

# HEMIPELVECTOMIES: TREATMENT, FUNCTIONAL OUTCOME AND PROGNOSTIC OF THE PELVIC TUMORS

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## ABSTRACT

**Objective:** To describe the experience of one single institution in internal hemipelvectomies without reconstruction and external hemipelvectomies. **Methods:** Twenty-one patients with primary tumors of the pelvic region underwent total hemipelvectomy, at Barretos Cancer Hospital, São Paulo, Brazil, between 2004 and July 2009. Of these, seven were treated with external hemipelvectomy (classic) and 14 with internal hemipelvectomy. Evaluation was done based on Enneking's surgical classification for internal hemipelvectomy. **Results:** Overall survival in two years was 63.9%. Median survival of 43 months. Functional outcomes demonstrated that procedures with innominate bone resection reached 12.5%, 62.5% and 25% of bad, good and excellent results, respectively. When innominate

bone was preserved the results were 16.7% and 83.3% good and excellent, respectively. No endoprosthesis or bone graft reconstructions were done. **Conclusions:** Hemipelvectomy is an unusual procedure that is rarely performed because it is infrequently indicated and because of its high morbidity rate. In some reports, the morbidity rate has reached 77% of the cases. We did not perform any type of reconstruction or arthrodesis based on complications and the experience of good results with this method. Our results are similar to the main reports and are still subject of discussion by the oncologic surgeons. Level of evidence IV, Case-control study.

**Keywords:** Hemipelvectomy, Neoplasms, Amputation. Soft tissue neoplasms, Survival rates.

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## INTRODUCTION

The bones of the pelvic region are a common location of primitive malignant tumors and metastatic lesions.<sup>1</sup> The malignant tumors most commonly found in this region are, in order of frequency, chondrosarcoma, Ewing's sarcoma and osteosarcoma.<sup>2</sup> Primary pelvic sarcomas are considered to have a worse prognosis than those located in long bones.<sup>3</sup>

With the advent of new chemotherapy drugs, radiotherapy and new diagnostic methods, such as computed tomography, magnetic resonance, and the new surgical techniques, there has been an increase in the number of patients undergoing surgery with preservation of limbs.<sup>2,4,5</sup>

External hemipelvectomy, also known as inter-ilioabdominal amputation, is the classical treatment for pelvic lesions and is historically associated with a poor functional and psychological result. Literature describes a risk of around 50% to 80% of complications related to the method, or to the disease, in the follow-up of external hemipelvectomy.<sup>6</sup>

The main objective of surgery is resection of the primary tumor

with oncologic margin, yet surgery of the pelvic region, in spite of all the advances in the form of approach and surgical treatment of malignant tumors, present a recurrence rate of around 27% after surgical treatment.<sup>7,8</sup>

The indication of limb preservation is only possible when it offers an adequate surgical margin, without increasing the chances of recurrence when compared to inter-ilio abdominal amputation.<sup>2</sup> Enneking's surgical classification modified for pelvic tumor resections, used in this article, is based on the region of the resected innominate bone, from posterior to anterior, dividing pelvic resections into four types: Type I –resection of the ilium, Type II –periacetabular resection, Type III –resection of the anterior arc, Type IV –en-bloc resection of the whole of the ilium, also called extended Type I. The functional results are distinguished when the hip joint is preserved or resected. Each type of hemipelvectomy is divided up into four categories, according to the extension of its resection.<sup>3,4</sup>

The aim of this study was to describe the experience of the orthopedic oncology group of Hospital de Câncer de Barretos

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in the treatment of pelvic tumors, to assess the prognosis of patients submitted to a hemipelvectomy, to stratify in functional results in the different types of resection and to determine the morbidity and mortality associated with the method.

## MATERIAL AND METHODS

A retrospective study was conducted through an analysis of the medical records of 21 patients between November 2004 and July 2009. All of them presented pelvic tumors and had undergone internal or external hemipelvectomy at the same institution. The cases of internal hemipelvectomy were performed without reconstruction. Seven patients were treated with external hemipelvectomy (classical) and 14 with internal hemipelvectomy. The 21 resected pieces were sent for anatomopathological analysis and exhibited free surgical margins.

The patients were treated by a multidisciplinary medical care team from Hospital de Câncer de Barretos.

