Primary Localized Retroperitoneal Sarcomas: Report from Slovenian Sarcoma Referral Center.

Marko Novak (mnovak@onko-i.si)
Institute of Oncology Ljubljana  https://orcid.org/0000-0002-1524-1478

Andraz Perhavec
Institute of Oncology Ljubljana

Milena Kerin Povsic
Institute of Oncology Ljubljana

Matej Amus
Institute of Oncology Ljubljana

Darja Erzen
Onkoloski Institut Ljubljana

Research

Keywords: Retroperitoneal sarcoma, referral center, surgery, survival

DOI: https://doi.org/10.21203/rs.3.rs-42717/v1

License: ☝️ ☐️ This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License
Abstract

**Background**: Sarcoma patients should be treated in high volume referral sarcoma centers. Compartmental resection is proposed as best treatment option in retroperitoneal sarcoma patients.

**Methods**: Institute of Oncology Ljubljana is the only referral sarcoma center in Slovenia. Having population of 2.1 million poses a unique situation. We manage all sarcoma patients in the country and operate on patients with soft tissue tumors of extremities, trunk and abdomen. Data for all consecutive patients surgically treated from January 1999 to December 2018 for primary localized retroperitoneal sarcoma was extracted from prospective surgical database. Clinicopathologic variables and the outcome were analyzed.

**Results**: In total 89 patients were included. Mean age was 59.2 years. Dedifferentiated liposarcoma was the most common histology (38.2 %). Mean tumor size was 23.5 cm. Compartmental resection was performed in 47.2 % (42/89). Postoperative complication grade 3a or higher according to Clavien-Dindo classification had 30.3 % (27/89) of patients. The 30-day and 90-day mortality rate was 2.2 % and 5.6 %. Median follow-up was 62.1 months. Corresponding 5-year overall survival was 67.2 %, 5-year disease specific survival was 72.6 % and 5-year local recurrence free survival was 81.5 %, respectively.

**Conclusion**: Results from our institution show that referral sarcoma centers may achieve very good results in management of retroperitoneal sarcoma patients, despite not meeting the criteria for high volume hospitals, as long as they have multidisciplinary team, appropriate facilities and expertise.

Background

Surgery is the mainstay of treatment in primary localized retroperitoneal sarcomas (RPS). Compartmental resection if necessary extended into multivisceral resection offers best chances for local control and/or potential cure to the patients [1, 2]. This approach comprises an en bloc resection of tumor with kidney, colon and psoas fascia or muscle. If other adjacent organs are infiltrated they are resected en bloc as well comprising multivisceral resection. A benefit of preoperative radiotherapy is still under research thus it is not routinely recommended. The EORTC 62092 trial (STRASS) failed to demonstrate the benefit of preoperative radiotherapy in abdominal recurrence of RPS although there might be benefit in liposarcoma histology [3]. Final results and publications about the STRASS study are awaited. The role of chemotherapy in RPS has not been investigated in a randomized controlled trial. En bloc resections for retroperitoneal tumors have been performed at the Institute of Oncology Ljubljana since 1975 [4, 5]. The aim of the study was to analyze the quality of surgery and the outcome of RPS patients treated at our institution in the last two decades. Surgical devices of the modern era enable more meticulous hemostasis and shorter operation times. At our institution there was also a change of generations of surgeons during this technological development. We decided to explore if those two factors influenced the quality of surgery and the outcome.
Methods

