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RECOSAN Tumors Study: Analysis of Patients with Spine Surgery due to Oncologic Pathology

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Abstract

Introduction: Primary bone tumors of the spine are rare and account for 2.8 to 13% of all bone tumors. On the other hand, the spine is a frequent location for metastatic disease. As local control of the primary tumor pathology continues to improve, survival rates improve, and, by extension, the chance of metastasis increases. Breast, lung, and prostate cancer are the main causes of spinal metastases. The RECOSAN (Santiago Spine Surgery Registry) project is the first multicenter, prospective, and national registry of spinal surgeries in Chile.

Purpose: The objective was to describe the epidemiological, diagnostic, surgical information, complications, and biopsy results of patients operated on for tumor pathology in the RECOSAN registry.

Materials and methods: The RedCap Database of the RECOSAN project's was used to obtain information on patients who underwent spinal surgery due to tumor pathology in five Chilean hospitals. Information on the biopsies of these patients was requested from the respective hospitals and clinics where they were admitted. Demographic data, surgical history, and results of biopsies performed were collected.

Results: Out of 1225 patients admitted to the registry, 82 correspond to spinal surgeries due to tumor pathology. Biopsy reports were obtained from 63 patients who underwent surgical biopsy plus tumor resection and instrumentation. 52% of the patients were male, and the mean age was 57 years. 44% of the biopsies were in the dorsal spine and 40% in the lumbar spine. Of the total number of biopsies performed, 84.1% resulted in tumor lesions. Of these, 66% corresponded to metastases and 34% to primary tumors. The most frequent histological diagnoses were breast carcinoma (20.8%), prostate carcinoma (11.3%) and plasma cell neoplasia (9.4%). The percentage of intraoperative complications of the instrumented patients was 18%, and the percentage of reoperation was 4.7%. There was agreement between the preoperative and final diagnoses based on the biopsy of 66% of the cases, reaching a moderate concordance (Kappa = 0.42).

Conclusion: Vertebral biopsy is an essential procedure for histological diagnosis in both primary and metastatic tumor lesions. This is the first national multicenter registry in Chile for patients undergoing surgery for tumors. It covers epidemiological data, clinical information, surgical techniques, biopsy results, as well as intraoperative and postoperative complications. In this series, the most frequent histological diagnoses coincide with those reported in the literature. The concordance between the preoperative diagnosis and the biopsy is moderate, which supports the importance of obtaining a biopsy for the treatment of spinal tumor pathology.

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Introduction

The detection and treatment of primary bone tumors of the spine have evolved in the last three decades, and it is currently possible to provide functional improvement and cure the disease. Primary bone neoplasms of the spine are rare and represent between 2.8 and 13% of all bone tumors [1]. Due to the low frequency, an individual surgeon's experience is limited, leading to a non-uniform approach to diagnosing and treating different spinal tumors.

Furthermore, the spine is a common site for metastatic disease. As local control of primary tumor pathology continues to improve, survival rates improve, and, by extension, the probability for metastasis increases. Breast, lung, and prostate cancer are the main origins of spinal metastases. Spinal metastases can cause bone pain, fractures, spinal instability, nerve, and spinal cord compression [2]. Some parameters, such as the global extent of the disease, mechanical pain, neurological status, and type and location of spinal injuries, are used to categorize patients and make recommendations for their treatment. Identifying and studying patients with spinal metastases can expedite diagnostic processes and enhance quality of life.

The RECOSAN register by its acronym in Spanish (Santiago Spine Surgery Registry), was created by the Spine Committee of the Chilean Society of Orthopedic Surgery (Sociedad Chilena de Ortopedia y Traumatología, SCHOT) in 2015. Since its creation, a group of spine surgeons from different hospitals in Santiago have been collaborating to record their regional experience on this registry. The goal is to analyze the data and draw conclusions from it. This project requires coordination and continuous communication among the participating physicians. They are collecting the data using a registry platform called RedCap.

