ORIGINAL PAPER

Diagnostic Value of Bone Marrow Biopsy in Dry-Tap Pancytopenia: A Secondary Analysis of a Hospital-Based Cohort

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ABSTRACT

Background: Bone marrow aspiration (BMA) is an important investigation in pancytopenia, but aspiration may occasionally result in a dry tap, limiting cytological assessment. Trephine bone marrow biopsy (BMB) preserves marrow architecture and may provide a diagnosis when aspiration is unsuccessful.

Objective: To evaluate the diagnostic contribution of trephine bone marrow biopsy in patients with pancytopenia who had a dry tap on bone marrow aspiration.

Materials and Methods: This secondary analysis used the 150-patient pancytopenia cohort described in the parent thesis. Clinical evaluation, complete blood count, peripheral smear, biochemical investigations, BMA and BMB were performed according to the original study protocol. The present analysis specifically evaluated documented dry-tap cases and their biopsy diagnoses.

Results: Nine of 150 patients (6.0%) had a dry tap. Trephine biopsy established a diagnosis in all nine cases (100%). Hematological malignancies accounted for 3 cases (33.3%), lymphoproliferative disorders for 2 (22.2%), and hypersplenism, aplastic anaemia, tuberculosis and reactive pathology for 1 case each (11.1%).

Conclusion: In this cohort, trephine biopsy provided a definitive diagnostic result in all dry-tap pancytopenia cases. The findings support biopsy as an important complementary investigation when aspiration is unsuccessful. The small dry-tap subgroup and absence of an independent reference standard preclude formal sensitivity and specificity estimates.

Keywords: Pancytopenia; Dry Tap; Bone Marrow Aspiration; Trephine Biopsy; Bone Marrow Biopsy; Hematological Malignancy

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INTRODUCTION

Pancytopenia has a broad etiological spectrum and often requires bone marrow examination for definitive evaluation. Bone marrow aspiration provides cytological information, whereas trephine biopsy permits assessment of marrow architecture and cellularity. A dry tap may occur when adequate aspirate material cannot be obtained, potentially limiting cytological diagnosis.

The parent cohort included 150 patients with pancytopenia. Aplastic anaemia was the most common overall diagnosis, followed by megaloblastic anaemia and hematological malignancies. The thesis specifically documented nine dry-tap cases, all of which were subsequently diagnosed on trephine biopsy. The present manuscript focuses on this clinically important subgroup.

MATERIALS AND METHODS

2.1 Study design and population

This manuscript represents a secondary analysis of a prospective hospital-based observational study conducted in the Department of Pathology in collaboration with Medicine and Paediatrics. The parent study included 150 patients with pancytopenia.

2.2 Clinical and laboratory evaluation

Patients underwent clinical assessment and laboratory evaluation including complete blood count, peripheral blood examination, renal and liver function tests, iron studies, viral markers, bone marrow aspiration and trephine biopsy according to the original thesis protocol.

2.3 Dry-tap definition and outcome

A dry tap was considered present when an adequate marrow aspirate could not be obtained for satisfactory cytological examination. The primary outcome was the final diagnosis established by trephine biopsy in these cases.