Institutional Review Board (KSOPKR-0020/2020) and Ethical Committee (ERIDEK-0023/2020) approved the study. Clinicopathologic and follow-up data for all consecutive patients surgically treated for primary localized RPS at our institution from January 1999 to December 2018 was extracted from a prospective surgical database. Primary end points of the study were quality of surgery, overall survival (OS), disease specific survival (DSS) and local recurrence free survival (LRFS). In the analysis of LRFS deaths without evidence of disease and distant metastases (DM), whichever occurred first, were regarded as competing events. Concomitant local recurrence (LR) and DM were not included in the estimation of LRFS. To explore the potential influence of the advances in surgical technique and surgeon generation influence the cohort was divided in two groups. Flowchart in Fig. 1 presents the process of patient selection. In the first group were those who underwent surgery in the period from 1999 to 2008 and in the second group those who underwent surgery in the period from 2009 to 2018. Secondary end points were quality of surgery, OS, DSS and LRFS analyzed comparatively for each decade. All cases were presented at the multidisciplinary team (MDT) before treatment. Clinical characteristics were summarized using frequencies and percentages for categorical variables and mean, median and range for continuous variables. Chi square test was used to compare categorical variables and t-test for continuous variables. Survival curves were estimated by Kaplan-Meier method and compared by the log-rank test. Results were considered statistically significant if two-sided p value <0.05 was achieved. Statistical analysis was carried out using SPSS version 25.

Results

In the study period 123 patients with RPS underwent resection at our institution. Only 89 patients with primary localized RPS were included in the study. Mean age of the patients was 59.2 years. At the referral in half of the cases tumor was palpable (49.4%, 44/89) and 43.8% (39/89) of patients lost weight. In 25.8% (23/89) the tumor was coincidental finding. Dedifferentiated liposarcoma was the most common histology (38.2%, 34/89). Mean tumor size was 23.5 cm. Macroscopic complete resection (R0/R1) was achieved in all patients with microscopic negative margins in 76.4% (68/89). Compartmental resection was performed in 47.2% (42/89) and it was extended into multivisceral resection in half of those cases (23.6%, 21/89). Only 2.2% (2/89) had the tumor removed without en bloc resection of any major organ. Organs were resected as follows: kidney in 57.3% (51/89), colon in 53.9% (48/89), adrenal in 42.7% (38/89), psoas fascia in 30.3% (27/89), psoas muscle in 28.1% (25/89), diaphragm in 20.2% (18/89), spleen and distal pancreas in 10.1% (9/89) each, inferior vena cava in 8.9% (8/89) and liver in 5.6% (5/89) of patients. Median number of resected organs per patient for the whole series was 4. Median hospital stay after surgery was 22 days. Postoperative complication grade 3a or higher according to Clavien-Dindo classification had 30.3% (27/89) of patients. Fifteen (16.9%, 15/89) required reoperation. The 90-day mortality rate was 5.6%. Reasons for reoperation and characteristics of patients who died within 90 days after surgery are summarized in Table 1.
Table 1
Morbidity for entire series and cause of death in five patients in 90-day postoperative period

| Patient (n = 89) | % | Complication                  |
|-----------------|---|-------------------------------|
| 4               | 4.5 | Postoperative bleeding       |
| 4               | 4.5 | Retroperitoneal abscess      |
| 3               | 3.8 | Abdominal abscess            |
| 2               | 2.2 | Anastomotic leak             |
| 1               | 1.1 | Intestinal gangrene          |
| 1               | 1.1 | Occlusion of iliac vessels   |

| Case (ASA) | Year of death | Complication                  | Cause of death                        | Time (days) |
|------------|---------------|-------------------------------|--------------------------------------|-------------|
| 1 (3)      | 2011          | Anastomotic leak              | Sepsis, fulminant disease            | 55          |
| 2 (4)      | 2011          | Tumor rupture, shock          | Sepsis, DIC                          | 10          |
| 3 (3)      | 2013          | Retroperitoneal abscess       | Sepsis, hepatorenal failure          | 79          |
| 4 (3)      | 2016          | Abdominal abscess             | Sepsis, cardiac decompensation       | 65          |
| 5 (3)      | 2018          | Coronary stent occlusion      | Intraoperative cardiac arrest        | 0           |

ASA - American Society of Anesthesiologists classification; DIC - disseminated intravascular coagulation

Median follow-up from surgery was 62.1 months. In total 39 patients died. The corresponding 5-year OS and DSS were 67.2% and 72.6% (Fig. 2). Twenty-five (28.1%) patients developed LR. LR only had 14 (15.7%) patients, 3 patients had DM followed by LR, 6 patients had LR followed by DM and 2 patients had concomitant LR and DM. The corresponding 5-year LRFS was 81.5% (Fig. 3).

