Results in surgery for primary and metastatic chest wall tumors

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Abstract

Objectives: Resection of chest wall tumors is often indicated for palliation from pain or chronic ulceration. However, under various conditions, it may lead to lasting tumor control and substantial freedom of disease might be achieved. Therefore, the long-term survival after chest wall resection for primary and metastatic tumors and its relation to the underlying histology was analyzed. Methods: The medical files of 82 consecutive patients with tumors of the chest wall operated between 1 January 1989 and 31 October 1998 were reviewed. Follow-up data were collected from the outpatient's clinic and house physicians, respectively. Complete excision was accomplished in 71 patients. In 19 patients, partial or complete resection of the sternum was performed. Twenty-eight patients underwent chest wall resection extending to intrathoracic structures (lung, diaphragm, pericardium). The following subgroups were defined according to the histology: (A), sarcoma (n = 32); (B), breast cancer (n = 22); (C), renal cell cancer (n = 9); (D), other metastases (n = 7); (E), miscellaneous (n = 12). The survival probability was calculated by the Kaplan–Meier method (SAS software system). Results: One of 41 female patients died from postoperative complications on day 30 after resection of ulcerating breast cancer recurrence (hospital mortality, 1.2%). The median survival times in groups A–E were 27, 32, 19, 16 and 22 months, respectively. Conclusions: Chest wall resection offers immediate relief in the case of severe pain and unpleasant sequela of ulceration. Moreover, it contributes to substantial long-term survival. This, in particular, applies to local recurrence after breast cancer. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Chest wall resection; Breast cancer; Renal cell carcinoma; Sarcoma; Aggressive fibromatosis; Long-term survival

1. Introduction

Tumors originating from the chest wall tend to infiltrate the external layers and may or may not affect the underlying lung, whereas lung cancer invasion will rarely affect the external soft tissue structures. Resection of such widely invasive tumors requires appropriate repair of the defect and reconstruction of the integument. The significance of long-term results of surgical treatment for metastatic lesions often ranks beyond the alleviation of symptoms like pain, necrosis, and ulceration. In many cases, there is no alternative treatment. In particular, breast cancer patients usually have already undergone previous radiotherapy of the affected area. The predominant purpose of this study was to evaluate the long-term results after chest wall resection in relation to the underlying disease. Therefore, the files of all consecutive patients from 1989 to 1998 were reviewed and follow-up data were obtained.

2. Patients and methods

From January 1989 until October 1998, 82 consecutive patients underwent chest wall resection. The series was subdivided into five subgroups according to the histology: (A), sarcoma; (B), breast cancer; (C), metastatic renal cell cancer; (D), metastases from various other carcinoma; (E), miscellaneous, including tumors of undefined morphology and borderline malignancy.

Identical principles of resection and reconstruction have been pursued over the decade. In the diagnostic work-up CT-scan, and where appropriate and available, MRI has been used routinely. In patients with primary breast cancer or with evidence of metastasis after former cancer history biopsies for a histological proof had not been taken in every case. In patients with mesenchymal tumors, the histology was either known from previous or incomplete operations in referring hospitals. Otherwise, samples were taken by incision biopsy or cutting needle biopsy prior to surgery. Where appropriate, chemotherapy was instituted, usually in cooperation with the oncology department of the children’s hospital. With regard to surgery, it was aimed to achieve excision within widely tumor-free margins. If possible, one adjacent uninvolved rib on either side was dissected,
whereas the tumor bearing ribs were removed entirely. The stabilization of the chest wall, in particular, in resections of the frontal barrier and in sternal resections, was achieved preferably with a 2 mm polytetrafluoroethylene (PTFE) graft (Gore-Tex®, W.L. Gore & Associates GmbH, D-83620 Feldkirchen, Germany).

In selected cases, methyl metacrylic-acid was applied in the early period of this series to protect the precordial area after resection of the lower sternum and adjacent left parasternal chest wall. In a recent case involving the total removal of seven ribs of the chest wall, this material was used to create artificial ‘pseudo ribs’ in order to maintain a chest cavity for the left lung. If temporary stabilization was desired, such as in posterior defects, vicryl net was inserted (Ethicon®, Ethicon GmbH, D-22851 Norderstedt, Germany).

