Histology and Cytology of Bone Marrow: Comparative Analysis of Diagnostic Value and Duration in Paediatric Practice

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Introduction. Morphology remains the foremost tool for diagnosing neoplastic processes in bone marrow (BM). Traditionally, histological samples (trephine biopsies) and cytological material (needle aspirates) have been used for examination. Both methods have advantages: cytology is fast and is easily combined with non-morphological methods like automatic cell counting, flow cytometry (FC) and molecular genetics; while histology, particularly in combination with immunohistochemistry (IHC), provides information on BM structure, non-hematological elements, and is considered less prone to sampling artefacts.

Aim, Material and Methods. The aim of the study was to retrospectively compare BM histology and cytology for diagnostic usefulness and time to report in paediatric patients. 284 consecutive BM analyses performed in 2013–2015 with histological and cytological samples taken simultaneously were included in the study. Clinical, histological and cytological diagnosis, information on IHC and FC and time span to report were obtained from the Children's Clinical University Hospital IS and the Clinical Laboratory IS. MS Excel and IBM SPSS v21 were used for statistical analysis, Mann-Whitney test was applied for differences.

Results. Clinical diagnosis in 106 cases was acute leukemia at presentation and during treatment, in 79 samples – solid tumours with initial BM involvement; in 99 cases patients had benign conditions. Histological and cytological diagnosis differed in 36 cases (12.7%); histology was more diagnostically informative in 24 instances and cytology in 12 ($p = 0.045$). Discrepancy in 18 cases was due to one of the samples being uninformative (6.3% of all cases); histology was not informative in 8 instances and cytology in 10. In no single instance both materials were uninformative. Cytological and histological diagnoses differed in other 18 cases (6.3%). In 4 cases of acute leukemia, IHC failed to detect existing residual blast population (7% from 57 blast-positive marrows), thus proving histology with IHC significantly less sensitive than FC ($p < 0.001$). In 14 out of 19 (73.7%) cases of patients with histologically proven BM, infiltration by solid tumours cytology with or without FC failed to detect malignant cells. Median time to histological report was 9 days and to cytological reports 0.5 days ($p = 0.002$). IHC was performed in 263 cases (92.6%) and significantly prolonged the time of analysis (from median 3 to 9 days, $p < 0.001$). FC was carried out in 120 cases (65.2%); time to report remained the same with and without FC

Conclusions. The study revealed a good diagnostic concordance between bone marrow cytology and histology in the studied group (93.2% of informative samples), with the marked exception of solid tumours. Diagnostic value of histology in paired tests was higher, cytology turned out to be non-applicable for detecting solid tumours in BM, even if assisted by FC. Sensitivity of cytology in combination with FC was superior to histology with IHC in the acute leukemia group. The result is not surprising, considering that multiparametric FC is the reference method for detecting small blast populations; still, there was 93% agreement between the methods.

The study demonstrated that cytological testing was significantly faster at Children's Clinical University Hospital setting, particularly if IHC was used. Considering the importance of correct morphological diagnosis in hematooncology and shortcomings of both methods, paired use of BM cytology and histology seems to be appropriate.