Musculoskeletal Oncology: State of the Art

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ABSTRACT: The outlook for the patient with sarcoma of the musculoskeletal system has improved dramatically because of recent advances in diagnosis and treatment. These new developments, as discussed in this review, allow greater success in achieving the goals of treatment, which include 1) control of the primary lesions, 2) maintenance of function, and 3) long-term survival.

Introduction

Treatment of patients with musculoskeletal sarcomas remains challenging and controversial. Although relatively rare, these sarcomas encompass a wide range of lesions, many with different biologic capabilities. Both their rarity and their insidious clinical presentation make early recognition difficult. Furthermore, the histologic interpretation of musculoskeletal sarcoma has been particularly difficult, and this problem has been compounded by the steady evolution in the classification of these tumors according to modern histologic criteria. From the clinical standpoint, the previous outlook for patients with these tumors was poor because of the high incidence of systemic metastasis. Most patients died of their disease within 5 years.\textsuperscript{1-3} Moreover, the high incidence of local recurrence after excision mandated amputation for most patients.

The outlook for the patient with sarcoma of the musculoskeletal system has improved dramatically because of recent advances in diagnosis and treatment. Recent developments include better classification systems; more sophisticated staging studies, including computed tomography of both the primary lesion and the lungs to detect pulmonary metastasis; and magnetic resonance imaging. Despite these advances, the care of the young patient with metastatic disease and local failure after chemotherapy continues to frustrate all members of the musculoskeletal oncology team.

There are three major goals in the treatment of these patients: 1) control of the primary lesion, 2) maintenance of function, and 3) long-term survival.

Control of Primary Lesion

In contrast to the controversy that has surrounded efforts to develop effective adjuvant chemotherapy to improve survival, methods of control of the primary lesion are more unified and accepted. During the past decade, many advances have been made in the evaluation and treatment of the primary lesion.

Classification

Currently, the confusion in the pathologic classification of musculoskeletal sarcomas is being clarified. The classification that has been most useful for bone sarcomas is a modification by Dahlin and Unni of Lichtenstein's original classification.\textsuperscript{4} This modified classification groups bone tumors into ten categories: hematopoietic, chondrogenic, osteogenic, unknown origin, histiocytic origin, fibrogenic, nodochordal, vascular, lipogenic, and neurogenic. Within these groups the lesions are classified as benign or malignant.

Such advances in clinical pathologic correlation have shown that some tumors, such as osteosarcoma, are not homogeneous. Dahlin has defined 11 different subvarieties of osteosarcoma.\textsuperscript{5} Chondrosarcomas also have been subclassified into different varieties, each having different biologic capabilities: conven-
tional chondrosarcoma, clear-cell chondrosarcoma, secondary chondrosarcoma, mesenchymal chondrosarcoma, and dedifferentiated chondrosarcoma. If meaningful results on the evaluation of bone tumors are to be obtained in clinical studies, it is important to recognize the various subvarieties, each of which has a different biologic capability.

For soft-tissue sarcomas, the World Health Organization’s classification system is utilized. Of the most common sarcomas in that classification, seven can be graded histologically while eight cannot. Those that can be graded include malignant fibrous histiocytoma, liposarcoma, fibrosarcoma, leiomyosarcoma, neurofibrosarcoma, hemangiopericytoma, and extraskeletal osteosarcoma. The nongradable tumors include synovial sarcoma, clear-cell sarcoma, epithelioid sarcoma, angiosarcoma, lymphangiosarcoma, alveolar soft-part sarcoma, mesenchymal chondrosarcoma, and myxoid chondrosarcoma.

In addition to the grading and pathologic classification, the use of electron microscopy and immunohistochemistry makes the diagnosis more precise. Although immunohistochemical definition of these sarcomas is still in its infancy, future developments will help resolve difficult problems in histogenesis, tumor heterogeneity, degree of differentiation, and prediction of the biologic potential of the lesion and its response to treatment.

Clinical Evaluation

The first problem with musculoskeletal tumors is recognizing the existence of a lesion. Evaluation of patients with musculoskeletal tumors is divided into four phases: 1) discovery, 2) diagnosis, 3) preoperative staging, and 4) biopsy. Clinical evaluation begins with a careful history and physical examination. Plain radiographs are one of the keystones in formulating a working diagnosis of bone lesions.