None of the patients required reconstruction of resected greater arteries. In one female, the invasion of the superior caval vein was resected followed by autologous plasty. Invaded large venous and arterial vessels were resected along with one right-sided and one left-sided amputation of the shoulder and upper limb, respectively. Until December 1993, the soft tissue transfer to the defect for the reconstruction of the integument was performed by the responsible thoracic surgeon (JH). After that time, with the institution of a specialized department of plastic surgery in complex situations, reconstruction was a matter of interdisciplinary cooperation.

The extent of resection, in terms of the number of ribs and sternum, respectively, was analyzed, as was the use of alloplastic material for the chest wall (Tables 1 and 2). Follow-up data were obtained from the files of the outpatient’s clinic and by written inquiries to the referring physician, respectively. The SAS software system was used for the statistical analysis of survival probabilities according to the Kaplan-Meier method.

3. Results

Of the 82 patients, 41 were females. The age range was from 2 to 77 years, with a median of 56 years. One female patient died at day 30 postoperatively, resulting in an overall hospital mortality of 1.2%. Six patients were lost to follow-up. The characteristics of the five subgroups are described in the following paragraphs.

Table 1

<table>
<thead>
<tr>
<th>Operation</th>
<th>Number</th>
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<tbody>
<tr>
<td>Resection of ≤ 2 ribs</td>
<td>15</td>
</tr>
<tr>
<td>Resection of three or more ribs (maximum, seven ribs)</td>
<td>42</td>
</tr>
<tr>
<td>Sternal resection and rib resection</td>
<td>19</td>
</tr>
<tr>
<td>Extended resection (lung, pericard, diaphragm)</td>
<td>28</td>
</tr>
<tr>
<td>Plastic reconstruction (muscle flap/omentum/flap)</td>
<td>20</td>
</tr>
<tr>
<td>Palliative resection</td>
<td>3</td>
</tr>
<tr>
<td>Amputation of upper limb</td>
<td>2</td>
</tr>
</tbody>
</table>

a Number of procedures.

Table 2

<table>
<thead>
<tr>
<th>Alloplastic material</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTFE</td>
<td>34</td>
</tr>
<tr>
<td>Vicryl</td>
<td>7</td>
</tr>
<tr>
<td>Methyl methacrylatea</td>
<td>4</td>
</tr>
<tr>
<td>Bovine pericard</td>
<td>1</td>
</tr>
</tbody>
</table>

a Polytetrafluoroethylene; GoreTex®, W.L. Gore & Associates GmbH, D-83620 Feldkirchen, Germany.

Group A (sarcoma) includes 32 patients, 21 male and 11 female, with sarcomas. This group had the widest age range, from 2 to 77 years. Four patients had Ewing sarcoma and received adjuvant chemotherapy and radiotherapy. Two of them died after 21 and 28 months, respectively from progressive disease. Two patients presented with recurrence and underwent second resections, with survival times from the primary resection of 26 months and 12 years, respectively, without evidence of disease. Five patients were treated for fibrosarcoma, one died from recurrence after 67 months. The overall cumulative survival rates were 58 (confidence interval (CI), 39–78%) and 26% at 5 and 10 years, respectively (see Fig. 1).

Group B (breast cancer) includes 22 women, aged 35–73 (median, 57) years, who underwent chest wall resection for recurrent breast cancer. In all patients, mastectomy and radiotherapy had been applied within an interval from 8 months to 11 years. In one patient, a chest wall radio-osteonecrosis after radiotherapy alone was present. The data on the amount of radiotherapy were not obtainable in a few patients who had immigrated from abroad. Patients with positive estrogen and/or progesterone receptor status had appropriate antihormonal therapy. One patient died from infection with subsequent respiratory insufficiency after wide anterior chest wall and sternal resection, complicated by a meningeoma and cerebral seizures. The cumulative 5-year survival rate was 58% (95% CI, 32–83%) and remained stable up to 10 years (see Fig. 2).

Group C (renal cell carcinoma) includes nine patients, eight male and one female, aged 49–71 years (median, 65 years) with metastases from renal cell cancer. In three patients, metastatic affection of the chest wall was synchronous to the primary tumor, in the other six patients, the interval ranged from 3 months to 8 years after the initial treatment. One of these patients presented with pulmonary and pleural metastases on the same side and underwent repeat chest wall and soft tissue resection, including transverse processus of the spine. He is alive 1 year after the last operation, and is presently free of disease 4 years from the first chest wall resection. The longest survival time in this group is 8 years (see Fig. 3).