The patients with osteosarcoma were submitted to pre and postoperative chemotherapy treatment when indicated, according to the protocol of the Brazilian Group for Osteosarcoma Treatment, or Grupo Brasileiro para Tratamento do Osteossarcoma (GBTO). Most of the individuals with chondrosarcoma were only submitted to surgery with a wide margin, without chemotherapy, due to the peculiarities of the tumor histology. Patients with malignant fibrous histiocytoma of bone were included in protocols similar to those of osteosarcoma, yet with periods of treatment and smaller doses of chemotherapy according to the age bracket.

The functional evaluation was based on the MSTS score as proposed by Enneking et al.<sup>4</sup> The score is based on six variables (pain, function, emotional acceptance, use of support such as canes or crutches, walking and gait) where each one is assigned a maximum of 5 points. The total sum can reach 30 points. The patient's number of points is then divided by the maximum value (30 points). This results in a percentage that is expressed as follows: excellent (67% -100%), good (50%-66%) and poor (<50%) according to a postoperative follow-up period of at least six months. All the patients were instructed to avoid weight-bearing activities after surgery for a period between 60 and 90 days and were included in a motor and proprioceptive rehabilitation program.

The data analysis was performed using SPSS (Statistical Package for the Social Sciences) software in version 17.0. The continuous variables were described through mean and standard deviation and the categorical variables were described through absolute and relative frequencies. To compare the continuous variables the participants used the one-way Analysis of Variance (ANOVA) and to compare the categorical variables they applied Pearson's chi-square test. To estimate the survival probability the participants used the Kaplan-Meier method and to compare the survival curves, the log-rank chi-square test. The statistical significance level considered was 5% ( $p \leq 0.05$ ).

## RESULTS

The sample was made up of 21 patients with pelvic tumors and mean age of 38.1 years ( $\pm 18.4$ ) ranging from 13 to 68 years. There was a preponderance of the male sex (65%) in stages IIB and III (66.7%) and diagnosis of Osteosarcoma (47.6%).

The mean follow-up time was 24.8 months ( $\pm 15.1$ ), ranging between 2 and 60 months.

Only five patients (23.8%) exhibited postsurgical complications, such as skin necrosis and superficial infection. Of these, only two required surgical intervention with debridement and cleaning. From the oncological point of view, the internal hemipelvectomy were performed with curative intent. According to Enneking's surgical classification for internal hemipelvectomy, the resections were of type I in four patients and of type II in three patients, while two resections were of type III, three of type IV and two of type I + II. The mean duration of surgery was three hours and fifteen minutes (90 - 300 minutes). The characterization of the sample is presented in Table 1.

**Table 1.** Characterization of the sample.

Characteristics*	n=21
Age (years)	38.1 18.4
Sex - n=20	
Male	13 (65.0)
Female	7 (35.0)
Diagnosis	
Osteosarcoma	10 (47.6)
Chondrosarcoma	6 (28.6)
GCT	2 (9.5)
Leiomyosarcoma	1 (4.8)
FHM	2 (9.5)
Stage	
IIA	3 (14.3)
IIB	8 (38.1)
III	6 (28.6)
B2	2 (9.5)
B3	2 (9.5)
Type of surgery	
I	4 (19.0)
II	3 (14.3)
III	2 (9.5)
IV	3 (14.3)
I + II	2 (9.5)
External	7 (33.3)

\*The data are described by mean  $\pm$  standard deviation (quantitative variables) or by no. of patients (%) for the qualitative variables.

Table 2 presents the situation of the patients in the total sample and by type of surgery. We observed worse prognosis in the external hemipelvectomy, and better in type I and III internal hemipelvectomy.

We grouped the surgeries in three groups with the intention of identifying the functional results based on anatomical criteria of resection either involving or not involving the innominate bone. The groups were divided as follows: type I and III hemipelvectomy formed the first group, where the femoroacetabular joint was preserved; type II, IV and I+II hemipelvectomy formed the second group; and the external hemipelvectomy the third group. The characterization of the groups is described in Table 3. We observed statistically significant difference between the types of hemipelvectomy and disease progression ( $p=0.030$ ) and death ( $p=0.020$ ). In terms of prognosis, that is, considering

