Surgical treatment of conventional primary central chondrosarcoma of pelvic bone: a multicenter study in 164 patients

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Background
The pelvis is among the preferential locations for conventional (grade 1-3) primary central chondrosarcoma of bone. To date, no effective adjuvant treatment modalities exist and therefore, resection with clear margins is the mainstay of treatment. However, studies focusing on outcome after surgical treatment of conventional primary central chondrosarcoma of pelvic bone are lacking.

Questions/Purposes
The aims of our study were to assess (1) disease-specific survival, (2) progression-free survival, (3) risk factors for impaired survival and (4) complications after surgery.

Patients and Methods
We retrospectively evaluated all consecutive patients who underwent surgical treatment of a conventional primary central chondrosarcoma of pelvic bone from 1985-2012, in five centers of musculoskeletal oncology. Patients with peripheral, secondary, dedifferentiated, clear-cell and mesenchymal chondrosarcoma were excluded. Surgical margins were classified as being wide, marginal or intralesional. Contaminated resections were considered to be intralesional. Kaplan-Meier curves were used to estimate disease-specific survival (DSS) and progression-free survival (PFS). We used chi-squared tests to compare the occurrence of complications between groups and Cox proportional hazards models to assess the influence of factors on survival.

Results
We included 164 patients (119 males, 73%) with a median age of 51 years (15-78) at surgery. At review, 102 patients were alive (62%), with a median follow-up of 8.9 years (2.0-27.5): 49 (30%) continuously had no evidence of disease, 40 (24%) had no evidence of disease following treatment of local recurrences or metastases and 13 (8%) were alive with disease. Sixty-two patients (38%) died, after a median of 3.3 years (0.1-15.1): 51 (31%) of disease and 11 (7%) of other causes. The tumors were grade 1 in 37 (23%), grade 2 in 92 (56%) and grade 3 in 36 (22%) patients. Median maximal tumor size was 11 cm (2.5-25.0). The tumor infiltrated surrounding soft-tissues in 114 patients (70%). Primary treatment consisted of hindquarter amputation in 27 patients (16%), curettage in 8 (5%; seven grade 1, one grade 3 lesion) and internal hemipelvectomy in 129 (79%; comprising the periacetabulum in 86 cases, 67%). Margins after hindquarter amputation were wide in 21 (78%), marginal in 4 (15%) and intralesional in 2 (7%), margins after internal hemipelvectomy were wide in 61 (47%), marginal in 38 (29%) and intralesional in 30 (23%) (p=0.02). Mean DSS was 25.0 years (95%CI 22.3-27.7) for grade 1, 13.6 (95%CI 1.0-11.7) for grade 2 and 10.1 (95%CI 1.5-7.2) for grade 3 lesions (p<0.001). Mean PFS was 20.2 years (95%CI 16.4-24.0) for grade 1, 11.3 (95%CI 9.4-13.3) for grade 2 and 6.8 (95%CI 4.0-9.6) for grade 3 lesions (p<0.001). Sixty-one patients (37%)

experienced residual or recurrent tumors, after a median of 1.9 years (0.1-27.3): 11 grade 1 (30%), 29 grade 2 (32%) and 21 grade 3 lesions (58%) (p=0.01). Median DSS from diagnosis of recurrence was 4.5 years (95%CI 3.3-5.6) for grade 2, and 3.3 (95%CI 0.1-6.5) for patients with grade 3 tumors. Metastases were diagnosed in 41 patients (25%), after a median of 2.2 years (0.1-10.6). Results of the Cox proportional hazards model (with grade, margins, soft-tissue infiltration, hemipelvectomy type and tumor size as variables) are detailed in table 1. During follow-up, a total of 253 re-operations were undertaken in 94 patients (57%; range, 1-19 procedures). Deep infection (n=106, 42%) was the predominant reason, followed by locally residual or recurrent tumors (n=64, 25%), wound problems (n=39, 15%) and complications of the reconstructions (n=38, 15%). The overall rate of deep infection was 18% (n=30); deep infections were more frequent in patients with an endoprosthetic reconstruction (17/59, 29%), compared with patients with other types of reconstruction (8/46, 17%) or no reconstruction at all (5/59, 8%) (p=0.02). Fifteen patients (9%) required ablative surgery, 11 (7%) for locally residual or recurrent tumors and 4 (2%) for infection; limb-salvage was achieved in 122 patients (74%).

Conclusions

We present the largest series to date focusing on patients with conventional primary central chondrosarcoma of pelvic bone. Tumor grade and resection margins are important prognostic factors for disease-specific and progression-free survival. Hindquarter amputation was associated with a higher rate of adequate margins; however, it did not result in improved survival. Progression of grade in case of tumor recurrence was the sole reason for disease-related death in grade 1 lesions. Although limited surgery might be adequate in treatment of carefully selected lesions, several problems remain, including the fact that it is not possible to reliably distinguish grade 1 from higher-grade lesions preoperatively. Further research is needed to solve these problems; until then, all central conventional chondrosarcomas require aggressive surgical treatment with nothing less than a wide surgical margin.

Table 1.

Results of multivariable Cox proportional hazards model for disease-specific and progression-free survival (n=156; eight patients who underwent curettage were excluded from these analyses).

	HR	95% CI	P-value
Disease-specific survival (DSS), variables:			
Tumor grade			
Grade 1	Ref	-	-
Grade 2	19.2	2.6 – 144.4	0.004
Grade 3	43.8	5.6 – 345.2	<0.001
Resection margins			
Wide	Ref	-	-
Marginal	3.4	1.6 – 7.1	0.002
Intralesional	2.8	1.3 – 6.2	0.009
Soft-tissue infiltration	2.1	0.8 – 5.0	0.111
Hemipelvectomy type (external vs. internal)	1.2	0.5 – 2.7	0.678
Maximal tumor size (≥10 cm vs. <10 cm)	1.7	0.8 – 3.3	0.151
Progression-free survival (PFS), variables:			
Tumor grade			
Grade 1	Ref	-	-
Grade 2	2.8	1.2 – 6.5	0.013
Grade 3	7.9	3.1 – 20.0	<0.001
Resection margins			
Wide	Ref	-	-
Marginal	2.1	1.1 – 3.8	0.023
Intralesional	2.1	1.1 – 4.0	0.030
Soft-tissue infiltration	2.4	1.1 – 5.4	0.026
Hemipelvectomy type (external vs. internal)	1.8	0.8 – 3.9	0.145
Maximal tumor size (≥10 cm vs. <10 cm)	1.2	0.7 – 2.1	0.497

Figure 1.

Survival curve obtained from Cox regression analysis of progression-free survival, with variables tumor grade, resection margins, soft-tissue infiltration, hemipelvectomy type (external vs. internal) and maximal tumor size (≥10 cm vs. <10 cm) (n=156; eight patients who underwent curettage were excluded from these analyses).