Group D (other metastases) are patients with metastases of tumors other than breast or renal cell cancer. In two patients aged 50 and 74 years, respectively, the primary tumor was thyroid cancer. Both are alive at 23 and 16...
months. One of two patients with prostatic cancer (65 years old) died 2 years after resection from diffuse metastatic disease. One patient with primary thymus carcinoma 8 years before chest wall resection is alive 12 months postoperatively. A single patient with melanoma (68 years old) died 7 months after resection (lung and bone metastases without local recurrence). One patient with colon cancer and simultaneous metastases to the liver and both lungs died 6 weeks after palliative chest wall resection (see Fig. 4).

Group E (miscellaneous) constitutes 12 patients with a variety of diseases, including three patients with malignant pleural mesothelioma who died after 6, 10 and 14 months, respectively; two patients with high grade malignant lymphoma being alive after 12 and 38 months. Three patients presented with a desmoid tumor (aggressive fibromatosis) with survivals of 21–98 months. Two of them were female, one with multifocal disease receiving long-lasting tamoxifen therapy for inguinal relapse, the other with stable recurrence extending to the neck and also under treatment with tamoxifen. In four patients, apparently benign osteobroma were present. All are alive from 20 to 66 months postoperatively (see Fig. 4).

4. Comment

Local control and pain relief are reasons for surgery of chest wall tumors in many cases. The aims are maintenance of lung function, stability of the rib cage and an adequate cosmetic result. Interdisciplinary planning involving medical oncology, radiotherapy, and sometimes plastic surgery, when available, should be a routine procedure in patients with chest wall tumors. Fine-needle aspiration or incisional biopsy are of importance, particularly when there is suspicion of sarcoma. If a preoperative treatment is indicated, the therapy should be performed with regard to an actual treatment protocol [1].

In sarcomatous tumors arising from ribs, safety margins of one healthy rib superiorly and inferiorly and the entire removal of the affected ribs itself is mandatory [2]. This is confirmed by our own results. For larger defects, especially of the anterior chest wall, alloplastic material for stabilization and a satisfactory cosmetic result is required. The choice of the synthetic material remains controversial and depends largely on the surgeon’s experience and preference. Several authors report on positive experience with the use of Marlex/methylacrylate sandwich prostheses. PTFE has proven advantageous since it is easily adjusted to the anatomic situation. Moreover, it facilitates rather tight closure of the pleural cavity [3,4].

In the areas of critical vascularization with myocutaneous flaps, e.g. recurrence of breast cancer after radiotherapy, the use of the greater omentum is helpful. It permits a wide range of transfer, simple access and high vascularity. Omental flaps may be particularly useful also for infected or poorly healing wounds [3,5]. Chest wall tumor resection is possible with an acceptable risk of perioperative mortality from 0 to 4.5% [2,6,7], which is confirmed in our series with a perioperative mortality of 1.2% (one of 82 patients). Even in large resections, with adequate pain control, prolonged
mechanical ventilation is dispensable. The rate of postoperative wound infection, which is of relevance if alloplastic implants are used, was low (3.7%, \( n = 3 \)).

Downey et al. [8] reported data from 38 women with chest wall resection in locally recurrent breast cancer. There was no perioperative mortality and the survival rates were 41% at 3 years and 18% after 5 years. After 3 years, there was a difference in those patients with and without synchronous lymph node metastases, but it was often impossible to obtain biopsy specimens of these nodes preoperatively (especially the retrosternal lymph nodes).

Faneyte and coworkers [9] reported longer tumor-free survival rates in patients with a disease-free interval of more than 2 years prior to local recurrence in contrast to patients younger than 35 years. No correlation was seen between patient age and the rate of complications in the postoperative course. In 44 women, the survival times of their series are comparable with our results, i.e. 70% 2-year survival and 50% 5-year survival.

The resection of sternal tumors is possible with partial or complete sternectomy as required to achieve clear resection margins. Soysal et al. [10] reported 5-year survival rates of 73% for sarcomas and 33% for locally recurrent breast cancer.