By dividing the cohort in two groups, 41 were resected in the first period and 48 in the second. Clinicopathologic characteristics for the entire series and comparison for both periods are presented in Table 2. In the first period none of the patients died within 90 days after surgery while in the second period 90-day mortality rate was 10.4%. In total 22 (53.7%) patients from the first and 17 (35.4%) from the second period died. Median follow-up for the first and second period was 95.9 and 46.2 months. The corresponding 5-year OS (Fig. 4) and DSS were 72.8% and 79.6% for patients from the first and 62.9% and 66.4% for patients from the second period. The corresponding 5-year LRFS was 77.3% and 87.8% for the first and second period, respectively (Fig. 5). The differences in OS, DSS and LRFS between the two periods were not statistically significant.

Discussion

Management of sarcoma patients in referral sarcoma centers is organized in different ways. In Europe for example, high volume institutions like National Cancer Institute Milan, Institute Curie Paris or Royal Marsden Hospital London they manage patients with sarcomas on all anatomic locations. On the other
hand, in Birmingham they manage patients with visceral and retroperitoneal sarcomas at the Queen Elisabeth Hospital and patients with extremity or trunk sarcomas at the Royal Orthopedic Hospital Birmingham. Anyway, it is crucial that sarcoma patients are managed by MDT and operated on by sarcoma surgeon. Slovenia has a population of 2.1 million. From the referral sarcoma centre point of view this poses a unique situation. Institute of Oncology Ljubljana was established in 1938 and is the only referral sarcoma center in the country. Sarcoma MDT was established in 1975. It currently involves 23 dedicated sarcoma specialists with two specialized sarcoma surgeons, three orthopaedic surgeons and a plastic surgeon. At the MDT we manage all soft tissue and bone sarcoma patients in the country since we are the only institution having facilities for management and treatment. The highest incidence of sarcoma patients in Slovenia so far was 98 noted in the national registry database in 2013 [6]. According to European Cancer Organisation recommendations the institution is considered a sarcoma referral centre if at least 100 new soft tissue and bone sarcoma patients are treated per year [7]. They also state that sarcoma surgeon should perform at least 2–3 sarcoma operations per month. We operate patients with soft tissue tumors of the extremities, trunk, superficial part of head and neck, retroperitoneum, pelvis, abdominal viscera and paediatric sarcoma patients at the University Clinical Centre Ljubljana. In total we perform around 60–70 sarcoma operations per year, additionally 10–15 operations per year for sarcoma recurrence or metastases and around 5 operations per year for benign retroperitoneal tumors. Hospital case volume of our institution is about 90 cases per year and surgeon case volume is at least 2 sarcoma operations per month. It is not clear yet, if it is going to be possible to improve the management of sarcoma patients in Southern Europe by establishing a sarcoma network with the neighboring countries, especially from the Balkan area. Nevertheless, the European Cancer Organisation expert group is aware that it is not possible to propose a ‘one size fits all’ system for all countries, but urges that access to MDT is guaranteed to all sarcoma patients [7].

Recently Villano et al. published a multi-institutional analysis of hospital volume-outcome relationship and identified 13 cases of RPS operations per year as a minimum volume threshold for optimal outcome [8]. Institutions meeting this threshold were declared as high volume hospitals (HVH). In our hospital the average number of resections for primary RPS was 4.5 cases per year in the study period not meeting the criteria for HVH. However, in the study period we operated on 28 additional patients with recurrent or residual RPS which are often much more challenging and demanding than the primary ones. Furthermore, factors likely to play a major role in the outcome such as availability of MDT, surgeon case volume and experience, intensive care unit specialists, team for clinical nutrition, interventional radiologists and other, were not accounted for in their analysis. In our hospital all the expertise mentioned needed for the optimal management of RPS patients is available. Actually, despite not meeting the criteria for HVH, our long-term results are comparable to the largest and most cited series of primary RPS, indicating that lower volume centers may achieve competitive results as long as they have appropriate facilities and expertise. 5-year OS and LRFS for the entire series from our institution were 67.2% and 81.5% and are comparable among other with results of the largest study so far, which included 1007 patients, reported in 2015 from the Transatlantic Retroperitoneal Sarcoma Working Group [9]. Comparison of the outcome data with reports from the literature is shown in Table 3.
Table 3
Some reported series of primary retroperitoneal sarcoma

