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QUANTITATIVE CD34+ BLAST CELL ENUMERATION USING AI: IMPROVING BMT ASSESSMENT IN MYELOPROLIFERATIVE NEOPLASMS

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INTRODUCTION

CD34+ blast estimation in bone marrow trephines (BMT) is central to myeloid disorder diagnosis and prognostication, with >5% blasts representing an excess/increase in blasts. **Manual estimation is subjective** with inaccuracies potentially impacting therapeutic decisions. Standardized, objective quantitation techniques integrating **machine learning (ML)** hold promise to improve CD34+ blast cell quantitation in BMT.

AIM

To apply AI to CD34+ blast detection and quantitation in BMT samples from patients with myeloproliferative neoplasms (MPNs) and compare performance to conventional assessment.

METHOD

❑ **SAMPLE PREPARATION & CD34 IMMUNOSTAINING**
- BMT samples of 38 CALR+ MPNs from Oxford University Hospitals were retrospectively selected.
- CD34 immunostaining was performed with the QBEnd/10 clone

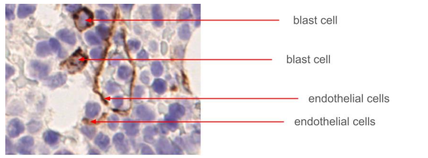
❑ **DIGITAL IMAGE PROCESSING**
- QuPath 0.5.1 was used for IHC thresholding to differentiate stained from unstained regions, aiding in initial cell detection.

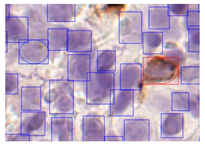
❑ **MANUAL ANNOTATION & AI TRAINING**
- Cell types were manually annotated into three categories: unstained cells, blast cells, and other cells (non-nucleated cells like RBCs or CD34+ vessels).
- The YOLOv7 model was trained with the annotations

❑ **ANALYSIS & COMPARISON**
- Spearman correlation and Bland-Altman plots were employed to compare AI counts with manual counts

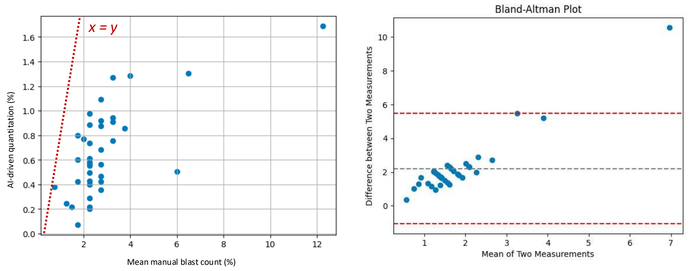
RESULTS

On the 38 WSIs, the correlation between hematopathologists' blast counts was 0.46 [95%CI=(0.16, 0.70)]. The automated approach correlated well with the average WSI estimation [ϱ=0.60, 95%CI=(0.31, 0.78)], and with expert estimates on 20 randomly sampled regions (662x662 µm) across all samples (ϱ=0.74). **Hematopathologists consistently overestimated blast counts compared to the AI approach,** with a median difference (MD) of 1.85% and limits of agreement (LoA) of (-1,1%, 5.5%). **Average manual assessments exceeded 5% in 3 cases (6%, 6.5%, and 12.25%) whereas AI detects significantly lower percentages (1.22%, 3.27%, and 4.02%, respectively)**. The total CD34+ blast cell area/total cell area ratio from the model showed an MD of 0.98% (LoA -1.6%, 4.1%) compared to hematopathologists' average estimation, indicating **manual estimation is likely influenced by cell area rather than actual cell enumeration.**

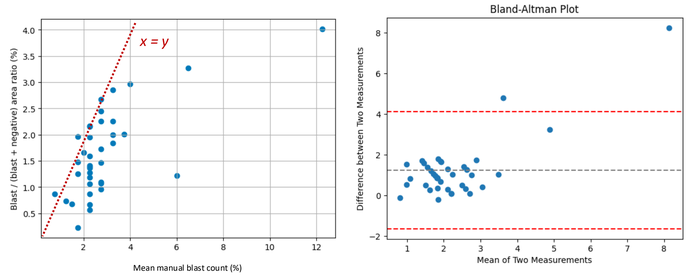




Blast cell area density is close to pathologists' estimations. The area for a single cell can be approximated by the biggest eclipse that can be drawn inside its prediction bounding boxes.



Correlation between mean manual estimation and AI-driven quantitation of blast cells computed as
total number of blast cells / total number of cells x 100 (%)
Spearman's ϱ : 0.595; 95% CI: [0.31, 0.78]
MD: 1.85%; LoA (-1,1%, 5.5%)



Correlation between mean manual estimation and AI-drive quantitation of blast cells computed as
the sum of areas of blast cells / sum of area of all cells x 100
Spearman's ϱ : 0.596; 95% CI: [0.34, 0.79]
MD : 0.98%; LoA (-1.6%, 4.1%)

CONCLUSIONS

AI-driven CD34+ blast quantitation in BMT automates assessment with high accuracy in a cohort of **chronic phase MPNs**. **Conventional quantitation significantly overestimates CD34+ blast proportions**, likely reflecting the influence of blast cell area. This has significance for classification and prognostication schemes in myeloid disorders and warrants further validation studies. **We are expanding AI-driven blast detection on MDS and AML cases,** where blast percentage holds a pivotal role. We are also testing vessel masks to quantitate microvessel density.

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