

Study of Prevalence of Hematological and Non-Hematological Disorders by Bone Marrow Aspiration at Tertiary Care Hospital

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Abstract

Background: Hematological disorders are quite frequent in all age groups. Most of the hematological disorders first present as anemia. Bone marrow aspiration plays major role in diagnosis of underlying cause.

Aim of the study: The aim of this study was to know the spectrum of various hematological and non hematological disorders diagnosed on bone marrow examination and to know the age and sex incidence.

Method This was retrospective study carried over a period of January 2023 to May 2025, in department of pathology P.D.U Medical College, Rajkot. Bone marrow examination was done on patients who referred with suspected hematological disorders and a total 91 cases were included in the study.

Results: In our study most common undergoing BMA was between 0-30 years. The male-to-female ratio was 1:1.4. The most common indications for BMA in this study were pancytopenia. Megaloblastic anemia was most common pathological finding, which is comparable to

other studies. Most common malignancy in this study is AML, ALL & lymphoproliferative disorder.

Conclusion: Bone marrow examination is an important step to arrive at the confirmatory diagnosis of many hematological and non hematological disorders including hematologic malignancies within a short span of time.

Keywords: Anaemia, Bone Marrow Aspiration, Leukaemia, Megaloblastic Anaemia

Introduction

Hematological disorders usually presents with anaemia in any age group. Anaemia is common worldwide and particularly so in developing countries. The spectrum of hematological disorders is relatively different in the developing world than the developed countries.² At most of the instances, the diagnosis can be made by complete clinical examination and by doing simple investigations. And sometimes the diagnosis can be confirmed only by bone marrow examination. Bone marrow picture along with peripheral blood smear and clinical findings can help in arriving at a conclusive diagnosis.

Bone marrow aspiration plays an important role to explain cytopenias and also aid to diagnose leukemias. Bone marrow examination is also done for the diagnosis as well as staging of neoplasm's and storage disorders.

Aim and Objectives

- This study was done to know the spectrum of various haematological disorders that can be diagnosed on bone marrow examination and to know the age and sex incidence.

Material and Method

The present study consists of 91 cases admitted to P.D.U. Medical College and Hospital, Rajkot, Gujarat as in-patients from January 2023 to May 2025 for the evaluation of various hematological disorders.

BMA was performed by trained pathologist, on those patients who were advised to do so by their consultants. Posterior Superior iliac crest was the site of choice for BMA in most of the patients, tibia for infants, and sternum in case of obese. Records regarding the patient detailed information, clinical history, physical examination, clinical indication for the procedure, and all laboratory tests findings including peripheral smear reports were recorded.

Procedure

- Posterior superior iliac spine is the most suitable and safe site for both aspiration and biopsy.
- The patients were explained about the procedure and made to lie either in the left or right lateral position with the knees drawn up.
- The skin in the area of procedure (posterior iliac spine) was cleaned with spirit and betadine.
- The skin, subcutaneous tissue and periosteum were infiltrated with 2ml of 2% Xylocaine (lignocaine) as local anaesthetic.

- With a boring movement, the bone marrow aspiration needle Was passed perpendicularly into the cavity of the bone.
- The stilette was then removed and 0.2-0.3ml of marrow contents were sucked with the help of 10ml syringe and delivered into a bottle containing EDTA to make films later and stained with Field stain & Leishman's stain.
- All slides were examined by the expert pathologist, and the data were manually collected and subsequently analyzed.

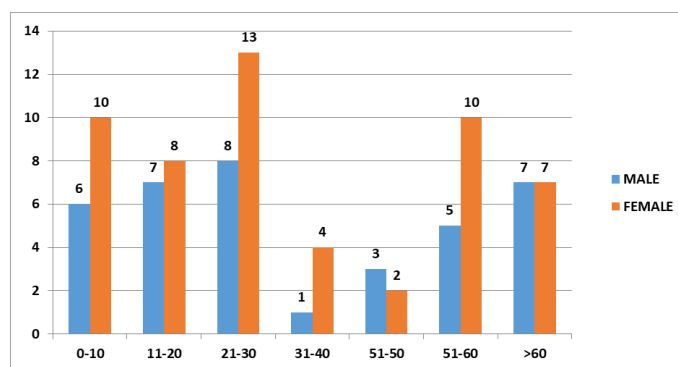
Observations and Result

91 patients diagnosed with various hematological disorders were studied during the period, January 2023 to May 2025, in the Department of Pathology, P.D.U Government Medical College and Hospital, Rajkot.