**Table 2.** Situation of patients after treatment in the total sample and by type of surgery.

Variables	Total sample n (%)	Type I (n=4) n (%)	Type II (n=3) n (%)	Type III (n=2) n (%)	Type IV (n=3) n (%)	Type I+II (n=2) n (%)	External (n=7) n (%)
<b>Functional Scale * (MSTS)</b>							
Poor	1 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)	-
Good	6 (42.9)	1 (25.0)	2 (66.7)	0 (0.0)	1 (33.3)	2 (100)	-
Excellent	7 (50.0)	3 (75.0)	1 (33.3)	2 (100)	1 (33.3)	0 (0.0)	-
<b>Disease Active</b>							
Yes	9 (42.9)	0 (0.0)	2 (66.7)	0 (0.0)	1 (33.3)	1 (50.0)	5 (71.4)
No	12 (57.1)	4 (100)	1 (33.3)	2 (100)	2 (66.7)	1 (50.0)	2 (28.6)
<b>DEATH</b>							
Yes	7 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	1 (50.0)	5 (71.4)
No	14 (66.7)	4 (100)	3 (100)	2 (100)	2 (66.7)	1 (50.0)	2 (28.6)

\* was not observed in the external surgeries (n=14).

**Table 3.** Association of variables in study with the type of surgery.

Characteristics	I / III (n=6)	II / IV / I+II (n=8)	External (n=7)	p
<b>Age (years)</b>	41.7 9.9	27.9 18.0	46.6 20.8	0.120*
<b>Sex – n=20</b>				
Male	6 (100)	2 (28.6)	5 (71.4)	0.024**
Female	0 (0.0)	5 (71.4)	2 (28.6)	
<b>Diagnosis</b>				
Osteosarcoma	2 (33.3)	4 (50.0)	4 (57.1)	0.365**
Chondrosarcoma	2 (33.3)	3 (37.5)	1 (14.3)	
GCT	1 (16.7)	1 (12.5)	0 (0.0)	
Leiomyosarcoma	1 (16.7)	0 (0.0)	0 (0.0)	
FHM	0 (0.0)	0 (0.0)	2 (28.6)	
<b>Stage</b>				
IIA	2 (33.3)	1 (12.5)	0 (0.0)	0.133**
IIB	1 (16.7)	3 (37.5)	4 (57.1)	
III	0 (0.0)	3 (37.5)	3 (42.9)	
B2	2 (33.3)	0 (0.0)	0 (0.0)	
B3	1 (16.7)	1 (12.5)	0 (0.0)	
<b>Active Disease</b>				
Yes	0 (0.0)	4 (50.0)	5 (71.4)	0.030**
No	6 (100)	4 (50.0)	2 (28.6)	
<b>Death</b>				
Yes	0 (0.0)	2 (25.0)	5 (71.4)	0.020**
No	6 (100)	6 (75.0)	2 (28.6)	
<b>Functional Scale * (MSTS)</b>				
Poor	0 (0.0)	1 (12.5)	-	0.092**
Good	1 (16.7)	5 (62.5)	-	
Excellent	5 (83.3)	2 (25.0)	-	

\* One-way Analysis of Variance (ANOVA); \*\* Pearson's chi-square test.

death and activity of the disease as an outcome, type I and III internal hemipelvectomies were better than the external ones. Of the 14 patients submitted to internal hemipelvectomy, only two died due to disease progression or activity. The first death was recorded six months after surgery and the second two years after. Twelve patients are alive (85%) and 10 of them remain in oncological remission (71.4%). Only two patients required ICU admission after surgery (4.3%), with one presenting non-oncologic pulmonary disease and the other, previously healthy, evolving with upper urinary tract infection and fever.

The functional result of the patients with limb preservation surgery was evaluated two months after the resection, repeated at the end of six months, and finally, after one year. It was based on the Functional Evaluation System standardized by Enneking et al.<sup>9</sup> and validated by the Musculoskeletal Tumor Society (MSTS).

Patients submitted to the internal hemipelvectomies with innominate bone resection, such as those of type IV, II and I+II, exhibited functional results inferior to those that preserved the hip joint. The functional evaluation demonstrated that the internal hemipelvectomies with innominate bone resection obtained 12.5%, 62.5% and 25% of poor, good and excellent results, respectively. (Figures 1 and 2) In the cases where the innominate bone was preserved, the results were 16.7% and 83.3% good and excellent, respectively. (Figure 3) We reiterate that there were no reconstructions with prostheses or structural graft.