2.4 Statistical approach

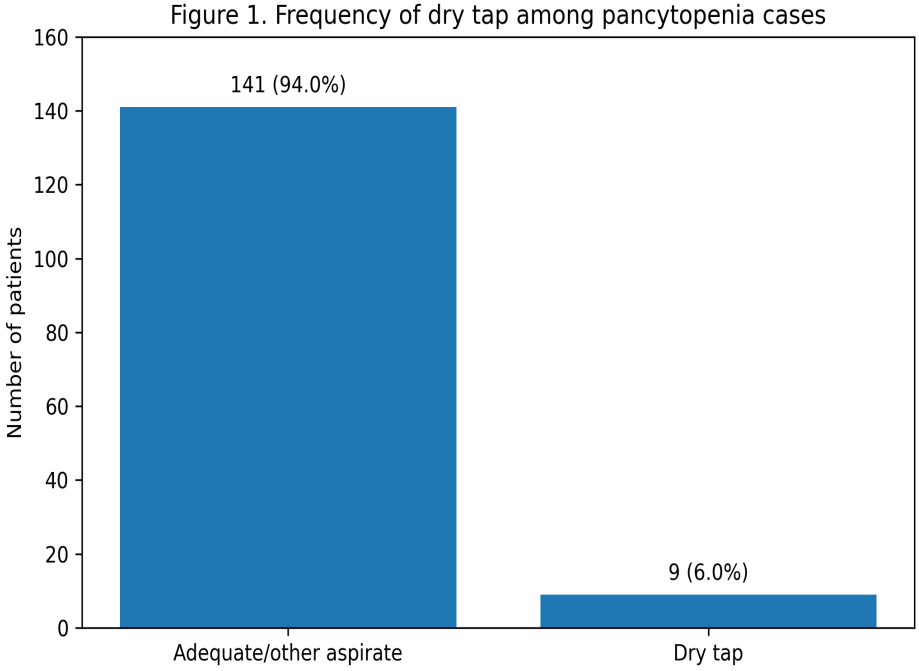
Descriptive statistics were used. Categorical variables are presented as frequencies and percentages. Because only nine dry-tap cases were identified and no independent reference standard was specified, sensitivity, specificity, predictive values and formal inferential comparisons were not calculated.

RESULTS

3.1 Frequency of dry tap

Nine of 150 pancytopenia cases (6.0%) had a dry tap, while 141 (94.0%) had an aspirate that was not classified as dry tap in the thesis dataset.

Figure 1. Frequency of dry tap among pancytopenia cases



Furthermore3.2 Diagnoses established by trephine biopsy in dry-tap cases

All nine dry-tap cases were diagnosed on trephine biopsy. Hematological malignancies were the most frequent finding (3/9; 33.3%), followed by lymphoproliferative disorder (2/9; 22.2%). One case each was classified as hypersplenism, aplastic anaemia, tuberculosis and reactive pathology.