Table 1: Shows age and sex of patient includes in this study.

Age Group	Male	Female
0-10	6	10
11-20	7	8
21-30	8	13
31-40	1	4
51-50	3	2
51-60	5	10
>60	7	7
Total	37	54

Chart 1: Shows age and sex of patient includes in this study



Males were 37 (40.66 %) and, females were 54 (59.34%).

Male: Female ratio in this study is 1: 1.4.

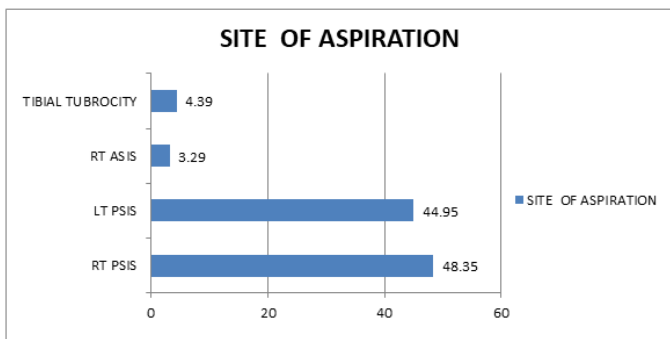
Ages of the patients ranged from 1 month to 80 years. Most common age group in this study is third decade of life.

Site of Aspiration

Table 2: shows the site of bone marrow aspiration.

Site of Aspiration	No. of Cases
RT PSIS	48.35%
LT PSIS	44.95%
RT ASIS	3.29%
Tibial Tubrocity	4.39%

Chart 2: Shows the site of bone marrow aspiration



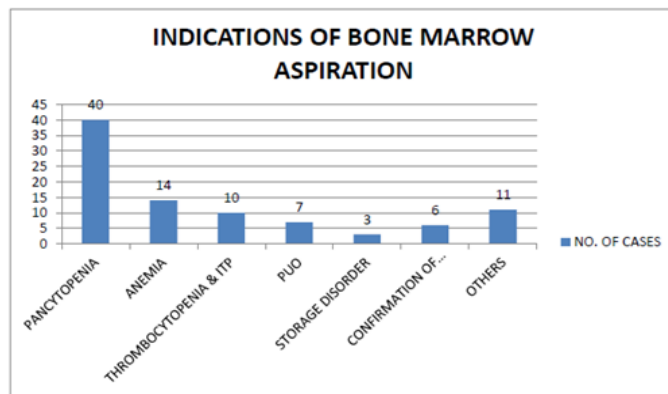
- Most common site is right posterior superior iliac spine that comprise of 43 (48.35%) cases followed by left posterior superior iliac spine.

Indication of BM Adspiration

Table 3: Shows the indication of bone marrow aspiration.

Indication of Bone Marrow Aspiration	No. of Cases
Pancytopenia	40
Anemia	14
Thrombocytopenia & ITP	10
PUO	7
Storage Disorder	3
Confirmation of Malignancy	6
Others	11
Total	91

Chart 3: Shows the indication of bone marrow aspiration.



Pancytopenia is the most common indication in this study.

Unexplained anemia is second most common indication followed by unexplained thrombocytopenia.

Table 4: Findings on bone marrow aspiration.

Diagnosis	Male	Female	Total
Normal	5	3	8
Erythroid Hyperplasia + Reactive	3	9	12
Megaloblastic Anemia	8	9	17
Nutritional Anmia (IDA)	1	5	6
Dimorphic Anemia	2	3	5
ITP	1	5	6
Aplastic/Hypoplastic Anemia	3	4	7
ALL	2	1	3
AML	2	1	3
MDS		2	2
MPN		1	1
Lymphoproliferative Disorder	2	1	3
MM	1		1
HLH		1	1
DRY TAPE		1	1
TB	1		1
Eosinophilia	1		1
Storage Disorder		1	1
Congenital Dyserythropoietic Anemia		1	1
Thrombocythemia		1	1
Others	1	4	5
Diluted Marrow	2	3	5

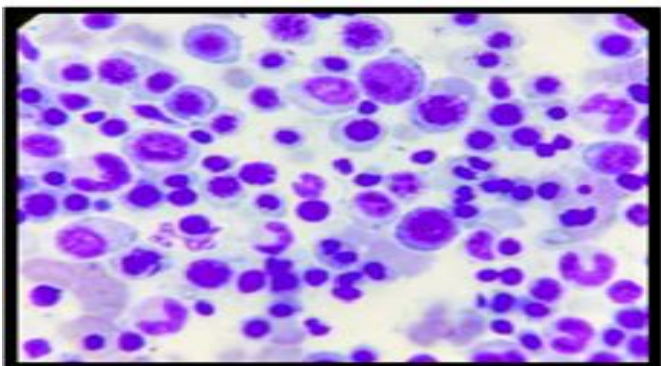


Figure 1: Bone marrow aspiration showing Giant metamyelocyte in Megaloblastic anemia. Field stain 100x.