Once a reasonable differential diagnosis is generated by clinical and radiographic correlation, the staging workup is completed in the preoperative phase. Careful preoperative evaluation is essential to determine evidence of acute systemic metastasis and the precise extent of local tumor involvement. Additional studies such as isotopic bone scan, CT of the lesion and lungs, MRI, and digital subtraction angiography may be necessary to aid in the preoperative planning. The advent of CT and MRI has enabled the clinician to better define the anatomic confines of the lesion. In addition, both CT and MRI can reveal pathognomonic features of various lesions—features that enable the clinician to make a diagnosis with a reasonable degree of certainty prior to biopsy. CT of the chest enables the clinician to detect occult pulmonary metastatic lesions.

The imaging techniques should be completed before the biopsy specimen is taken because changes induced by the biopsy will alter the critical staging studies. The preoperative evaluation may be modified depending on the location of the tumor. With pelvic and spinal lesions, excretory urography or cystography may give information on the extent of deviation of the ureters and bladder, and a barium enema study will indicate the relationship of a pelvic tumor to the large bowel. If the lesion is in the spinal column, a myelogram is necessary to assess the relationship of the spinal tumor to the neural contents. A liver and spleen scan may be helpful in patients with disseminated sarcoma or to determine the pattern of a lymphoma. The preoperative evaluation of a patient with a musculoskeletal neoplasm, however, must be individualized, depending on the expected diagnosis.

Biopsy

Once the clinical evaluation is completed, biopsy of the lesion allows the clinical diagnosis to be confirmed. Difficulty in histologic interpretation usually mandates an open biopsy with careful removal of adequate representative tissue. Numerous pitfalls that may adversely affect the outcome are associated with the biopsy. Much care must be exercised in preoperative planning, during which time the definitive surgical procedure should be kept in mind. In this way, if resection is performed, the biopsy site can be removed en bloc with the tumor specimen. Transverse wounds on the extremity must be avoided because they make subsequent surgery difficult. Contamination of surrounding soft-tissues must be avoided because contamination will result in soft tissue recurrence. Moreover, meticulous hemostasis is essential to avoid a wound hematoma. Contamination of multiple compartments by a poorly planned biopsy incision or the development of a hematoma after biopsy will preclude a successful limb-sparing procedure.

Surgical Staging

Advances in pretreatment assessment studies and
pathologic assessment of the lesion have resulted in more accurate surgical staging. The development of a surgical staging system by the Musculoskeletal Tumor Society has been one of the most significant advances in the treatment of patients with musculoskeletal sarcomas (Table 1). The surgical staging system is based on the surgical grade of the lesion (low or high) and the anatomic confines of the lesion. Patients with metastatic disease are identified as being at high risk and are placed in a separate category independent of the grade and anatomic features of the lesion. Stage I lesions are low-grade lesions. This stage is further divided into stage IA (low-grade intracompartamental lesions) and stage IB (low-grade extracompartamental lesions). Compartmentalization refers to the presence or absence of penetration of the lesion beyond the bone compartment or the anatomic fascial barriers in soft-tissue sarcomas. Stage II lesions are high-grade lesions, while stage III is metastatic disease.

The adequacy of surgery is judged by grading the surgical margin achieved in either local resection (such as a limb-salvage procedure) or amputation. Intralosional margins involve cutting across the tumor, leaving tumor tissue behind; a marginal line of resection involves only removal of the lesion but cutting through the reactive capsule; wide margins reveal a cuff of normal tissue around the lesion; and a radical margin is one associated with the removal of the lesion and its entire compartment. Studies have shown that intralosional and marginal lines of resection lead to unacceptably high rates of local recurrence, exceeding 80%. However, wide surgical margins lower the local recurrence rate to less than 10%. Although radical margins are more satisfactory in achieving local control, with recurrence rates less than 1% or 2%, the functional morbidity after removing the entire compartment is significant. The current methods of resection have dramatically lowered the local recurrence rate to less than 10% in most large series.

**Maintenance of Function**

The second goal in treatment is the maintenance of function. Maintenance of adequate function can be achieved with both limb-salvage procedures and amputation. Although amputation may be mutilating and undesirable, patients usually accept their deficit and become useful members of society. In contrast, a successful limb-salvage surgery restores function and usually leaves the patient well satisfied. Unfortunately, in limb salvage, the morbidity of major resections and reconstructions can be significant. Failed limb-salvage surgery is disappointing to both the patient and the surgeon, resulting ultimately in function similar to that achieved with a primary amputation.