| Author               | Published | Period     | Patients | Median FU (months) | Complete resection % | 5-year OS % | 5-year LRFS % |
|----------------------|-----------|------------|----------|-------------------|----------------------|-------------|---------------|
| Kilkenny et al. [12] | 1996      | 1970–1994  | 63       | *                 | 78                   | 48          | *             |
| Lewis et al. [13]    | 1998      | 1982–1997  | 231      | 28                | 80                   | 54          | 59            |
| Stoeckle et al. [14] | 2001      | 1980–1994  | 145      | 47                | 65                   | 49          | 42            |
| Ferrario et al. [15] | 2003      | 1977–2001  | 79       | 41                | 99                   | 65          | 43            |
| Hassan et al. [16]   | 2004      | 1983–1995  | 97       | 36                | 78                   | 51          | 56            |
| Van Dalen et al. [17]| 2007      | 1989–1994  | 143      | 122               | 55                   | 39          | *             |
| Strauss et al. [18]  | 2010      | 1990–2009  | 200      | 29                | 85                   | 68          | 55            |
| Toulmonde et al. [19]| 2014      | 1988–2008  | 389      | 78                | 100                  | 66          | 46            |
| Gronchi et al. [9]   | 2015      | 2002–2011  | 1007     | 58                | 95                   | 67          | 74            |
| Our series           | -         | 1999–2018  | 89       | 62                | 100                  | 67          | 81            |

* - not applicable

Postoperative complication grade 3a or higher according to Clavien-Dindo classification had 30.3% of patients (Table 2) and 2.2% of patients died within 30 days after the operation. These data could be compared to Transatlantic Retroperitoneal Sarcoma Working Group report published by MacNeill et al. in 2018 where the rate of severe postoperative adverse events was 16.4% and 1.8% of patients died in the early postoperative period [10]. Our results are acceptable but 90-day mortality rate of 10.4% in the second period was, however high in our series (Table 1). In the future we are going to try to adopt the enhanced recovery after surgery protocol to try to improve the results.
| Characteristic               | All patients, n = 89 | First period, n = 41 | Second period, n = 48 | p     |
|-----------------------------|----------------------|----------------------|-----------------------|-------|
| Gender                      |                      |                      |                       | 0.833 |
| Male                        | 47 (52.8%)           | 21 (51.2%)           | 26 (54.2%)            |       |
| Female                      | 42 (47.2%)           | 20 (48.8%)           | 22 (45.8%)            |       |
| Age, mean (years)           | 59.2 (range 24–84)   | 60.7 (range 31–82)   | 57.8 (range 24–84)    | 0.331 |
| ASA score                   |                      |                      |                       | 0.108 |
| 1                           | 17 (19.1%)           | 11 (26.8%)           | 6 (12.5%)             |       |
| 2                           | 43 (48.3%)           | 17 (41.5%)           | 26 (54.2%)            |       |
| 3                           | 22 (24.7%)           | 9 (22.0%)            | 13 (27.1%)            |       |
| 4                           | 4 (4.5%)             | 1 (2.4%)             | 3 (6.3%)              |       |
| Unknown                     | 3 (3.4%)             | 3 (7.3%)             | 0                     |       |
| Histologic subtype          |                      |                      |                       | 0.424 |
| Dedifferentiated liposarcoma| 34 (38.2%)           | 14 (34.1%)           | 20 (41.7%)            |       |
| Well-differentiated liposarcoma | 19 (21.3%)     | 12 (29.3%)           | 7 (14.6%)             |       |
| Leiomyosarcoma              | 14 (15.7%)           | 7 (17.1%)            | 7 (14.6%)             |       |
| Solitary fibrous tumor      | 8 (9.0%)             | 3 (7.3%)             | 5 (10.4%)             |       |
| Malignant peripheral nerve sheath tumor | 2 (2.2%)             | 0                     | 2 (4.2%)              |       |
| Other                       | 12 (13.5%)           | 5 (12.2%)            | 7 (14.6%)             |       |
| FNCLCC Grade                |                      |                      |                       | 0.054 |
| I                           | 31 (34.8%)           | 21 (51.2%)           | 10 (20.8%)            |       |
| II                          | 16 (18%)             | 5 (12.2%)            | 11 (22.9%)            |       |
| III                         | 30 (33.7%)           | 13 (31.7%)           | 17 (35.4%)            |       |