This study aims to describe the epidemiological and diagnostic information, surgery, biopsy results, and complications of patients operated on for tumor pathology registered in the RECOSAN database.

Materials and methods

In this multicenter retrospective observational study, the RedCap Database of the RECOSAN Project was used to obtain information on patients with spine surgery due to tumor pathology between September 2020 and August 2022.

The biopsy reports for these patients were requested by coordinating physicians in five hospitals and clinics in Santiago de Chile and entered into a shared database.

The ethics committee of each participating center in the RECOSAN Project approved the study.

The study collected demographic data, surgical history, and histological results from medical records, operative, and biopsy reports.

The variables included in this study were sex, age, medical history, previous surgery, preoperative diagnosis, type of surgery performed, surgical technique, operated vertebral segment, intraoperative and postoperative complications, reoperations, type of injury, and histological diagnosis.

Based on the surgical protocol, the surgery was categorized as either a biopsy alone or a biopsy with tumor resection and spinal fixation.

The lesions were categorized as either tumor or non-tumor based on the biopsy's histological result. Non-tumor lesions were excluded from the statistical analysis.

Histologically, the tumors were divided into primary and metastasis. Furthermore, primary tumors were subdivided into benign and malignant tumors. Postoperative complications were classified according to their treatment, as described by Landriel et al. [3] (Table 1).

Statistical analysis

The categorical variables were summarized in frequency and percentage. Interobserver agreement with two single observers was estimated using kappa. The kappa coefficient was interpreted as follows: 0 to 0.20 = no agreement; 0.21 to 0.39= minimum agreement; 0.40 to 0.59= weak agreement; 060 to 0.79= moderate agreement; 0.80 to 0.90= strong agreement; above 0.90= almost perfect [4].

Logistic regression was used to estimate epidemiological parameters for each biopsy diagnosis. The variables were transformed into dummies, which means that each diagnosis was compared with the probability of being the same in the biopsy or any other. For example, the accuracy of "Metastasis" is the probability of being previously diagnosed with metastasis or any of the other three (MPBT, BPBT, non-tumor lesion). Likewise, the ROC Curve was estimated for each diagnosis, and the degree of discrimination was interpreted according to Hosmer and Lemenshow [2] as follows: <0.50: Luck; 0.51 to 0.70 Low; 0.71 to 0.80: Acceptable; 0.81 to 0.90: Very good; 0.91 to 1: excellent [5].

Results

Of 1,225 spine surgery patients registered into the RECOSAN registry, 82 correspond to tumor pathology, constituting 6.7% of the total surgeries performed. Biopsy reports were obtained from 77 patients (the biopsies of the other five patients could not be obtained).

The following patients were eliminated:

- 9 patients underwent percutaneous biopsy only, without any other surgical procedures being performed.

- 5 non-bone tumors (Schwannoma, synovial sarcoma, meningioma)

Finally, the information from 63 biopsies was used for

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analysis, of which 10 were non-neoplastic lesions, leaving 84% (53) of tumor lesions included in the statistical analysis. Of the 53 patients included, 52% were male, and the average age was 57. By location, 44% of the biopsies were in the dorsal spine, 40% in the lumbar spine, 8% in the cervical spine, and 8% in the sacrum. 49% of the patients had a history of cancer. The most frequent finding was Metastases in 66% (n=35), followed by benign primary bone tumors with 21% (n=11) and malignant primary bone tumors with 13% (n=7). The most frequent metastases were breast carcinoma, prostatic carcinoma, and digestive carcinoma, with 20.8%, 11.3%, and 9.4% respectively (Table 2).

When performing a subgroup analysis, within the primary malignant lesions, the three most frequent diagnoses were: plasma cell carcinoma (9.4%), Ewing Sarcoma, and Myeloid Sarcoma (1.9%). Regarding benign primary lesions, the most frequent diagnoses were brown tumor, osteochondroma, and osteoblastoma, with 3.8% each (Table 2).