Limb-salvage surgery revolves around performing an oncologically sound resection of the tumor. In all circumstances, a cuff of normal tissue must be removed with the specimen. Intralosional margins will always result in local recurrence. In a similar fashion, marginal lines of resection will result in local recurrence unless adjuvant chemotherapy or radiation therapy is added to the primary surgery.

**Primary Bone Tumors**

After a biopsy specimen has been obtained and an accurate diagnosis has been made on the basis of clinical, radiographic, and pathologic correlation, a treatment plan is formulated and executed. Treatment depends on the relative radiosensitivity of the tumor. With a radiosensitive tumor such as Ewing's sarcoma, lymphoma, or myeloma, radiation therapy and chemotherapy will be the primary treatment modalities.

In Ewing's sarcoma, approximately 5,000 rad (50 Gy) are given to control the primary lesion. Moreover, aggressive chemotherapy regimens to control microscopic metastasis have altered the course of this tumor, resulting in improved prognosis. The use of surgical resection to control the primary lesion has been emphasized. Recent experience has suggested that survival is improved if surgery is included in the treatment protocol. This approach also helps avoid the morbidity that occurs secondary to radiation. Moreover, approximately 15% of these
patients suffer local recurrence after radiation therapy.\textsuperscript{14}

Currently, the prognosis for patients with localized Ewing's sarcoma has improved, with as many as 60% expected to survive 5 years. While various combinations of surgical management, radiation therapy, and chemotherapy are currently under investigation, the role of surgery in the treatment of primary lesions should increase as more experience is gained.

A radioresistant tumor such as osteosarcoma, chondrosarcoma, or fibrosarcoma requires surgical ablative, either by amputation or resection. The selection varies primarily according to the surgical stage of the lesion rather than the histogenesis of the lesion.

**Limb Salvage**

Whereas amputation has been the standard recommended treatment for high-grade lesions (stage II), recent advances have changed this. In recent years, there has been increased interest in limb salvage and the treatment of malignant bone tumors fostered by enthusiasm for neoadjuvant chemotherapy as well as improved techniques of reconstruction.\textsuperscript{16,17} The major concerns associated with limb salvage for high-grade sarcomas have been its safety and adequacy of functional restoration.

**Safety.** To be a viable option, a limb-salvage procedure must not adversely affect the outcome. Use of limb-salvage procedures in osteosarcoma does not seem to affect survival adversely. In a Mayo Clinic series, the 5-year survival of 49 patients with high-grade osteosarcoma (stage II) who underwent limb-salvage procedures was 49% compared with 54% of the 160 patients who underwent amputation during the same time period.\textsuperscript{18} These results are consistent with those of other reports. In the UCLA experience with 226 patients who underwent amputation and 78 who underwent resection, there was no difference in survival. In addition, the study showed that limb salvage was as effective as amputation in obtaining local control of the tumor, with a local recurrence rate of only 3.8%.\textsuperscript{19}

Promising results with limb salvage have also been reported from other institutions. Recently, Gebhart et al\textsuperscript{20} reviewed their results of limb salvage for osteosarcoma. In a group of 154 consecutive patients, also treated with preoperative and postoperative chemotherapy, there was no significant difference in survival between patients who had resection and those who had amputation. The overall local recurrence rate was 15%, but this was dramatically reduced to 6% when the duration of preoperative chemotherapy was kept to 6 months or less. Malawer, from the Children’s Hospital National Medical Center, reported on 33 patients who had an average follow up of 31 months.\textsuperscript{21} He noted an overall survival of 77% and a local recurrence rate of only 6%, with only four patients subsequently requiring secondary amputation.

Murray et al\textsuperscript{22} achieved favorable results in 62 patients with osteosarcoma treated at M.D. Anderson Hospital by interarterial cisplatin plus doxorubicin alternately. In that series, 73% of the patients were continuously tumor-free after a mean follow up of 25 months. Six of the 62 patients experienced local recurrence.

**Functional Restoration.** In addition to achieving comparable control, the limb-salvage procedure must produce functional status that is superior to amputation and prosthetic fitting.

In limb-salvage procedures, the goal of resection is to achieve local control of the tumor with an appropriate surgical margin; this usually results in a large osseous and soft-tissue defect. The goal of reconstruction is to restore as much function as possible, and this often presents a complex surgical problem that can be managed by a number of techniques, depending on the location of the tumor and the functional expectations of the patient.