Although we did not perform any type of reconstruction, we obtained encouraging functional results for the pelvic resections. The individuals submitted to the more functionally limiting surgeries, such as type I+II, II and IV internal hemipelvectomies, came as a positive surprise, returning to daily activities with good emotional acceptance.

The indication of inter-ilio abdominal amputation was based on the tumor dimensions, invasion of soft parts and neurovascular bundle. Patients in whom the imaging exams and the clinical analysis did not offer a safety margin for preservation were amputated. (Figure 4) The seven amputated cases presented preservation impracticability, and the results in terms of prognosis were also worse. Two amputated patients required ICU admission (28%) in the immediate postoperative period due to cardiorespiratory complications.

The survival curve, through the Kaplan-Meier method, of the



**Figure 1.** Postoperative control radiography of pelvis showing the resection of the entire left hemipelvis and adaptation of the lower limb in walking with the sacrum.



**Figure 4.** Magnetic resonance of patient with tumor involving the right hemipelvis with biopsy confirming diagnosis of osteogenic sarcoma.



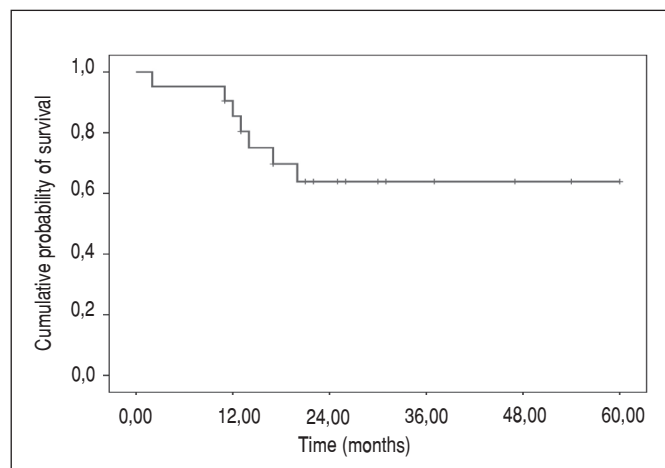
**Figure 2.** Functional evaluation with excellent result 4 years after surgery.



**Figure 3.** Postoperative radiography of hemipelvectomy showing the resection of the pubic symphysis and pubic branches.

total sample of patients is presented in Figure 5. The patients chance of survival was 85.4% (CI 95%: 70.1% to 100%) and 63.9% (CI 95%: 42.3% to 85.5%) at 12 and 24 months, respectively. The mean survival of the whole group was 43 months (CI 95%: 32.9 to 53.2).

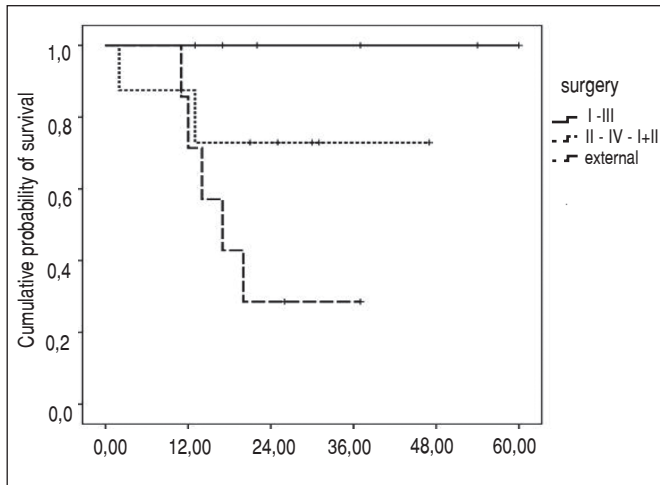
We observed important differences between the hemipel-