The expected agreement between the preoperative diagnosis and random biopsy was 42.43%, and the agreement achieved was 66.67%, achieving a kappa of 0.42 (0.07) (confidence interval 95%, 0.28 to 0.57).

The most accurate diagnosis was achieved in cases of benign tumors (92.1%), reaching a high negative predictive

Table 1: Landirel classification of neurosurgical complications [3].

Grade I	Any non–life-threatening deviation from normal postoperative course, not requiring invasive treatment
Grade Ia	Complication requiring no drug treatment
Grade Ib	Complication requiring drug treatment
Grade II	Complication requiring invasive treatment such as surgical, endoscopic or endovascular interventions
Grade IIa	Complication requiring intervention without general anesthesia
Grade IIb	Complication requiring intervention with general anesthesia
Grade III	Life-threatening complications requiring management in ICU
Grade IIIa	Complication involving single organ failure
Grade IIIb	Complication involving multiple organ failure
Grade IV	Complication resulting in death
Surgical Complications	Adverse events that are directly related to surgery or surgical technique
Medical Complications	Adverse events that are not directly related to surgery or surgical or surgical technique
ICU – Intensive care unit.	
Suffix T (Transient)	New neurological deficit improving within 30 days of surgical procedure; can be added to each grade of complication
Suffix P (Persistent)	New neurological deficit extending beyond 30 days of surgical procedure; can be added to each grade of complication

Table 2: Postoperative biopsy results.

Metastatic Lesion (35)		**Primary Tumor (18)**	
Breast carcinoma	20.8 % (11)	**Malignant etiology (7 patients- 13%)**	
Prostate carcinoma	11.3 % (6)	Plasma cell carcinoma	9.4% (5)
Digestive carcinoma	9.4% (5)	Ewing's sarcoma	1.9% (1)
Lung carcinoma	7.5% (4)	Myeloid sarcoma	1.9% (1)
Renal carcinoma	3.8% (2)	**Benign etiology (11 patients - 21%)**	
Cervical carcinoma	1.9% (1)	Brown tumor	3.8% (2)
Undifferentiated malignant neoplasm	1.9% (1)	Osteochondroma	3.8% (2)
Liposarcoma	1.9% (1)	Osteoblastoma	3.8% (2)
Non-Hodkin lymphoma	1.9% (1)	Osteoid osteoma	1.9% (1)
Pleural fibrous tumor	1.9% (1)	Langerhans cell histiocytosis	1.9% (1)
Spindle cell sarcoma	1.9% (1)	Paget's disease of bone	1.9% (1)
Melanoma	1.9% (1)	Aneurysmal bone cyst	1.9% (1)
		Meningioma	1.9% (1)
	66.00%		**34.00%**

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value in this cohort. However, the sensitivity was low (62.5%). Furthermore, the AUC of the ROC curve was the highest, but a high dispersion in the confidence interval was observed. The sensitivity was high for the diagnosis of metastasis, but on the other hand, the specificity was like chance (50%), which led to the lowest accuracy of the three diagnoses (73%). The most notable parameter in the case of MPBT was specificity (92.3%), but sensitivity was below 50%, resulting in the lowest AUC of the three diagnoses (0.68). (Table 3). For non-tumor diagnosis, calculating the parameters was impossible due to collinearity.

Seventy percent of the operations were performed through open surgery, while the remaining 30% were done percutaneous. The percentage of intraoperative complications in instrumented patients was 1.6% (1 patient due to dural rupture).

There were nine postoperative complications, which correspond to 16%. Based on Landriel´s classification, they are categorized as follows: Grade Ia: one neurological injury; Grade Ib: two infections and two decompensations of the underlying disease. Grade IIb: three instrumental failures, Grade IV: one death.

The percentage of reoperation was 4.7% (3 patients), and the cause was instrumentation failure in all cases.