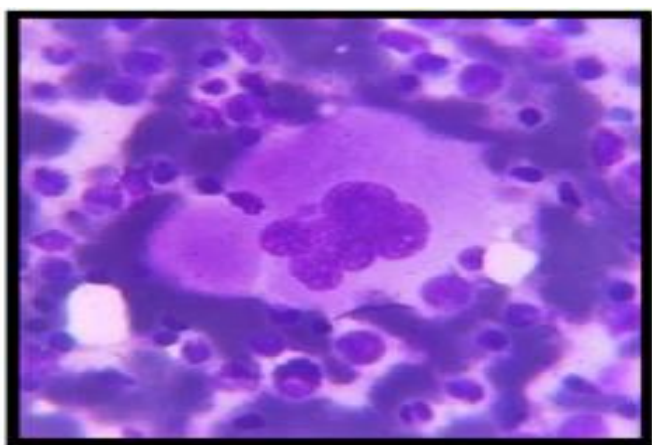


Figure 2: Bone marrow aspiration showing Hypoblasted Megakaryocyte cytoplasmic border and reduced granularity ITP.

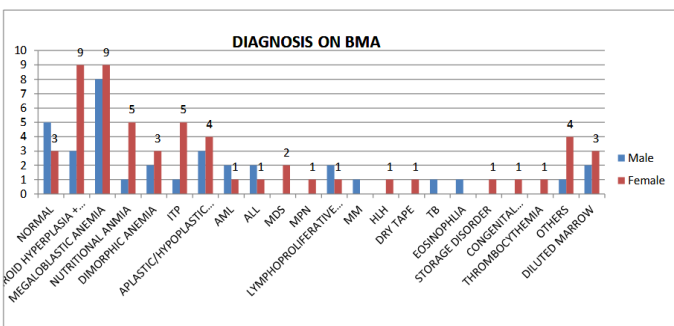


Chart 4: Findings on bone marrow aspiration.

Most common diagnosis made in this study is megaloblastic Anaemia which is more common in female. Nutritional anemia is most common in female also dimorphic anemia observed more in females than male in this study.

Lymphoproliferative disorder and all hematological malignancy more common in male than female.

Table 5: Spectrum of nonmalignant disorder.

	Male	Female	Total	Percentage
Normal	5	3	8	10%
Erythroid Hyperplasia + Reactive	3	9	12	15%
Megaloblastic Anemia	8	9	17	21.25%
Nutritional Anemia	1	5	6	7.50%
Dimorphic Anemia	2	3	5	6.25%
ITP	1	5	6	7.50%
Aplastic/Hypoplastic Anemia	3	4	7	8.75%
HLH		1	1	1.25%
DRY TAPE		1	1	1.25%
TB	1		1	1.25%
Eosinophilia	1		1	1.25%
Storage Disorder		1	1	1.25%
Congenital Dyserythropoietic Anemia		1	1	1.25%
Thrombocytopenia		1	1	1.25%
Others	1	4	5	6.25%
Diluted Marrow	2	3	5	6.25%
MDS		2	2	2.25%
Total	28	52	80	99.75%

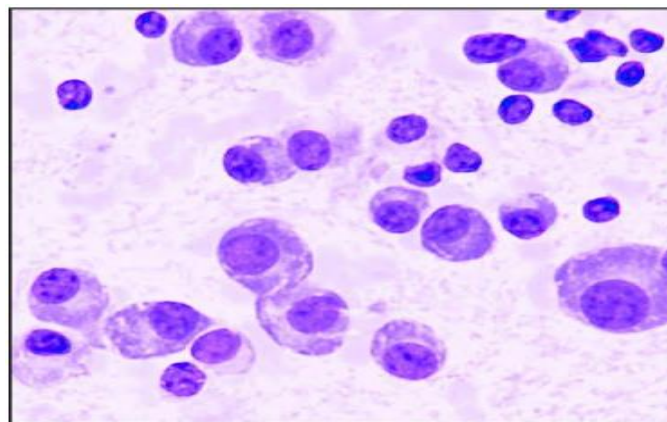


Figure 3: Bone Marrow aspiration showing mainly many abnormal plasma (white arrow) Cells having eccentric nucleus in Multiple Myeloma. Field stain 100x