ASA - American Society of Anesthesiologists classification; FNCLCC - Fédération Nationale des Centres de Lutte Contre Le Cancer; AJCC - American Joint Committee on Cancer; ICU - Intensive care unit
| Characteristic                          | All patients, n = 89 | First period, n = 41 | Second period, n = 48 | p    |
|----------------------------------------|----------------------|----------------------|-----------------------|------|
| Unknown                                | 12 (13.5%)           | 2 (4.9%)             | 10 (20.8%)            |      |
| Mean tumor size (cm)                   | 23.5 (range 3–80)    | 26.2 (range 7–80)    | 21.2 (range 3–58)     | 0.085|
| Radiotherapy                           |                      |                      |                       |      |
| Neoadjuvant                            | 4 (4.5%)             | 0                    | 4 (8.3%)              | 0.059|
| Adjuvant                               | 7 (7.9%)             | 5 (12.2%)            | 2 (4.2%)              | 0.241|
| Chemotherapy                           |                      |                      |                       |      |
| Neoadjuvant                            | 2 (2.2%)             | 1 (2.4%)             | 1 (2.1%)              | 1.0  |
| Adjuvant                               | 2 (2.2%)             | 2 (4.9%)             | 0                     | 0.209|
| Surgical resection margin              |                      |                      |                       | 0.044|
| R0                                     | 68 (76.4%)           | 27 (65.9%)           | 41 (85.4%)            |      |
| R1                                     | 21 (23.6%)           | 14 (34.1%)           | 7 (14.6%)             |      |
| R2                                     | 0                    | 0                    | 0                     |      |
| Median time to treatment (days)        | 27.0 (range 0–181)   | 16.0 (range 0–65)    | 35.0 (range 4–181)    | < 0.001|
| Mean weight of the specimen (g)        | 3652.4 (range 12-32600) | 4559.4 (range 86-32600) | 2861.3 (range 12-13000) | 0.071|
| Stage (AJCC 8th edition)               |                      |                      |                       | 0.166|
| 1A                                     | 1 (1.1%)             | 0                    | 1 (2.1%)              |      |
| 1B                                     | 42 (47.2%)           | 23 (56.1%)           | 19 (39.6%)            |      |
| 3A                                     | 7 (7.9%)             | 1 (2.4%)             | 6 (12.5%)             |      |
| 3B                                     | 39 (43.8%)           | 17 (41.5%)           | 22 (45.8%)            |      |
| Median surgery duration (hours)        | 7.3 (range 1.3–19.0) | 7.5 (range 2–14.5)   | 7.0 (range 1.3–19)    | 0.669|
| Median blood loss (l)                  | 1.0 (range minimal-32) | 0.8 (range minimal-32) | 1.4 (range minimal-30) | 0.853|
| Resection type                         |                      |                      |                       | 0.266|
| Tumorectomy                            | 2 (2.2%)             | 0                    | 2 (2.2%)              |      |

