

Review at a Multidisciplinary Tumor Board Impacts Critical Management Decisions of
Pediatric Patients with Cancer

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Abbreviations	
MTB	multidisciplinary tumor board

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ABSTRACT

Background

Optimal cancer care requires a multidisciplinary approach. The purpose of the current study was to evaluate the impact of a multidisciplinary tumor board on the treatment plans of children with solid tumors.

Procedures

The records of 158 consecutive patients discussed at a formal multidisciplinary pediatric tumor board between July 2012 and April 2014 were reviewed. Treatment plans were based on clinical practice guidelines and on current Children's Oncology Group protocols. Alterations in radiologic, pathologic, surgical, and medical interpretations were analyzed to determine the impact on changes in recommendations for clinical management.

Results

Overall, 55 of 158 children (35%) had alterations in radiologic, pathologic, medical or surgical interpretation of clinical data following multidisciplinary discussion. Of these, 64% had changes to the initial recommendation for clinical management. Review of imaging studies resulted in interpretation changes in 30 of 158 patients studied (19%), with 12 clinical management changes. Six of 158 patients (3.9%) had changes in pathologic interpretation, with 4 patients (2.5%) requiring treatment changes. In 8 patients (5%), a change in medical management was recommended while in 11 patients (7%) there were changes in surgical management that were based solely on discussion and not on interpretation of imaging or pathology.

Conclusions

Formal multidisciplinary review led to alterations in interpretation of clinical data in 35% of patients, and the majority led to changes in recommendations for

treatment. Comprehensive multidisciplinary tumor board incorporated into the care of children with cancer provides additional perspectives for families and care providers when delineating optimal treatment plans.

INTRODUCTION

The contemporary care of pediatric cancer has become increasingly complex and specialized. With the advent of multimodal therapies that span a broad spectrum of medical and surgical advancements, optimal therapeutic plans have become sub-specialized in nature. Nearly all children diagnosed with cancer in the United States are managed based on protocols and standard-of-care set by the Children's Oncology Group. The most successful survival outcomes are achieved by multidisciplinary treatment strategies that incorporate chemotherapy, surgery, radiation oncology, immunotherapy, and targeted therapy. Given this, there is increasing need for involvement of pediatric specialists in decisions made regarding diagnostic testing, biopsy technique, surgical resectability, chemotherapy regimen, and surveillance plans. To enhance communication and interaction among specialists, formal multidisciplinary tumor boards (MTB) and case conferences are utilized in many health care settings to formulate treatment plans. Although multidisciplinary care has become accepted as the optimal mechanism for delivering care in adult oncology, little qualitative or quantitative data exists to determine the impact of MTB on patient outcomes 1-4. The paucity of objective data is even more pronounced when examining pediatric MTB, as there are currently no standard requirements or recommendations for MTB review for children.

At our institution, patients with solid tumors are diagnosed primarily or are referred for second opinion after initial diagnosis or suspicion of cancer. Cases are

discussed at a weekly MTB with 30-35 participants from pediatric subspecialties in oncology, surgery, diagnostic and interventional radiology, and pathology. Specialists in nuclear medicine, radiation oncology, adolescent gynecology, and cancer genetics are also present and participate in the weekly care conference. We sought to examine our own experience with children evaluated in this manner and to determine the impact of MTB on clinical management.

MATERIALS AND METHODS

The records of 158 consecutive patients referred to pediatric MTB for discussion over a two-year time period between July 2012 and April 2014 were retrospectively reviewed. With approval of the Institutional Review Board, patient records were reviewed for changes in final radiologic, pathologic, medical, and surgical interpretations, and the effects these alterations had on clinical management. Patients with solid tumors were initially diagnosed at C.S Mott Children's Hospital, Ann Arbor, MI, or referred for second opinion consultation from an outside institution. Referring physicians at outside institutions were provided the option of presenting their patients and joining into the tumor board discussion either in person or by teleconference. Brain tumors are a part of a separate tumor board and were not included in this pediatric MTB. Patients with leukemia and lymphomas were included if there was a need for potential surgical intervention or multidisciplinary consensus on imaging or pathology (e.g. nodal status and biopsy, mass resection, lung lesions). Referral for discussion at pediatric MTB was then made by the initial evaluating service and medical records, imaging, histologic slides, and other diagnostic materials were forwarded for review. All imaging studies and reports were submitted to the pediatric diagnostic radiologists for interpretation and specimen slides were submitted to the pediatric pathologists. The list

