Orthopaedics & Traumatology: Surgery & Research xxx (2017) xxx–xxx

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EM|consulte
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Original article

Management of metastatic humeral fractures: Variations according to orthopedic subspecialty, tumor characteristics☆

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suppl. Informations

ARTICLE INFO

Article history:
Received 9 June 2017
Accepted 8 November 2017

Keywords:
Metastasis
Oncology
Resection
Fixation
Humerus

ABSTRACT

Hypothesis: This study assessed, if there was a difference in surgical decision making for metastatic humeral lesions based on; orthopaedic subspecialty, tumor characteristics.
Study type: Cross sectional survey study.
Materials and methods: Twenty-four case scenarios were created by combining: tumor type, life expectancy, fracture type, and anatomical location. Participants were asked for every case: what treatment would you recommend? Participants were 78 (48%) orthopaedic oncologists and 83 (52%) orthopaedic surgeons that were not regularly involved in the treatment of bone tumors.
Results: There was a difference between orthopaedic oncologists and other subspecialty surgeons in recommendation for specific treatments: intramedullary nailing was less often recommended by orthopaedic oncologists (53%, 95%CI: 47–59) compared to other surgeons (62%, 95%CI: 57–67) ($p = 0.023$); while endoprosthetic reconstruction (orthopaedic oncologists: 8.8% [95%CI: 6.6–11], other surgeons: 3.6%[95%CI: 2.3–4.8], $p < 0.001$) and plate-screw fixation (orthopaedic oncologists: 19%[95%CI: 14–25], other surgeons: 9.5%[95%CI: 5.9–13], $p = 0.003$) were more often recommended by orthopaedic oncologists. There was no difference in recommendation for nonoperative management. There were differences in recommendation for specific treatments based on tumor type, life expectancy, and anatomical location, but not fracture type.
Discussion: Subspecialty training and patient and tumor characteristics influence the decision for operative management and the decision for a specific implant in metastatic humeral fractures.
Level of evidence: : Level 3.

1. Introduction

Treatment of metastatic humeral lesions is a challenge as indications vary, several implant options exist, different types of adjuvant treatment are available, and many patient and tumor factors need to be considered. Commonly used implants are intramedullary nails, endoprostheses, and plate and screws [1,2]. Case-series and retrospective studies support the use of each of these implants and high quality comparative studies are lacking [1]. Commonly cited patient and tumor factors that are considered in surgical decision making are: tumor type, life expectancy, location of the tumor, and fracture type [2–5]. Several orthopaedic subspecialties take care of patients with metastatic humeral fractures, including orthopaedic oncology surgeons, trauma surgeons, and general orthopaedic surgeons. As training among these subspecialties differs, their surgical approach might differ as well. We therefore investigated if orthopaedic oncology surgeons approach metastatic humeral lesions differently than surgeons who are not regularly involved in the treatment of bone tumors.

It is unclear to what extend these patient, tumor, and surgeon factors influence surgical decision making. Better understanding of what treatment is recommended and the factors that have the greatest influence on recommending specific treatment for metastatic humeral fractures would help: development of guidelines, highlight areas that require further (comparative) study, create techniques to improve measurement of these criteria (e.g. techniques to estimate life expectancy or fracture risk), and educate trainees.

☆ This work was performed at Massachusetts General Hospital, Boston, MA, USA.

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https://doi.org/10.1016/j.otsr.2017.11.008
1877-0568/

Specifically, we assessed:

- if there was a difference between orthopaedic oncology surgeons and other orthopaedic surgeons in their recommendation for treatment and;
- what patient and tumor characteristics were associated with the decision for treatment [6].

2. Methods

2.1. Study design

Our IRB exempted this study from review and informed consent was not needed. We created 24 case scenarios by combining four categorical variables: tumor type (breast, renal cell, lung; 8 cases each), estimated life expectancy (< 3, > 3 months; 12 cases each), fracture type (displaced pathological, impending; 12 cases each), and anatomical location (proximal, diaphyseal; 12 cases each) (Appendix 1). Humeral metastases from breast, renal cell, and lung tumors were chosen because these are most common [1]. We explained for every case that the patient had activity related pain, that the tumor was widely metastatic, that the patient walked with a walker, and that he or she has not had radiotherapy. We searched our institutions' humeral metastases database for the first random radiograph that matched the constructed case scenario (i.e. matched tumor type, fracture type, and anatomical location).