Among the nine patients with renal cell cancer, three survived more than 2 years. There was a tendency for a favorable prognosis if a long interval between the initial diagnosis and chest wall metastases was present.

Chest wall metastases in renal cell cancer are less frequently an indication for resection than local recurrence of breast cancer. Since non-surgical treatment options usually fail, surgery might be considered under the following conditions: exclusion of other distant disease, no tumor at the primary site and the probability of complete resection [3].

In patients who had malignant pleuramesothelioma, the indication of surgery might be debatable, as indicated by short survival times in all cases.

Referring to the patients with benign osteofibroma and desmoid tumors, it must be stressed that in the latter, local recurrence is likely to occur despite very extensive resections. Particular problems arose when prior operations were performed. Judgement of the resection margins is difficult. One female with three relapses is currently free from disease another 30 months with ongoing tamoxifen therapy. The resection should perform as wide as possible, especially in desmoid tumors. If the diagnosis desmoid is made postoperatively, extended complementary surgery must be considered.

In accordance with the literature, also in this series, surgery of malignant and low grade malignant tumors to the chest wall is associated with rather low operative mortality, which compares favorably with the expected long-term survival (Fig. 5).

References

Appendix A. Conference discussion

**Dr B. Boylston** (Harrisburg, PA, USA): It’s well-known that if you increase your resection margin on a chondrosarcoma or osteosarcoma to 4 cm or greater that your survival is increased, and using a PTFE to cover the deficit going from a 2 cm to 4 cm margin really doesn’t change the wound all that much. My question is, in review of your osteosarcoma and chondrosarcoma, would you consider in your next study increasing the resection margin?

**Dr Warzelhan**: The group with the sarcomas were heterogeneous and the subgroups were very small, and very wide resection margins were not possible in all cases. If possible, they are wider than 2 cm.

**Dr Hasse**: I would like to state that the distances were at least 2 cm. If there is a possibility to achieve a larger distance to the tumor, we always pursue that, of course. However, that prerequisite is not always achievable, in particular, when the tumor location is close to the spine. In those cases, in more recent times, we have been using intraoperative radiotherapy, which was mentioned on one slide as ‘IORT’. I think we should make more use of that tool in the future. Once having it at hand, it gives a further advantage.

**Dr J. Hutter** (Salzburg, Austria): There were 15 patients where you only resected a single rib. In the beginning, you said you always remove the upper and lower ribs as well. Were those 15 patients only benign disease?

**Dr Warzelhan**: In 15 cases, we resected one or two ribs. In that group, there were benign diseases, chest wall metastases and children at low ages with osteosarcoma. We resected not always the upper and lower ribs, but in most cases, we tried to do so.

**Dr Hasse**: I would like to add to this. There were a few cases with benign disease, but the majority were patients of low age with osteosarcoma of a single rib. Both intercostal muscle bundles were resected. Patients who got excision of one rib, i.e. complete excision for establishing the diagnosis, afterwards received chemotherapy and/or radiotherapy. This was a concept mostly followed in children with a genuine sarcoma of one single rib. In such a wide excision of a sarcoma limited to one rib, the latter was exarticulated from the spine and was cut well within the cartilaginous segment in the sense of total compartment resection.

**Dr Y.T. Kim** (Seoul, South Korea): You mentioned that intraoperative radiation therapy may have some role for this kind of patient. I think that IORT is usually for the area where the external radiation treatment is not feasible. However, the chest wall tumor is usually not enough or is not very close to the vital organ. In which case did you use IORT in your series?

**Dr Warzelhan**: We used this if the resection was not possible with 2 cm margins; for example, close to the spine.

**Dr Hasse**: If I may add to the technique: IORT was applied via a tube through the chest to the inner surface of the operative area.

**Dr J.-F. Velly** (Pessac, France): What is your policy to obtain diagnosis before treatment? I know that in these kinds of primary tumors, there are multimodality therapies. So, do you use open biopsy to assess diagnosis?

**Dr Warzelhan**: In most cases, we used incisional biopsy or open biopsy.

**Dr Velly**: Most of the cases or all?

**Dr Warzelhan**: In most cases, and nearly all cases were discussed with the oncologists and the Department of Radiotherapy.

**Dr Hasse**: I may add that in metastatic disease, like breast cancer or renal cell, we did not use, of course, the incisional biopsy or excisional biopsy.