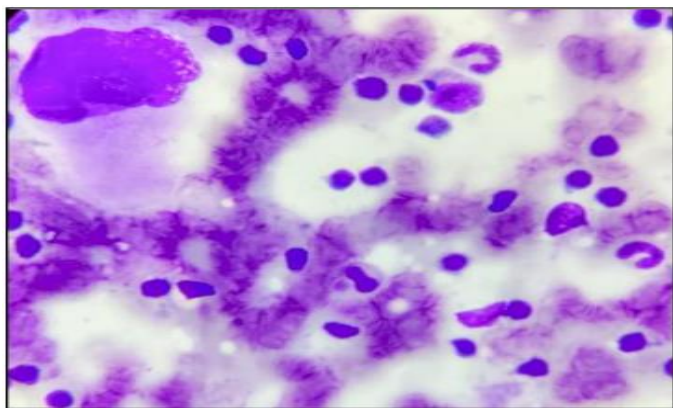
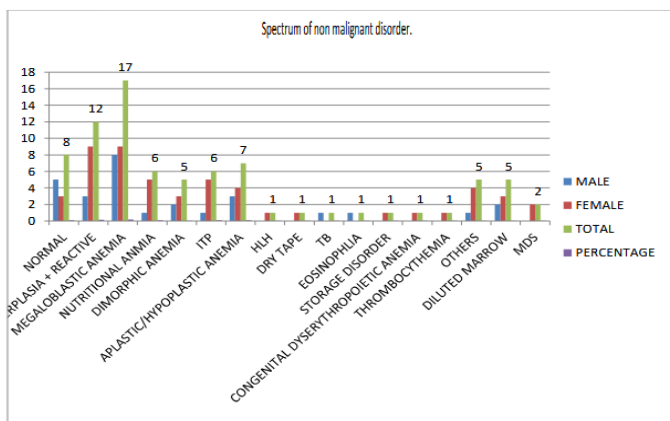


Figure 4: Bone Marrow aspiration showing megakaryocyte (white arrow) along with many mature lymphocytes seen (black arrow).

Chart 5: Spectrum of nonmalignant disorder.



Most common disorder in this Non-malignant hematological study is megaloblastic anaemia followed by erythroid hyperplasia and reactive marrow.

Table 7: Age Wise Distribution of Various Disorders

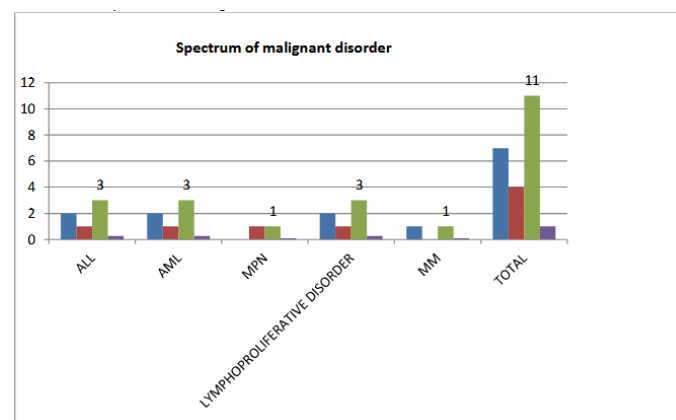
Diagnosis	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total
Normal	3		5					8
Erythroid Hyperplasia + Reactive		2	3	3		3	1	12
Megaloblastic Anemia	1	3	3		1	7	2	17
Nutritional Anmia		2	1				3	6
Dimorphic Anemia	1	1	3					5
ITP	1	1	2	1	1			6
Aplastic/Hypoplastic Anemia	1	1	1			2	2	7
ALL	1	2						3
AML		1	2					3
MDS						1	1	2

Hypoplastic/Aplastic anaemia is 4th most common diagnosis made in this study followed by ITP and nutritional anemia.

Table 6: Spectrum of malignant disorder.

