in bone marrow aspiration was comparatively low in our study because aspiration in few cases either yielded dry tap or admixed with blood showing scant cellularity probably due to faulty technique.

Hence improved techniques of bone marrow aspiration helps in increasing the diagnostic accuracy of bone marrow aspiration. Few cases like aplastic anaemia and myelofibrosis show dry tap on bone marrow aspiration and the diagnosis in such cases is done mainly by bone marrow biopsy findings. The sensitivity of bone marrow aspiration was found to be 88.5%, Negative Predictive Value (NPV) was 94.4% and since the total number of false positive cases (cases which are malignant on aspiration and benign on biopsy) were zero, the specificity and Positive Predictive Value (PPV) was 100%. The p value was 0.001 and was statistically significant and the Kappa value of 0.91 shows an excellent agreement between bone marrow aspiration and biopsy diagnosis.

Bone marrow aspiration(Leishman 100x) Fig 1a: Megaloblasts displaying sieve-like chromatin in megaloblastic marrow. Fig 1b: Bi and trinucleated plasma cells in multiple myeloma .

Fig 1c :Acute myeloid leukemia-Myeloblasts with auer rods in the cytoplasm .Fig 1d: Monotonous population of lymphocytes and plasma cells in lymphoplasmacytic lymphoma.

SL. No.	BIOPSY DIAGNOSIS	No.	ASPIRATION DIAGNOSIS	NO.
1	Aplastic anaemia	1	Dry tap	1
2	Acute lymphoblastic leukemia	2	Acute lymphoblastic leukemia	2
3	Acute myeloid leukemia	1	Acute leukemia	1
4	Multiple myeloma	13	Multiple myeloma	11
			Plasma cell dyscrasia	2
5	Myelodysplastic syndrome	3	Myelodysplastic syndrome+fibrosis	1
			Megaloblastic marrow	1
			Inconclusive	1
6	Myeloproliferative neoplasm	2	Chronic myeloid leukemia	1
			Polycythemia vera	1
7	Immune thrombocytopenic purpura	2	Immune thrombocytopenic purpura	2
	Lymphoproliferative Disorder			
8	Chronic lymphoblastic leukemia	1	Chronic lymphoblastic leukemia	1
	Lymphoplasmacytic lymphoma	1	Non Hodgkin's lymphoma	1
	Non Hodgkin's lymphoma	2	Leukemia/lymphoma	1
			Leukemia/lymphoma	1
	TOTAL	28		28
Inference : 78.5% of the Aspiration Diagnosis Correlated with the Biopsy Diagnosis in Haematological Malignancy				
Table 1: Aspiration and Biopsy Correlation of Haematological Malignancy				

DISCUSSION

Of the 100 cases studied, the age of the patients in our study ranged from 4-78 years with the mean age of 50.05 years. This range was comparable to the studies conducted by Jha et al. (2008).⁶ Kibria et al. (2010).⁷ Gayatri et al. (2011).⁸ and Pudasini et al. (2012).⁹ The most common age group undergoing bone marrow examination in our study was 41-50 years comprising of 29% of the cases. In a study conducted by Shastry et al. (2012).¹⁰ and Egesie et al. (2009).¹¹ the majority of the patients were from the age group of 21-30 years. The total number of males in the present study were 57% and females were 43%.

Sex distribution was comparable to the studies conducted by Kibria et al. (2010).⁷ and Pudasini et al. (2012).⁹ A total of 9% showed dry tap on aspiration, studies conducted by Navone et al. (1984).¹² Engeset et al. (1979).¹³ Humphries et al. (1990).¹⁴ and Pandya et al. (2012).¹⁵ showed 5%, 7%, 4% and 18% respectively.

We encountered 13% of cases of multiple myeloma. This incidence was found to be higher in our study compared to the studies conducted by Pudasini et al. (2012).¹⁴ Pandya et al. (2012).¹¹ and Shastry et al. (2012).¹² which showed incidence of 3.5%, 3.7% and 0.9% respectively. The remaining cases were comparable to other studies shown in Table 2.

SL. No.	CONDITIONS	Kibria et al. (2010)	Pudasini et al. (2012)	Pandya et al. (2012)	Shasrty et al. (2012)	Parujali et al. (2014)	Present Study (2014)
1	Anaemia	24.87	40.3	14.8	64.54	37.48%	47
2	Infective pathology (Myeloid hyperplasia)	-	12.3	-	1.81	6.81%	4
3	Acute leukemia	36.6	12.3	14.8	3.63	13.63%	3
4	Chronic myeloid leukemia	7.34	-	14.8	0.9	5.68%	1
5	Chronic lymphoblastic leukemia	-	-	11.2	-	2.27%	1
6	Immune thrombocytopenic purpura	6.2	10.5	-	-	13.6%	2
7	Myeloma	-	3.5	3.7	0.9	2.27%	13
8	Myelofibrosis	1.69	-	3.7	-	-	-
9	Myelodysplastic syndrome	7.91	3.5	-	0.9	2.27%	3
10	Aplastic anaemia	10.7	5.3	-	11.81	-	1
11	Normal	1.69	10.5	25.9	9	9%	11
12	Others	1.69	10.5	25.9	2.7	5.0%	1

Table 2: Comparison of Distribution of Cases

CONCLUSION

Bone marrow aspiration and biopsy are diagnostic procedures and are used now-a-days in a routine day to day practice. Bone marrow aspiration is easy to perform and gives better morphological details of the individual haematopoietic cells compared to biopsy. Bone marrow biopsy is mainly used for assessment of cellular architecture, pattern of distribution of cells and reticulin framework of marrow. It is also useful when bone marrow aspiration yields dry tap or is admixed with blood. In such cases bone marrow biopsy is considered superior than bone marrow aspiration. Improved techniques of aspiration helps in increasing the diagnostic accuracy. Overall, both bone marrow aspiration and biopsy are complementary to each other, hence combined evaluation of bone marrow aspiration and bone marrow biopsy with clinical and haematological parameter helps in accurate diagnosis and management of the patient.

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