ISSN 2282-0930 • Epidemiology Biostatistics and Public Health - XIII^th SISMEC Congress - Vol. 20 Suppl. 1

Clinical Impact of Molecular Tumor Boards on Patient Care: A Systematic Review and Meta-Analysis

Lentini Nicolò[1], Russo Luigi[1], Giacobini Erika[1], Osti Tommaso[1], Pastorino Roberta[1,2], Boccia Stefania[1,2]

(1) Section of Hygiene, Department of Life Sciences and Public Health, Università Cattolica del Sacro Cuore, Rome, Italy
(2) Department of Woman and Child Health and Public Health, Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy

CORRESPONDING AUTHOR: *Lentini Nicolò. nicolo.lentini@unicatt.it*

INTRODUCTION

Precision oncology has transformed cancer treatment by enabling personalized strategies based on tumor molecular profiling. Molecular Tumor Boards (MTBs), which are multidisciplinary teams of specialists, interpret genomic alterations and provide evidence-based treatment recommendations. These teams play a pivotal role in translating complex molecular data into clinical practice. Despite their growing adoption, the medical community continues to debate the clinical effectiveness of MTBs, as outcomes vary considerably across study designs, tumor types, and healthcare settings

OBJECTIVES

This systematic review aimed to evaluate the clinical impact of therapies recommended by MTBs in oncology practice.

METHODS

We conducted this systematic review and meta-analysis in accordance with PRISMA 2020 guidelines. We searched PubMed, Embase, Scopus, and CENTRAL comprehensively up to March 2025. We included studies that reported clinical outcomes for cancer patients evaluated by an MTB, including overall survival (OS), progression-free survival (PFS), the proportion of patients achieving a progression-free survival ratio (PFSr) ≥ 1.3, objective response rate (ORR), and disease control rate (DCR). We included all study designs: randomized controlled trials (RCTs), non-randomized clinical trials, prospective and retrospective observational studies.

We assessed the risk of bias using the RoB 2.0 tool for RCTs and the ROBINS-I tool for non-randomized studies. We stratified all analysis by study design. We calculated pooled estimates and 95% confidence intervals (CIs) using a random-effects model with inverse-variance weighting method. We estimated between-study variance with the REML method and quantified heterogeneity using the I^2 statistic. To test the robustness of our findings, we performed sensitivity analysis that included leave-one-out analysis and excluded studies with serious or critical risk of bias. We assessed publication bias through funnel plots, Egger's test, and excess significance tests. We conducted meta-regression to explore sources of heterogeneity, reporting R^2 values to indicate the proportion of variance explained.

RESULTS

After screening 6,846 records, we included 78 studies in our analysis. We classified them as RCTs (n = 7, 9.0%), non-randomized clinical trials (n = 16, 20.5%), prospective observational studies (n = 20, 25.6%), and retrospective observational studies (n = 35, 44.9%).

For OS, we observed a reduction in the risk of death ranging from 12% to 43%, depending on study design. Specifically, the meta-analysis of four RCTs showed a pooled hazard ratio (HR) of 0.88 (95% CI: 0.75–1.04; I^2 = 0.0%). For PFS, we found a 27% to 37% reduction in the risk of disease progression, with a significant pooled HR of 0.73 (95% CI: 0.64–0.84; I^2 = 0.0%) in the meta-analysis of four RCTs. Regarding the proportion of patients achieving a PFSr ≥ 1.3, pooled estimates ranged from 33.1% to 43%, depending on study design. The only RCT included reported a PFSr ≥ 1.3 in 36.8% of patients (95% CI: 24.6–48.6).

In the meta-analysis of relative risk (RR) for ORR, patients treated according to MTB recommendations showed a significantly higher likelihood of achieving an objective response,

DOI: 10.54103/2282-0930/29228

with RRs ranging from 1.72 to 3.32 across study designs. The meta-analysis of five RCTs produced a significant pooled RR of 1.72 (95% CI: 1.23–2.42; I^2 = 0.0%). For DCR, pooled RR estimates ranged from 1.20 to 1.65 depending on study design. The meta-analysis of three RCTs showed a significant pooled RR of 1.20 (95% CI: 1.03–1.40; I^2 = 19.9%).

Meta-regression analysis that considered study design and cancer type focus of the MTB (single cancer vs. multiple cancers) explained a substantial portion of the between-study variance, particularly for OS (R^2 = 58.2%) and ORR (R^2 = 60.8%). Funnel plots, Egger's test, and tests for excess significance did not indicate any publication bias or selective reporting. Excluding studies with serious or critical risk of bias did not substantially change the direction or magnitude of the pooled estimates, except for OS in non-randomized clinical trial and retrospective observational studies.

Among RCTs, the overall risk of bias was low, with only one rated as having some concerns. In contrast, the risk of bias was predominantly serious for non-randomized clinical trials (n = 9, 56.3%), prospective observational studies (n = 18, 90.0%), and retrospective observational studies (n = 27, 77.1%). Additionally, four retrospective studies (11.4%) were rated as having a critical risk of bias, while the remaining 13 studies were considered to have a moderate risk.

CONCLUSIONS

Therapies guided by MTBs are associated with improved clinical outcomes in cancer patients, including reductions in disease progression and increases in response and disease control rates. While RCTs provide the most robust and reliable evidence, findings from observational studies, despite their inherent risk of bias, largely corroborate these benefits. The clinical effectiveness of MTBs is influenced by factors such as timely access to targeted treatments, the accuracy and comprehensiveness of molecular profiling, and the expertise and resources available within healthcare institutions. To fully establish the role of MTBs in precision oncology, there is a critical need for additional well-designed, large-scale RCTs that also address cost-effectiveness, implementation feasibility, and strategies for sustainable integration into diverse clinical settings. These efforts will be essential to optimize MTB-driven personalized therapies into routine oncology practice and maximize patient benefit across cancer types.

DOI: 10.54103/2282-0930/29228