of tumor board patients for discussion at the weekly meeting was then sent out by email to all invited participants including pediatric oncologists, surgeons, radiologists, pathologists, interventional radiologists, and radiation oncologists prior to each meeting. There was interdepartmental commitment (pediatric oncology, surgery, radiology, and pathology) that at least one but ideally two to three consistent pediatric physician representatives from each specialty would participate in tumor board discussions each week. The entire multidisciplinary team then met in consultation to discuss each child. Team members present at MTB also included advanced practice nurses and physician assistants, dieticians, social workers, child-life specialists, and trainees from all disciplines. During the comprehensive meeting, the pertinent history, physical examination findings, diagnostic tests, and original plan for each patient were presented and outlined. Pertinent radiologic and pathologic studies were displayed and collectively discussed. A consensus diagnosis, staging, and treatment plan was then agreed upon and carried forward. Treatment plans were made based on current Children's Oncology Group clinical trial protocols, literature review, and guidelines when available for each pediatric solid tumor. After review at tumor board, a detailed progress note entitled "Multidisciplinary Care Note" was placed in the patient's chart, which included a summary of the discussion and any changes in interpretation of pathology or radiology. Any official amendments of previous interpretations were made by the original interpreting physicians. Patients received resultant information from the involved physicians and the recommendations for treatment plans were shared either by clinic appointment or by phone conversation on the same day as the tumor board discussion. Patients were provided the opportunity for coordinated follow-up appointments for surgery, chemotherapy, and radiation planning based on the

individualized treatment plans. Details of MTB findings and recommendations were documented and communicated back to referring physicians and outside institutions.

RESULTS

Review of Imaging

Review of imaging at MTB resulted in changes in original interpretations in 30 of 158 patients studied (19%). Interestingly, nine of these changes (5.6%) in interpretation were in radiologic studies already previously reviewed at our institution. The most common change, found in 18 patients (11%) was the level of suspicion in a previously noted lesion. Twelve of these cases were a downgrade in the level of suspicion and thereby led to a consensus that there was no need for immediate intervention or therapy. Five patients (3.1%) were recommended to undergo additional imaging to evaluate inconclusive lesions, and additional suspicious lesions were found in three patients (2%). Two patients (1.2%) were recommended to undergo additional biopsies based on radiologic review, and in two patients (1.2%) the dominant lesion planned for biopsy was changed (Table 1). Overall, in 12 of the 30 cases (7.6%), in which there was a change in radiologic interpretation, there was a subsequent change in the clinical management that led to either a recommendation of observation (5%), change in staging (0.6%), change in the dominant lesion planned for biopsy or resection (1.2%), or plan for immediate operative intervention (0.6%) (Table 1).

Review of Pathology

Review of pathologic specimen and histologic slides by tumor board participants resulted in changes in interpretation for 6 of 158 patients (3.8%) and confirmation of

diagnosis in 152/158. Three patients (1.9%) had complete changes in their pathologic diagnosis, while three patients (1.9%) had an upgrade in stage of their disease (Table 2). These changes resulted in alterations in clinical management in four patients (2.5%), with one patient initiating chemotherapy, one patient changing chemotherapy protocol, one initiating radiation therapy, and one requiring further surgical resection (Table 2).

Clinical Review by the Multidisciplinary Tumor Board

In eight patients (5%), case review at tumor board led to changes in the recommended chemotherapeutic and medical management that were not based on changes in interpretation of radiologic or pathologic findings, but based primarily on multidisciplinary discussion and review of guidelines as interpreted by the medical, surgical, and radiation oncologists. For three patients, this resulted in a continuation of the current chemotherapy regimen, while two patients were recommended initiation of a new cytotoxic regimen. Cessation of chemotherapy was recommended in one patient and two patients were referred for surgical management rather than chemotherapy (Table 3).