	Male	Female	Total	Percentage
ALL	2	1	3	27.27%
AML	2	1	3	27.27%
MPN		1	1	9.09%
Lymphoproliferative Disorder	2	1	3	27.27%
MM	1		1	9.09%
Total	7	4	11	99.99%

Chart 6: Spectrum of malignant disorder



Most common malignancy in this study is AML, ALL & lymphoproliferative disorder. Second most common malignancy were MM, MPN both observed in one-one case only.

MPN							1	1
Lymphoproliferative Disorder	1				1		1	3
MM					1			1
HLH			1					1
Dry Tape						1		1
TB				1				1
Eosinophilia	1							1
Storage Disorder	1							1
Congenital Dyserythropoietic Anemia	1							1
Thrombocytopenia		1						1
Others	1	1			1	1	1	5
Diluted Marrow	2	1				1	1	5
Total	15	16	21	5	5	16	13	91

Most common age group in this study is third decade of life.

Most of the patients are below of 30 years of age.

Most of the anemia was seen in children, adolescents, Women in reproductive age group in this study.

Though iron deficiency anemia is more common, megaloblastic anaemia most common diagnosis in this study.

Table 8: Comparison of this study with other studies.

Finding	Current study (Out of 91 cases)	Niranjan Mainali et al (1) (Out of 88 cases)	Vidhisha Mahajan et al (2) (Out of 460 cases)	N.A Okinda et al (3) (Out of 356 cases)	Munir AH et al (4) (Out of 157 cases)
Normal	8 (8.79%)	4 (4.5%)	100 (21.7%)	74 (20.7%)	18 (11.4%)
Erythroid Hyperplasia + Reactive	12 (13.18%)	-	40 (8.7%)	51 (14.3%)	-
Megaloblastic Anemia	17 (18.68%)	12 (13.6%)	153 (33.2%)	29 (8.1%)	26 (16.5%)
Nutritional Anemia	6(6.59%)	10(11.3%)	-	23 (6.4%)	9(5.7%)
Dimorphic Anemia	5(5.49%)	-	-	1(0.2%)	-
ITP	6(6.59%)	15(17.0%)	1(0.2%)	15(4.2%)	26(16.5%)
Aplastic/Hypoplastic Anemia	7(7.69%)	26(29.5%)	20(4.3%)	5(1.4%)	9(5.7%)

Leukemia	6(6.59%)	4(4.5%)	30(6.5%)	29(8.1%)	30(19.1%)
MDS	2(2.19%)	3(3.4%)	6(1.3%)	9(2.5%)	-
Leishmaniasis	-	3(3.4%)	4(0.8%)	-	2(1.2%)
Lymphoproliferative Disorder	3(3.29%)	1(1.1%)	54(11.7%)	24(6.7%)	-
MM	1(1.09%)	2(2.2%)	20(4.3%)	20(5.6%)	-
HLH	1(1.09%)	-	-	-	-
Dry Tape	1(1.09%)	6(6.8%)	23(5%)	10(2.8%)	-
Granulomatos Reaction (TB)	1(1.09%)	-	8(1.7%)	-	-
Metastasis	-	2(2.2%)	1(0.2%)	9(2.5%)	2(1.2%)
Storage Disorder	1(1.09%)	-	-	-	-
Congenital Dyserythropoietic Anemia	1(1.09%)	-	-	-	-
HIV Dyspoiesis and Other Infection	-	-	-	39(10.9%)	-
Diluted Marrow	5(5.49%)	-	15(4.2%)	10(2.8%)	-
Drug Induced Bonemarrow Supression	-	-	5(1.4%)	4(1.1%)	-
Anemia Of Chronic Disease	-	-	29(8.1%)	-	8 (5.1%)

Discussion

Bone Marrow Aspiration is a cytological preparation of bone marrow cells obtained by aspiration of marrow and a smear of the cells. It is used to diagnose, confirm, and/or stage Hematologic malignancies. It helps to evaluate cytopenias, thrombocytosis, leukocytosis, anemias, and iron status. It is also a diagnostic tool in non-hematological disorders Such as Storage disorders and systemic infections.

The spectrum of hematological disorders is very wide. It is an ambulatory procedure performed under local anesthesia with minimal morbidity. It is a safe and useful test in reaching the final diagnosis. The present study determines the indications and prevalence of various

hematological and non-hematological disorders diagnosed by Bone Marrow Aspiration cytology examination.

Most of the aspirate specimens (93.05%) were taken from the posterior iliac spine. The tibia is the preferred site in children aged <18-24 months. Only 4 aspirate taken from tibial tuberosity in our study. The sternum was the last choice due to the possible fatal risk of damage to the great vessels during sternal puncture. In our study no single aspirate taken from sternum.