Many potential procedures for various situations have been described. The specific choice of the reconstructive technique best suited for a particular patient must be individualized according to the patient's age, life-style, and vocational needs. Each method of reconstruction has advantages and disadvantages, proponents and opponents. In deciding which reconstructive procedure is best suited after resection, the surgeon must consider the availability of the procedure, level of surgical difficulty, morbidity, and incidence of complications associated with the procedure. On the basis of individual factors, the reconstructive options are osteochondral allograft, resection arthrodesis, and custom joint arthroplasty.

**Osteochondral Allografts**

Because of concerns involving the durability of prosthetic materials, increased emphasis has been
placed on biologic reconstruction. This concern is increasing because more patients with life-threatening sarcomas are expected to survive longer owing to improvements in medical and surgical management.17,19,23-27 Allograft replacement continues to have many proponents, but is somewhat limited by its availability. Complication and failure rates are still high with this method.28-33 Mankin reported a 42% rate of major complications after this technique.30 Moreover, chemotherapy is always a concern when allograft reconstruction is contemplated.

Data suggest that chemotherapy and radiation therapy retard allograft "survival," but this does not contraindicate their use.34 With improvements in patient selection, allograft banking, and surgical technique, biologic replacement will become increasingly useful. However, allograft reconstruction generally is indicated for benign and low-grade malignant tumors (Fig. 1).

Resection Arthrodesis

Durability of the reconstructive procedure is another important consideration. If the patient is going to place heavy physical demands on the reconstruction, then resection arthrodesis may be the most realistic choice. An arthrodesis to restore skeletal continuity after resection may be considered in patients who are young and active, who have aggressive benign lesions, and who are grossly overweight. These patients must be emotionally able to accept the arthrodesis. With this technique, as with others, the rate of complications is significant35 (Fig. 2). An arthrodesis is a definitive procedure capable of providing a stable, pain-free, weight bearing extremity with the least restrictions for strenuous working and recreational activities.

Custom Prosthetic Replacement

Custom-made segmental prostheses for the hip, knee, and shoulder are effective in restoring skeletal continuity while maintaining the function of the neighboring joint. Although alternative methods of reconstruction are available, custom segmental bone and joint implants seem to offer certain advantages over the alternatives. Prosthetic reconstruction has the inherent advantage of immediate functional restoration and preservation of movement. The implants also may compensate for the varying lengths of resected bone. Although recommended for older patients who make less functional demands on the implants, the custom arthroplasty has been used primarily in the young patient with a life-threatening sarcoma because of the advantage of immediate functional restoration with minimal morbidity. In addition, routine preoperative and postoperative chemotherapy has favored the use of a prosthesis because incorporation of the bone graft is unpredic-
Fig. 3: Anteroposterior (A) and lateral (B) views of distal femur showing large chondroma. Anteroposterior (C) and lateral (D) views after en bloc resection and reconstruction with total knee arthroplasty. Kinematic rotating hinge was utilized.

Fig. 2: (Right) Anteroposterior roentgenogram of distal femur showing large osteosarcoma. (Left) Reconstruction of distal femur with segmental arthrodesis using vascularized fibular grafts after resection of osteosarcoma. (From Sim et al.18 By permission of US Department of Health and Human Services.)

table after the administration of high-dose chemotherapy.

While the early results have been satisfactory, concern for long-term prosthetic function has limited any widespread acceptance. Recent advances in implant design and the use of new materials to promote biologic fixation by bony ingrowth should improve the long-term results (Fig. 3, 4).

Long-Term Survival

Perhaps the most controversial of the treatment goals is long-term patient survival. Once adequate control of the primary lesion has been achieved, adjuvant chemotherapy seems to have made an important contribution in maintaining the patient in a disease-free status. Historically, surgery, which is the primary treatment of osteosarcoma, has been associated with a poor prognosis in all large series, the 5-year survival being approximately 20%.36-40 This low survival rate in spite of an adequately controlled primary lesion suggests that pulmonary metastasis was present before the initial surgical treatment. Accordingly, chemotherapy should be tried in an attempt to improve long-term survival.

The first breakthrough in chemotherapy was in 1974, when Jaffe et al showed that massive doses of methotrexate, along with citrovorum factor, caused metastatic osteosarcoma to regress.23 Soon thereafter, a number of nonrandomized studies showed that high-dose methotrexate or doxorubicin could give projected 5-year disease-free survival rates of
between 45% and 60%.\textsuperscript{24, 25, 41, 42} When compared with historical controls, this represented a therapeutic triumph, and improved survival was attributed to adjuvant chemotherapy. However, some investigators believe that the entire issue was clouded by the use of historical controls and that the better results could be due to other factors, including earlier diagnosis, more aggressive treatment, better clinical staging, and even possible changes in the biologic nature of the tumor. In addition, the occurrence of late relapse has led some to believe that metastatic disease is not prevented by chemotherapy, but just delayed.