ASA - American Society of Anesthesiologists classification; FNCLCC - Fédération Nationale des Centres de Lutte Contre Le Cancer; AJCC - American Joint Committee on Cancer; ICU - Intensive care unit
Finally, in a series of 89 consecutive patients surgically treated for primary localized RPS at our institution in a period of 20 years, 41 were treated in the first and 48 in the second decade. Comparing clinical and pathologic variables and the management of patients between the two periods we found no major differences. Only variables that significantly differed were mean time to treatment and proportion of R0 resection. Mean time to treatment was more than twice as long in the second period. Possible reasons that might explain the difference are: higher number of patients transferred directly from a local hospital to the Institute for treatment in the first period (26.8% vs 4.2%), higher number of patients having core needle biopsy (CNB) in the second period (31.3% vs 2.4%) and a trend towards longer preparation for surgery with parenteral nutrition in the second period (11.5 days vs 8.2 days). The rate of CNBs is relatively low. In the entire series only 3 patients (3.4%) were operated on without the biopsy, 62.9% (56/89) had a fine needle aspiration, 23.6% (21/89) had CNB and 10.1% of patients (9/89) had fine needle aspiration and CNB. In 2014 Wilkinson et al. reported that percutaneous CNB for RPS does not influence the oncological outcome and is safe [11]. Consequently, the rate of CNBs increased to 43.7% (7/16) since 2015. The proportion of R0 resections in the second period was 85.4%, almost 20% higher than in the first period. Possible reason could be a trend to smaller pathologic specimen. There was a trend towards overrepresentation of higher grade and smaller tumors in the second period, higher
proportion of neoadjuvant radiotherapy in the second period and smaller mean weight of the specimen in the second period.

**Conclusion**

We are aware that HVH offer best chances for the optimal treatment to RPS patients but results from our institution show that referral sarcoma centers may achieve very good results in management of these patients, despite not meeting the criteria for HVH, as long as they have MDT, appropriate facilities and expertise.

**Abbreviations**

RPS - retroperitoneal sarcoma; OS - overall survival; DSS - disease specific survival; LRFS - local recurrence free survival; DM - distant metastases; LR - local recurrence; MDT - multidisciplinary team; HVH - high volume hospital; CNB - core needle biopsy.

Declarations

**Declarations**

Ethics approval: Institutional Review Board (KSOPKR-0020/2020) and Ethical Committee (ERIDEK-0023/2020)

Consent for publication: Not applicable

Availability of data and materials: The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: Nothing to declare.

Authors contributions: All authors helped in study design, interpreted and critically revised the previous versions of the manuscript. MN collected part of the data and was a major contributor in writing the manuscript, AP performed the statistical analysis, interpreted the statistical data and wrote part of the manuscript, MKP was the editor, MA created the Tables and DE collected major part of the data. All authors read and approved this version of the manuscript.

Acknowledgements: Not applicable

**References**
[1] Bonvalot S, Rivoire M, Castaing M, Stoeckle A, Le Cesne A, Blay JY. Primary retroperitoneal sarcomas: A multivariate analysis of surgical factors associated with local control. J Clin Oncol. 2009; https://doi.org/10.1200/JCO.2008.18.0802

[2] Gronchi A, Lo Vullo S, Fiore M, Mussi C, Stacchiotti S, Collini P, et al. Aggressive surgical policies in a retrospectively reviewed single-institution case series of retroperitoneal soft tissue sarcoma patients. J Clin Oncol. 2009; https://doi.org/10.1200/JCO.2008.17.8871

[3] Bonvalot S, Gronchi A, Le Pechoux S, Swallow CJ, Strauss DC, Meeus P, et al. STRASS (EORTC 62092): A phase III randomized study of preoperative radiotherapy plus surgery versus surgery alone for patients with retroperitoneal sarcoma. J Clin Oncol. 2019; doi: 10.1200/JCO.2019.37.15

[4] Erzen D, Sencar M, Novak J. Retroperitoneal sarcoma: 25 Years of experience with aggressive surgical treatment at the Institute of Oncology, Ljubljana. J Surg Oncol. 2005; https://doi.org/10.1002/jso.20265

[5] Erzen D, Novak J, Spiler M, Sencar M. Aggressive surgical treatment of retroperitoneal sarcoma: long-term experience of a single institution. Surg Technol Int. 2007;16:97-106.

[6] Zadnik V. Cancer in Slovenia 2013. Ljubljana: Institute of Oncology Ljubljana, Epidemiology and Cancer registry, Cancer Registry of Republic Slovenia, 2016. 48-55.