This study like other studies has shown that BMA Cytology can be carried out in all age groups. The age range (1 month to 80 years) as well as the sex ratio of subjects undergoing BMA evaluation is similar to that

reported in other studies, in our study, the most common age group undergoing BMA was between 0-30 years. The male-to-female ratio Was 1:1.4. In a study done by Niazi and Raziq, the majority of the patients were from the age group 1 to 30 years

Cytopenias generally result from accelerated peripheral destruction of blood cells as in autoimmune disease, underproduction, or maturation defects. [67] most times, if the Cause is not found peripherally, there is a need for examination of the bone marrow, the site of hematopoiesis. It is therefore not surprising that unexplained cytopenia was the most frequent indication for bone marrow examination in the study.

The most common indications for BMA in this study were pancytopenia and unexplained anemia, followed by thrombocytopenia, unexplained fever and leukemia. In contrast, Damulak and Damen and Tripathy and Dudani also reported anemia as the most common indication for BMA cytology in their studies, but similar studies by Pudasaini et al. and Bashawri showed pancytopenia is most Common indication for this procedure.

Mahabir et al to exclude other hematological diseases like leukemia in corroborated in a survey in which 74% of pediatric hematologists were of the view that bone marrow examination is necessary in acute childhood immune thrombocytopenia, and the main reason cited Was the need to exclude other hematological disorders such as leukemia, dysmyelopoietic syndrome, and aplastic anemia.

Megaloblastic anemia was most common pathological finding, which is comparable to other studies. In a study done by Vidhisha Mahajan et al (2) megaloblastic anemia was the most Common cause of pancytopenia and was the most common finding in BMA.

The increasing incidence of megaloblastic anemia and dimorphic anemia reflects the higher prevalence of

nutritional deficiency in developing countries. Microcytic anemia was observed in 7.50% of cases in this study. However, study done by Niranjani Mainali et al.

11.3 % of cases were diagnosed as iron deficiency anemia. Although the most common anemia in our country is due to iron deficiency, there is no need of BMA for diagnosis Hence, the prevalence of megaloblastic anemia is a higher side in the study. Thus, bone Marrow examination could be used effectively in most cases to determine the cause of anemia.

Immune thrombocytopenia found in 6 cases (7.50 %). Other studies [1,2,3,4] showed 17%, 0.2%, 4.2% and 16.5% cases with ITP.

Only 2 cases (2.25%) were diagnosed having MDS which are compared to 1.3% of Vidhisha Mahajan et al (2) and other studies Niranjani Mainali et al (1) and N.A. Okinda et al [3] Showed 3.4% and 2.5% respectively.

We found hematological malignancies in 9.87% of cases, of which acute myeloid leukemia (AML) & acute lymphoid leukemia had same prevalence in contrast to study done by Egesie et al.[20] Kibria et al.[21] and Gayathri and Rao [12] had reported acute myeloid leukemia more common than ALL.

Multiple myeloma diagnosed in 1 case (1.09 %). Compared other studies Niranjani Mainali et al (1) 2.2%, Vidhisha mahajan et al 4.3% and N.A. Okinda et al [3] 5.6%.

Aplastic/Hypoplastic anemia was seen in 18 Cases (7.69 %). Compared to our study, 29.5%, 4.34%, 1.4% and 4.35 % Cases of Aplastic/hypoplastic anemia were seen in other studies. [1,2,3,4].

Recent advances in the malignancies have been paralleled by renewed interest on the treatment part of pathologists and hematologists in methods of obtaining of and preparing bone marrow for diagnostic studies.

Conclusion

Bone-marrow Aspiration is a minimally invasive and cost effective and OPD based diagnostic procedure and should be done for early diagnosis of various hematological disorders when suspected.

The study provides a valuable insight into the causes of anemia or pancytopenia in our country. The procedure remains a veritable tool in the diagnoses and management of a wide range of hematological and some non-hematological disease.

Anemia (especially the due to nutritional deficiency), were the commonest disorder among the non-malignant hematological disorders in our study.

Acute Myeloid leukemia & acute lymphoid leukemia was the most Common malignant hematological disorder diagnosed in Bone marrow aspiration in this study.

No any non- hematological disorder diagnosed in this study. Over all Bone marrow aspiration is an important investigation to arrive at the confirmatory diagnosis of hematological disorder in resource-poor country like India.

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