One of the first studies to report the generally improved survival was done at the Mayo Clinic.\textsuperscript{43, 44}
Of the 41 patients treated by surgery alone between 1972 and 1974, 66% survived 5 years and 43% were disease-free without chemotherapy. These percentages were not significantly different from those reported by many of the nonrandomized chemotherapy trials. A prognostic index was developed to explain some of these differences (Table 2). A patient with four, five, or six of these factors has a worse prognosis than a patient with only one or two factors.

Subsequently, many diverse adjuvant programs were developed which, when compared with historical controls, were all considered to be effective but which, when compared with current controls, can best be considered equally ineffective. Thus, there was great disappointment with the results of chemotherapy after the initial wave of enthusiasm in the mid-1970s.

One of the first studies to compare the results of a chemotherapy program with those achieved by a concurrent surgical control without adjuvant therapy was also done at the Mayo Clinic. The overall survival of 52% and a disease-free survival of 42% were not different between the patients who were treated with chemotherapy and surgery and those treated with surgery alone. Another prospective randomized study was carried out in 1978 by the Children Cancer Study Group. At 36 participating institutions, more than 280 patients were randomized to regimens of either high-dose or moderate-dose methotrexate. The study reported a 5-year disease-free survival of 32%. There was no significant difference in overall survival or disease-free survival in patients who had received high-dose
methotrexate and those who had received moderate-dose methotrexate (Makley et al., unpublished data). Several recent studies, however, have achieved significant results with adjuvant chemotherapy. At the NIH Consensus Meeting in 1984, the results in three successive adjuvant trials at the Dana Farber Cancer Institute were reported. The first pilot study involved 12 patients who were given vincristine alone or vincristine and methotrexate, and a disease-free survival of 42% was achieved at 10 years. The second protocol, combining doxorubicin with vincristine and methotrexate and involving 22 patients, achieved a 5-year disease-free survival of 58%. The third protocol increased the dose of methotrexate and achieved a 5-year disease-free survival of 59%.

To further define the role of adjuvant chemotherapy, the Multi-Institutional Osteosarcoma Study Group was initiated in 1982. Of the 141 patients seen by the participating institutions during the 2-year period, 107 were eligible for randomization. Thirty-seven patients were randomized: 18 to immediate chemotherapy and 19 to observation. Of the 18 patients who had chemotherapy, only 5 had relapse, while 14 of the 19 with no chemotherapy had recurrence. Of patients who were not randomized, 49 received chemotherapy and 19 did not. Fifteen of the 19 who did not have chemotherapy had a relapse. A life table analysis of the total study population showed a projected survival rate of 59% for the group that received chemotherapy and only 6% for the group that did not. The report concluded that every patient with osteosarcoma should receive chemotherapy.

In a recent prospective randomized study at UCLA, Eckardt et al found a definite advantage for patients treated with chemotherapy over patients who received no chemotherapy. The number of patients in the series, however, was small (27 were randomized to no chemotherapy and 32 to chemotherapy) and the follow up was only 2 years. The 2-year disease-free interval in the group that did not receive chemotherapy was 20% compared with 55% in the group treated with chemotherapy. Twelve of the 14 patients who received chemotherapy and who had failed treatment developed lung metastases, while only 9 of the 20 patients who received no chemotherapy developed lung metastases. Six of the 20 patients developed bone metastases. If the patients with pulmonary metastases in the two treatment arms are compared, the incidences are similar—33% in the group that received no chemotherapy and 36% in the group that received chemotherapy.

While the status of chemotherapy in the treatment of musculoskeletal sarcoma has been controversial, these ongoing clinical trials with various chemotherapeutic agents, usually including high-dose methotrexate, doxorubicin, and cisplatin, show promise. Preliminary reports of treatment with newer agents such as ifosfamide are very encouraging. In addition, current protocols using preoperative (neoadjvant) chemotherapy rely on the extent of tumor necrosis at surgery as a measure of chemotherapy effectiveness.