Figure 2. Final diagnoses established in dry-tap cases

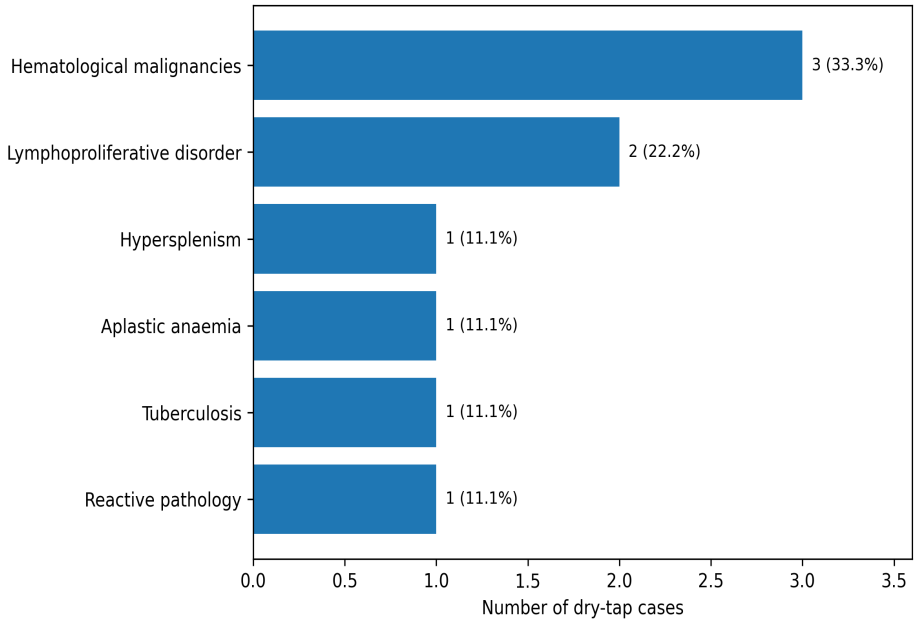


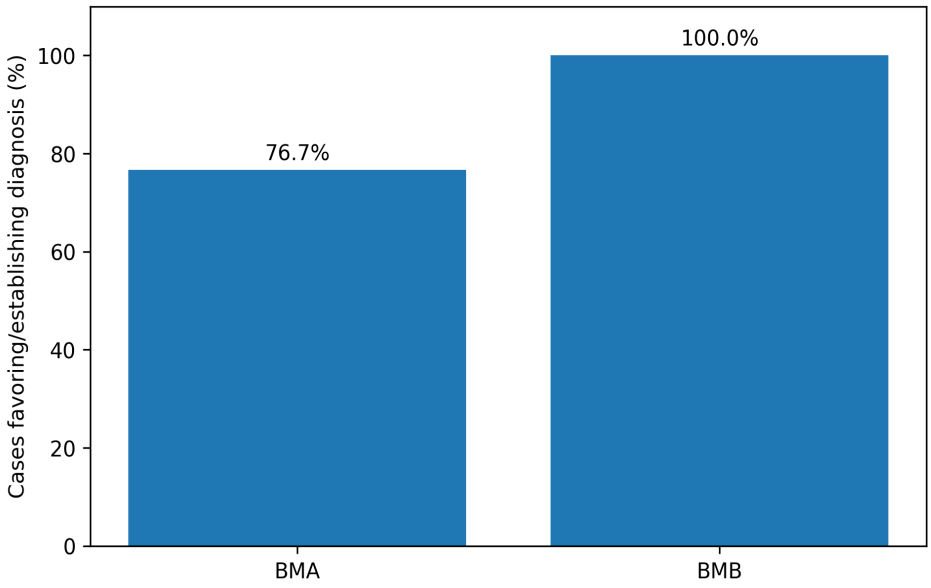
Table 1. Final Diagnoses Among Dry-Tap Cases

Final diagnosis	**n**	**%**
Hematological malignancies	3	33.3
Lymphoproliferative disorder	2	22.2
Hypersplenism	1	11.1
Aplastic anaemia	1	11.1
Tuberculosis	1	11.1
Reactive pathology	1	11.1
Total	9	100.0

3.3 Diagnostic contribution of BMA and BMB in the parent cohort

In the parent thesis, BMA favored or established a diagnosis in 115 of 150 cases (76.7%). BMB favored or established a diagnosis in 57 of 57 biopsy cases (100%). These denominators differ and therefore the percentages should not be interpreted as a direct paired accuracy comparison.

Figure 3. Diagnostic contribution of BMA and BMB in the parent cohort



Note: denominators differ (BMA n=150; BMB n=57); values are not a paired accuracy comparison.

DISCUSSION

The principal finding of this analysis is that trephine biopsy provided a diagnostic result in all nine patients in whom bone marrow aspiration resulted in a dry tap. Although the subgroup was small, the result is clinically relevant because a dry tap can prevent adequate cytological assessment and may occur in disorders in which marrow architecture is diagnostically important.

The spectrum of diagnoses in the dry-tap subgroup was heterogeneous. Hematological malignancies and lymphoproliferative disorders together accounted for five of nine cases. Other cases included hypersplenism, aplastic anaemia, tuberculosis and reactive pathology. This distribution indicates that a dry tap should not be interpreted as synonymous with a single disease process.

The parent thesis also demonstrated only 49.1% concordance for cellularity between aspiration and biopsy among 57 paired specimens. This supports the complementary nature of the two techniques rather than treating them as interchangeable. Biopsy retains architectural information that may be unavailable when aspiration is inadequate.

The findings are consistent with the established role of trephine biopsy as an adjunct when aspiration is unsuccessful or insufficient. However, the present analysis should be interpreted as a diagnostic-yield study rather than a diagnostic-accuracy study because there was no independent reference standard and the dry-tap subgroup was small.

STRENGTHS

The analysis benefits from a prospectively assembled parent cohort, standardized clinical and laboratory evaluation, and documented paired marrow examination. It specifically addresses an underrepresented but practically important subgroup of pancytopenia patients.

LIMITATIONS

The major limitation is the small number of dry-tap cases (n=9). The analysis is also a secondary analysis of an existing cohort and was not prospectively powered for dry-tap outcomes. No independent diagnostic gold standard was defined. Consequently, formal sensitivity, specificity and predictive values cannot be validly derived from the available thesis tables. The single-centre setting may also limit generalizability.