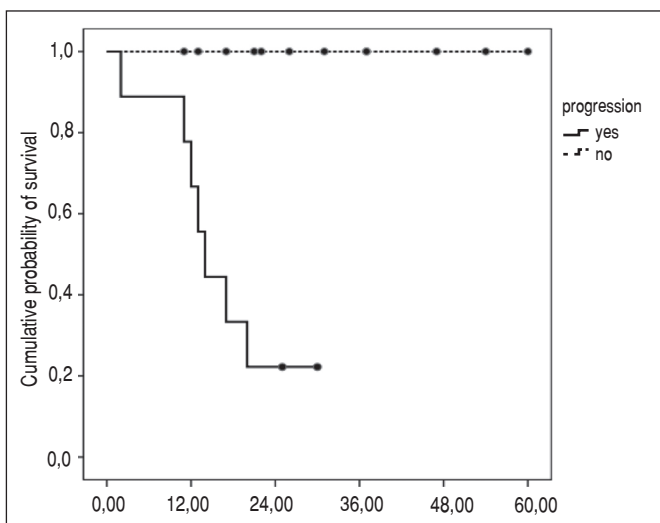
**Figure 5.** Survival analysis, through the Kaplan-Meier curve, of the sample of 21 patients.

vectomy groups that should be emphasized. In the type I/III hemipelvectomy group, the chance of survival was 100%, and it was not possible to calculate the confidence interval, as there were no deaths in this group. In the group of type II, IV and I+II surgeries, the chance of survival at one year was 87.5% (CI 95%: 64.6% to 100%), at two years 72.9% (CI 95%: 40.6% to 100%) and at five years the probability was the same as at two years. However, in the group of external hemipelvectomy the chance of survival at one year was 71.4% (CI 95%: 37.9% to 100%), dropping to 28.6% (CI 95%: 0% to 62.1%) at two years. The probability at five years was also identical to that at two years. (Figure 6) When they evaluated the survival time in the presence of disease activity (Figure 7), there was a statistically significant difference ( $p < 0.001$ ). The patients with active disease, also called disease progression, had a chance of survival of 66.7% (CI 95%: 35.9% to 97.4%) and 22.2% (CI 95%: 0% to 49.4%) at 12 and 24 months, respectively. At five years once again the chance of survival was the same as at two years. These values were already expected, as it is a consensus in international literature that the prognosis is closely related to disease progression.





**Figure 6.** Survival analysis, through the Kaplan-Meier curve, of the patients with pelvic tumors by group of surgeries.



**Figure 7.** Survival analysis, through the Kaplan-Meier curve, of patients with pelvic tumors due to disease activity.

## DISCUSSION

Internal hemipelvectomy offers patients with pelvic lesions better function and less prevalence of postsurgical complications, when compared to the classical hemipelvectomy. The option of

reconstructing or not reconstructing the pelvic ring with the use of structural graft or endoprosthesis depends on the experience of the surgeons and of their team.

There is no consensus in literature regarding what would be better in terms of functional results and complications when comparing resection methods with and without reconstruction. O'Connor and Sim et al.<sup>10</sup> compared the use of arthrodesis technique to non-reconstruction of the pelvic ring and found better results in favor of arthrodesis. However, Hillmann et al.<sup>11</sup> found 37% of poor results in reconstructions with endoprostheses and amputations against 79% of good results when reconstruction was not performed. The cost of treatment has also appeared high in cases where the surgeon opts for reconstruction due to the complications and price of implants. Complications frequently identified in reconstructions are fracture of the bone graft, infection, loosening of the prosthetic implant and pseudoarthrosis. In the patients submitted to hemipelvectomy without reconstruction we observed greater limb discrepancy with resection of the innominate bone that reaches 6 to 10 cm on average as described in the majority of articles.<sup>12</sup>

The functional results of our group in the hemipelvectomies without reconstruction encourage the orthopedic oncologist to execute the procedure. We identified low rates of infection (23.8%) and, undoubtedly, a lower operating cost. The operating time without the need for reconstruction was also shorter, around 3 hours and 15 minutes on average. The complications resulting from reconstructions with autografts, allografts, plates and endoprostheses do not justify the functional or psychological gain in our opinion.

The survival of patients with pelvic tumors at our institution is very similar to the other studies published at national level.<sup>12</sup> The peculiarity of our hospital in receiving patients from Brazilian states that do not offer adequate healthcare support exacerbates the prognosis and hinders the indication of preservative surgery. For this reason, 1/3 of our patients were submitted to disarticulation of the hemipelvis.

## CONCLUSION

We are in favor of hemipelvectomies without reconstruction, regardless of the involvement of the innominate bone with the disease. Our results support this affirmation, and the objective of demonstrating the advantages of hemipelvectomies without reconstruction was achieved.

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