Table 3: Summarize epidemiological parameters for Metastasis, BPBT and MPBT.

	Metastasis	BPBT	MPBT
Sensitivity	93.90%	62.50%	45.50%
Specificity	50.00%	96.40%	92.30%
PPV	67.39%	71.40%	55.60%
NPV	88.20%	94.60%	88.90%
Accuracy	0.73	0.921	0.841
AUC ROC	0.72 (0.62 to 0.82)	0.79 (0.61 to 0.98)	0.68 (0.53 to 0.85)

Abbreviations: PPV=Positive predictive value; NPV=Negative predictive value; AUC=Area under the ROC curve; BPBT = Benign primary bone tumor; MPBT=Malignant primary bone tumor.

Discussion

It is essential to perform a vertebral biopsy in order to obtain a histological diagnosis of both primary and metastatic tumor lesions. Early and accurate diagnosis plays a crucial role in determining the appropriate treatment and improving the prognosis. Metastatic lesions are the most common among spine tumor pathologies. In our series, metastases corresponded to 66%, with breast, prostate, and digestive origin being the most frequent. Metastases of pulmonary origin are reported more frequently in other reports [6,7] and reach 7.5% in our series (Table 4). Primary bone tumor lesions are less common. In our study, malignant primary tumors accounted for 13%, and benign primary tumors accounted for 21%. The most frequent primary malignant lesion was plasma cell carcinoma (9.4%), consistent with other reports. Of the primary benign lesions, the most frequent were brown tumors (3.8%), osteochondroma/enchondroma (3.8%), and osteoblastoma (3.8%).

An important aspect of medical analysis is the ability to make a preliminary diagnosis that is consistent with the final diagnosis. A previous study that examined this topic is the Leeds Regional Bone Tumor Registry, which was previously mentioned [1]. This registry followed 126 cases over a period of 42 years, and in 116 of those cases, the spine surgeon who took the sample made a correct histological diagnosis. This corresponds to a success rate of 92%. Although a concordance analysis is not performed as in our series, the initial percentage of concordance is higher than ours.

Bone tumor records can be traced back to 1922, when Codman documented his first experiences with them [8]. Its initial objective was to accumulate experience from different centers regarding clinical, radiological, and histopathological data. In Latin America, there is no data on the bone tumors registry. This would be the first national multicenter registry in Chile, which includes epidemiological, clinical, surgical technique, biopsy results, and intra- and postoperative complications of operated patients due to spinal tumor pathology.

Undertaking a multi-center study is a challenging task that requires substantial effort from researchers to coordinate, organize, and standardize the recording of the information obtained. It is essential to achieve a consensus among the authors concerning the objectives, methodology, and data to be collected. This often entails being flexible and prioritizing the group's interests over individual ones. Approval is required from the different Ethics Committees of the participating centers.

We recorded the information using RedCap as a database due to its ease of use and system security, which has been validated in numerous multicenter studies. To ensure that the records are complete and timely, it is crucial to have a study coordinator.

To our knowledge, the agreement between the preoperative diagnosis and the definitive biopsy results is a new finding that has not been mentioned in other studies on spine tumors.

The agreement between the preoperative diagnosis and the biopsy in our study is moderate, based on the Kappa coefficient, which supports the importance of taking a biopsy to treat spinal tumor pathology. This initial insight is essential for suspicion and early diagnosis.

Conclusion

According to the RECOSAN project, 6.7% of patients who undergo spinal surgery are due to tumor pathology.

Vertebral biopsy is an essential procedure for the final diagnosis of tumor pathology due to the moderate agreement between pre- and postoperative diagnosis.

Based on biopsies, breast and prostate carcinoma are the most frequent etiologies of metastasis, consistent with international literature.

This is the first RECOSAN subanalysis on tumor pathology obtaining epidemiological, clinical, histological, and surgical information.

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