We used SurveyMonkey (Palo Alto, CA, USA), a web-based assessment tool, to develop a survey including the 24 case scenarios. For all cases, we asked: *what treatment would you recommend: intramedullary nailing, endoprosthetic reconstruction, plate-screw fixation, or nonoperative management?* In addition, we asked for the 12 impending fracture cases: *What is the fracture risk on a scale from 0 to 100%?* We collected the following demographics from participants: year finished residency, sex, country, subspecialties, and the proportion of practice dedicated to oncology.

This was the first study of a new collaborative in musculoskeletal oncology, named the Skeletal Oncology Research Group (SORG). The idea to develop this collaborative was based on the existing Science of Variation Group (SOVG, an international group of upper extremity and trauma surgeons) [7]. The objective of this new group is to study variation in interpretation and management of musculoskeletal tumors. We invited people to this new group by emailing the members of two professional organizations (the European MusculoSkeletal Oncology Society [$n = 156$] and the Connective Tissue Oncology Society [$n = 783$]) and we also reached out to our colleagues, friends, and acquaintances ($n = 83$); we welcome all interested physicians involved in treatment of musculoskeletal tumors who wish to join. Eighty-five people subscribed (8.3% [85/1,022]) and 71 orthopaedic oncology surgeons completed this study.

We also invited all trauma surgeons and shoulder and elbow surgeons of the SOVG ($n = 441$) and specifically asked them to only complete the survey if they treat metastatic humeral fractures. One hundred thirty (29%) members responded: 22 indicated that they do not treat this condition, and 18 did not complete all questions, leaving 90 (20%) complete surveys. However, 7 SOVG members indicated that orthopaedic oncology was one of their subspecialties and we therefore grouped them with the orthopaedic oncologists from the SORG; of the 161 participants in total, 78 (48%) were orthopaedic oncologists (surgeons), the remaining 83 (52%) participants were not.

2.2. Participants

Of the 161 participants, 149 (93%) were men and the mean years in practice was 15 (Table 1). There was no difference in

Table 1
Baseline characteristics of participating surgeons per group ($n = 161$).

	Group 1: Orthopaedic oncology surgeons ($n = 78$)	Group 2: Other subspecialty orthopaedic surgeons ($n = 83$)	
	Mean (±SD)	Mean (±SD)	*P*-value
Years in practice	15 (10)	16 (8.9)	0.495
	n (%)	*n* (%)	
Sex			
Men	70 (90)	79 (95)	0.235
Women	8 (10)	4 (4.8)	
Location of practice			
North America	50 (64)	29 (35)	0.001
Europe	22 (28)	40 (48)	
Asia	3 (3.8)	6 (7.2)	
Autralia	0 (0)	5 (6)	
South America	3 (3.8)	3 (3.6)	
Percentage of practice dedicated to orthopaedic oncology surgery			
0–25%	8 (10)	–	–
25–50%	6 (7.7)	–	
50–75%	15 (19)	–	
75–100%	49 (63)	–	
Surgical Subspecialties[a]			
Orthopaedic oncology	78 (100)	0 (0)	< 0.001
Trauma	8 (10)	73 (88)	< 0.001
Arthroplasty	19 (24)	15 (18)	0.342
Shoulder and elbow	2 (2.6)	28 (34)	< 0.001
General Orthopaedics	5 (6.4)	14 (17)	0.052
Hand and wrist	1 (1.3)	14 (17)	0.001
Foot and ankle	3 (3.8)	3 (3.6)	0.999
Spine	8 (10)	5 (6)	0.391
Sports	1 (1.3)	10 (12)	0.010
Paediatric	5 (6.4)	4 (4.8)	0.739
Other	2 (2.6)	1 (1.2)	0.609

SD: standard deviation - indicates not applicable.
[a] Participants can have multiple subspecialties.

Please cite this article in press as: Janssen SJ, et al. Management of metastatic humeral fractures: Variations according to orthopedic subspecialty, tumor characteristics. Orthop Traumatol Surg Res (2017), https://doi.org/10.1016/j.otsr.2017.11.008