Similarly, case review at MTB led to changes in the recommended surgical management of 11 patients (7%), independent of changes in the interpretation of radiologic or pathologic findings. For three patients, additional procedures including interventional radiology-based biopsy were recommended. Changes in technical specifics of the operative plan were recommended in two patients. In four patients, the original operative plan was not previously determined and was therefore confirmed and agreed upon based on MTB discussion. Operative intervention was no longer recommended in two patients (Table 3).

Collectively, when alterations in analysis of diagnostic or clinical data (radiologic, pathologic, and clinical reviews) were combined, a total of 55 of 158 patients evaluated (35%) had changes in interpretation. Significantly, of these, 35 patients (64%) had changes that resulted in a change in treatment or clinical management recommendations.

DISCUSSION

MTBs are designed to enhance patient management and foster inter- and intra-disciplinary discussion⁵. MTBs allow specialists to work together to develop consensus recommendations in accordance with guidelines and protocols endorsed by the clinical team⁶. Contemporary MTBs were first established in the United Kingdom following a landmark report published in 1995 that recommended that all cancer patients be assessed by surgeons who work with other specialists as part of a multidisciplinary team⁷. Since then, mandates for multidisciplinary assessment in cancer care have been developed in Australia, Canada, and in the United States⁵. The Commission on Cancer of the American College of Surgeons now makes MTB mandatory for accreditation of hospitals responsible for providing multidisciplinary cancer care⁸. What remains unknown is the impact of MTBs on clinical management and patient outcomes.

Review of multidisciplinary cancer care in the United Kingdom demonstrated that MTB improves communication, coordination, and decision-making between healthcare professionals when weighing treatment options⁹. Several studies, however, have also demonstrated that poor organization, communication, and leadership often hinder MTB and actual clinical decision-making is a difficult and time-consuming process¹⁰⁻¹². Moreover, several studies have also demonstrated that there is variability in the implementation of MTB management decisions.

In terms of patient outcomes, a limited number of studies in adults have assessed the impact of MTBs¹⁷⁻¹⁹. The common conclusion from these studies has been that MTB is associated with improved survival. For example, a retrospective review of lung cancer patients found an improvement in median survival with the introduction of MTBs (3.2 months before implementation versus 6.6 months after implementation, $p < 0.002$)²⁰. It remains difficult to interpret the results of these studies given their diverse design and objectives, and the confounding variables involved in evolving cancer care.

Therefore, it is perhaps more useful to evaluate whether MTB has an impact on clinical management decisions. Several studies in the adult population have examined this question²¹⁻²⁴. These studies demonstrated that review in a MTB resulted in changes in clinical management in anywhere from 20 to 60% of cases presented. These changes included reinterpretation of radiologic findings, pathologic findings, staging, need for additional imaging or procedures, or treatment strategies.

Before now, there have been no studies examining pediatric MTB, and its impact on clinical management of children with cancer. The current weekly format for pediatric MTB at C.S. Mott Children's Hospital was established in July of 2012. The format includes a weekly meeting of pediatric health care professionals from many disciplines including radiology, pathology, radiation oncology, pediatric oncology, and pediatric surgical specialties. Cases are initially referred to tumor board by the initial evaluating service and the cases to be discussed for the week are sent out to all attendees prior to the meeting. During the meeting, a brief history of the patient is provided and the radiologic and pathologic findings are reviewed and discussed together. The case is then open to discussion to all attendees and consensus recommendations are made and forwarded back to the admitting service.

This study is a review of the first 158 cases presented at the MTB between July 2012 and April 2014. Significantly, we found that review at MTB resulted in changes in management in 35 patients. These changes were a result of differences in radiologic interpretation, pathologic interpretation, and evaluation by medical, radiation, and surgical oncologists. Within these differences, the most frequent change was observed in radiologic interpretation (19%). These differences may reflect the importance of clinical context, the importance of continuity of interpretation, and comparative review with previous imaging findings. Also of note, in 12 cases, changes in radiologic interpretation resulted in a decrease in the level of suspicion of lesions. Direct discussion between the pediatric radiologist and the clinicians allowed for a more nuanced discussion of the level of suspicion for a given lesion compared to a written report. Additionally, familiarity between the clinical teams and the radiologists allowed improved communication that enhanced patient care. In the current study, this was exemplified by avoidance of potentially unnecessary and costly initiation of new therapies or procedures.