### Soft-Tissue Sarcomas

Currently, many continuing clinical trials are emphasizing the efficacy of various adjuvant surgical treatment regimens in the management of soft-tissue sarcomas (Table 1). These trials include both preoperative and postoperative programs using radiation, single- or multiple-agent chemotherapy, and immunotherapy in various combinations (Table 3). The value of radiation therapy in decreasing the local recurrence rate and allowing local tumor control has

### Table 2

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<th>Characteristics Identified as Prognostically Unfavorable in Patients with Osteosarcoma</th>
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<tr>
<td>Age</td>
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<td>Sex</td>
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<tr>
<td>Diameter of tumor</td>
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<td>Cell type</td>
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<td>Duration of symptoms</td>
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<td>Site</td>
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### Table 3

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<th>Surgical Adjuvant Therapy Currently Studied</th>
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<td>1. Radiation</td>
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<td>a. Preoperative</td>
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<td>b. Intraoperative</td>
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<tr>
<td>c. Postoperative</td>
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<tr>
<td>2. Cytotoxic drugs</td>
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<tr>
<td>a. Preoperative (intravenous or regional intra-arterial)</td>
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<tr>
<td>b. Postoperative</td>
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<tr>
<td>3. Biologic response modifiers</td>
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<tr>
<td>a. Active specific immunotherapy (tumor vaccines, viral oncolytics)</td>
</tr>
<tr>
<td>b. Active nonspecific immunotherapy (BCG, interferons, interleukin-2)</td>
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<tr>
<td>c. Passive specific immunotherapy (antitumor antibodies, especially monoclonal; adaptive transfer of tumor-specific cytotoxic T cells)</td>
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<tr>
<td>d. Passive nonspecific immunotherapy (tumor necrosis factor, lymphokine-activated killer cells, high-dose interferons)</td>
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been well demonstrated. The role of adjuvant chemotherapy in the treatment of soft-tissue sarcomas remains unsettled and requires continued evaluation of prospective clinical trials. There is promise that new agents and combinations of therapies will ultimately improve survival.

Metastatic Bone Disease

In the United States, approximately one million new cases of cancer are diagnosed each year. Improvements in oncologic management of the primary tumor, due primarily to advances in chemotherapy, immunotherapy, and radiation therapy, have resulted in increased survival of patients with cancer. Because of this increase in survival, approximately 50% of patients will be expected to develop metastasis to bone during the course of their disease. Therefore, the orthopedic surgeon can expect to see more patients who have compromised function of the musculoskeletal system secondary to dissemination of the cancer cells. Accordingly, methods of preventing and limiting the destruction of bone must be developed.

Treatment of patients with metastatic bone disease is palliative; however, aggressive management will preserve function and improve the quality of the patient's life. With the recent advances in fixation devices for fracture management and prosthetic implants for joint reconstruction, the surgeon has the means of restoring the structure of the diseased bone and maintaining the skeletal function and ambulatory status. The value of aggressive surgical fixation of these lesions is well documented. The use of methylmethacrylate has allowed the reconstruction of extensive bony deficits with immediate rigid fixation. This gives the patient excellent pain relief and mobilization. Moreover, early fixation avoids further debilitation. These techniques are used in conjunction with medical oncology and radiation therapy to control the basic underlying neoplastic process. Moreover, to extend a functional life requires involvement by many disciplines. Careful consideration must be given to other areas, including nutrition, pain relief, and rehabilitation, as well as to the very important psychosocial aspects of the disease.

Summary

Musculoskeletal oncology requires teamwork, with effective coordination among the clinician, orthopedist, radiologist, and pathologist, to provide an accurate diagnosis and effective treatment. Musculoskeletal sarcomas present challenging problems that require a high index of suspicion. Once a lesion is discovered, an organized and systematic approach to preoperative evaluation is mandatory in order to provide effective management. Careful preoperative evaluation to determine the surgical stage of the lesion will help in selecting the most effective surgical procedure and in deciding whether an amputation is necessary or a limb-saving resection can be successfully performed.

As in the treatment of all cancer patients, the clinical follow up should be meticulous. Patients should be followed up at close intervals to detect the presence of local recurrence and metastatic disease. The same staging studies are employed in the follow up.

In addition, functional determination of limb-salvage procedures must be obtained. The rating system of the Musculoskeletal Tumor Society is strict and allows the functional status of the patient's limb-salvage procedures to be accurately determined. These limb-salvage procedures must be critically evaluated in order to justify the high morbidity that often accompanies major resections and reconstructions.

While benefits have been noted because of improvement in clinical diagnosis, pathologic interpretation, and treatment modes for musculoskeletal sarcomas, advances in biomedical research and development of sophisticated techniques of molecular biology will lead to more effective treatment.

References


December 3-5, 1984, p 74.