CONCLUSION

Dry tap occurred in 6.0% of patients with pancytopenia in this cohort. Trephine biopsy established a diagnosis in all nine dry-tap cases and identified hematological malignancies, lymphoproliferative disorder, hypersplenism, aplastic anaemia, tuberculosis and reactive pathology. These findings support careful evaluation of trephine biopsy whenever aspiration is unsuccessful. Larger multicentre studies with case-level paired data and predefined reference standards are required to quantify the incremental diagnostic accuracy of biopsy.

DECLARATIONS

Ethics approval number Dean/2022/EC/3550,

Informed consent: Written informed consent was obtained according to the parent study protocol.

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Conflict of interest: No Conflict of interest .

Author contributions: Dr. Shivam Gupta: Conceptualization, data collection, pathology evaluation, data interpretation and manuscript preparation.

Dr. Arti Gupta: Supervision, methodology and critical revision.

Dr. Anurag Kapoor: Statistical analysis and manuscript review.

Data availability: To be stated according to institutional policy and participant confidentiality requirements.

REFERENCES

1. Gayathri BN, Rao KS. Pancytopenia: A clinic-hematological study. J Lab Physicians. 2011;3:15-20.
2. Jha A, Sayami G, Adhikari RC, Panta AD, Jha R. Bone marrow examination in cases of pancytopenia. J Nepal Med Assoc. 2008;47:12-17.
3. Jain A, Naniwadekar M. An etiological reappraisal of pancytopenia—largest series reported to date from a single tertiary care teaching hospital. BMC Hematol. 2013;13:10.
4. Aziz T, Liaquat Ali L, Ansari T, et al. Pancytopenia: Megaloblastic anaemia is still the commonest cause. Pak J Med Sci. 2010;26:1132-1136.
5. Metikurke S, Rashmi K, Bhavika R. Correlation of bone marrow aspirate, biopsies and touch imprint findings in pancytopenia. Journal of Hematology. 2013.
6. Gilotra M, Gupta M, Singh S, Sen R. Comparison of bone marrow aspiration cytology with bone marrow trephine biopsy histopathology: an observational study. J Lab Physicians. 2017;9:182-189.
7. Chandan RH, Giriyan SS. Role of bone marrow aspiration and biopsy in elaborating the diagnosis of pancytopenia. Trop J Path Micro. 2018;4:144-149.
8. Jha et al./Relevant institutional and published sources cited in the parent thesis should be cross-checked and formatted according to the target journal.
9. Weinzierl EP, Arber DA. The differential diagnosis and bone marrow evaluation of new-onset pancytopenia. Am J Clin Pathol. 2013;139(1):9-29. doi:10.1309/AJCP50AEEYGREWUZ.
10. Weinzierl EP, Arber DA. Bone marrow evaluation in new-onset pancytopenia. Hum Pathol. 2013;44(6):1154-1164. doi:10.1016/j.humpath.2012.10.006.
11. Gnanaraj J, Parnes A, Francis CW, Go RS, Takemoto CM, Hashmi SK. Approach to pancytopenia: Diagnostic algorithm for clinical hematologists. Blood Rev. 2018;32(5):361-367. doi:10.1016/j.blre.2018.03.001.
12. Our approach to bone marrow biopsies in cytopenia. Pathol Res Pract. 2019;215(7):152447. doi:10.1016/j.prp.2019.152447.
13. Humphries JE. Dry tap bone marrow aspiration: clinical significance. Am J Hematol. 1990;35(4):247-250. doi:10.1002/ajh.2830350405.
14. Moix PA, Favre L, Rosselet A, Monti M. Bone marrow aspiration and biopsy. Rev Med Suisse. 2008;4(177):2337-2340, 2342.
15. Maung ZT, Bown NP, Hamilton PJ. Collagenase digestion of bone marrow trephine biopsy specimens: an important adjunct to haematological diagnosis when marrow aspiration fails. J Clin Pathol. 1993;46(6):576-577. doi:10.1136/jcp.46.6.576