Similarly, changes in pathologic interpretation at the MTB had a direct impact on clinical management. Three patients had an upstaging of cancer based on pathology and four patients had a change in treatment plan, namely chemotherapy versus radiation versus surgical treatment. In the absence of changes in radiologic and pathologic interpretation, discussion and consensus opinion at the MTB resulted in changes in the clinical management of an additional 19 patients (12%). Though not measured in this report, such discussions also consistently led to consideration of referrals for fertility preservation, cancer genetic testing, and coordination of social services that had not been previously offered.

While review at MTB resulted in changes in management in nearly 1/3 of patients, there were many patients who did not have any changes but received confirmation of diagnostic tests and treatment plans. As this was a newly implemented tumor board, we did not turn away any patients and discussed each patient as requested. As the volume of patients discussed during MTB grows, mechanisms to screen patients to determine who will benefit the most from MTB review will be important.

As a retrospective review, this study has limitations. Recommendations from the tumor board were based on the best judgment of the tumor board physicians and specialists for each patient. Given this, it is occasionally difficult to determine the “gold standard” interpretation. To address this in the weekly meetings, we requested and recommended that at least two to three specialists from each discipline be present and available for MTB discussion. On the rare occasion that this was not possible or in cases where a change in interpretation during MTB was significantly different than the original interpretation, we consulted with the original radiologist or pathologist, as well as an additional pediatric radiology or pathology subspecialist (outside of the MTB meeting) for consensus conclusions. Although the goal of the MTB is to adhere to established National Cancer Institute and Children’s Oncology Group guidelines, no internal controls were in place to ensure accuracy of this process, and therefore decisions were subject to some level of physician preference and opinion. In addition, although the MTB made recommendations, individual providers directly responsible for the patients may have pursued alternative treatment courses. There is currently no mechanism in place to assess the accuracy of adoption of MTB recommendations. Many patients were presented several times during the course of treatment and this has allowed us to begin follow-up analysis of whether recommendations manifested into

treatment changes and impacted patient outcomes. This will be a future area of investigation.

In summary, this is the first review of the experience of pediatric MTB. Our study reveals that tumor board review can lead to recommendations for change in treatment in a significant number of patients, and provides additional perspectives for families and care providers when delineating optimal treatment plans.

CONFLICT OF INTEREST STATEMENT: The authors declare no conflict of interests.

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TABLE 1. Changes in Radiologic Interpretation and Management (n=158)

Changes in Radiologic Interpretation	No.	%
Additional lesions	3	1.9
Increased or decreased suspicion of lesion	18	11
Need for additional biopsy	2	1.2
Need for additional imaging	5	3.1
Different lesion marked for biopsy	2	1.2
Total	30	18.4
Changes in Management Based on Review of Radiology		
Observation	8	5
Change in staging	1	0.6
Change in lesion planned for biopsy	2	1.2
Change in initial management from medical to surgical	1	0.6
Total	12	7.6

TABLE 2. Changes in Pathologic Interpretation and Management (n=158)

Change in Pathologic Interpretation	No.	%
Change in pathologic diagnosis	3	1.9
Change in pathologic staging	3	1.9
Total	6	3.8
Change in Management Based on Review of Pathology		
Initiate new therapy	2	1.2
Change current therapy	1	0.6
Require surgical management	1	0.6
Total	4	2.5

TABLE 3. Changes in Management Decisions Made During Tumor Board Review

Change in Management Based on Oncology or Surgical Review	No.	%
Initiation of new chemotherapy	2	1.2
Continuation of current chemotherapy regimen	3	1.9
Cessation of chemotherapy	1	1.2
Referral for surgical management	2	1.9
Recommend additional procedures prior to surgery	3	1.9
Confirm operative plan	4	2.5
Change operative plan	2	1.9
No longer recommend surgical management	2	1.9
Total	19	14.4