[7] Andritsch E, Beishon M, Bielack S, Bonvalot S, Casali P, Crul M, et al. ECCO essential requirements for quality cancer care: soft tissue sarcoma in adults and bone sarcoma. A critical review. Crit Rev Oncol. 2017; http://dx.doi.org/10.1016/j.critrevonc.2016.12.002

[8] Villano AM, Zeymo A, Chan KS, Shara N, Al-Refaie WB. Identifying the minimum volume threshold for retroperitoneal soft tissue sarcoma resection: merging national data with consensus expert opinion. J Am Coll Surg. 2019; https://doi.org/10.1016/j.jamcollsurg.2019.09.013

[9] Gronchi A, Strauss DC, Miceli R, Bonvalot S, Swallow CJ, Hohenberger P, et al. Variability in patterns of recurrence after resection of primary retroperitoneal sarcoma (RPS). Ann Surg. 2016; https://doi.org/10.1097/sla.0000000000001447

[10] MacNeill A, Gronchi A, Miceli R, Bonvalot S, Swallow CJ, Hohenberger P, et al. Postoperative morbidity after radical resection of primary retroperitoneal sarcoma. Ann Surg. 2018; https://doi.org/10.1097/SLA.0000000000002250

[11] Wilkinson MJ, Martin JL, Khan AA, Hayes AJ, Thomas JM, Strauss DC. Percutaneous core needle biopsy in retroperitoneal sarcomas does not influence local recurrence or overall survival. Ann Surg Oncol. 2015; https://doi.org/10.1245/s10434-014-4059-x

[12] Kilkenny JW, Bland KI, Copeland EM. Retroperitoneal sarcoma: The University of Florida experience. J Am Coll Surg. 1996;182:329-39.
[13] Lewis JJ, Leung D, Woodruff JM, Brennan MF. Retroperitoneal soft-tissue sarcoma: Analysis of 500 patients treated and followed at a single institution. Ann Surg. 1998; https://doi.org/10.1097/00000658-199809000-00008

[14] Stoeckle E, Coindre JM, Bonvalot S, Kantor G, Terrier P, Bonichon F, et al. Prognostic factors in retroperitoneal sarcoma: A multivariate analysis of a series of 165 patients of the French Cancer Center Federation Sarcoma Group. Cancer. 2001; https://doi.org/10.1002/1097-0142(20010715)92:2<359:AID-CNCR1331>3.0.CO;2-Y

[15] Ferrario T, Karakousis CP. Retroperitoneal sarcomas: Grade and survival. Arch Surg. 2003; https://doi.org/10.1001/archsurg.138.3.248

[16] Hassan I, Park SZ, Donohue JH, et al. Operative management of primary retroperitoneal sarcomas: A reappraisal of an institutional experience. Ann Surg. 2004; https://doi.org/10.1097/01.sla.0000108670.31446.54

[17] van Dalen T, Plooij JM, van Coevorden F, van Geel AN, Hoekstra HJ, Albus-Lutter C, et al. Long-term prognosis of primary retroperitoneal soft tissue sarcoma. Eur J Surg Oncol. 2007; https://doi.org/10.1016/j.ejso.2006.09.020

[18] Strauss DC, Hayes AJ, Thway K, Moskovic EC, Fisher C, Thomas JM. Surgical management of primary retroperitoneal sarcoma. Br J Surg. 2010; https://doi.org/10.1002/bjs.6994

[19] Toulmonde M, Bonvalot S, Méeus P, Stoeckle E, Riou O, Isambert N, et al. Retroperitoneal sarcomas: Patterns of care at diagnosis, prognostic factors and focus on main histological subtypes: A multicenter analysis of the French Sarcoma Group. Ann Oncol. 2014; https://doi.org/10.1093/annonc/mdt577

Figures
Figure 1

Flowchart. Patients with primary localized retroperitoneal sarcoma included in the study.
Figure 2

Overall survival for all patients.
Figure 3

Local recurrence free survival for all patients.
Figure 4

Overall survival divided by the period (p=0.510).
Figure 5

Local recurrence free survival divided by the period (p=0.876).