Surgical epidemiology of spinal cord tumors at Dr. Kariadi Hospital, Semarang, Indonesia

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ABSTRACT

Background: Primary spinal cord tumors are rare central nervous system tumors that could develop at any age and have different management strategies based on the histopathological types. However, there is a lack of literature in Indonesia regarding the epidemiology and surgical treatment of patients with spinal cord tumors. This study aims to review and address the incidence of primary spinal cord tumors in Dr. Kariadi Hospital, Semarang.

Methods: A retrospective descriptive study was conducted using medical records of patients with spinal cord tumors at Dr. Kariadi Hospital, Semarang, Central Java, from 2019 to 2022. The frequency of each tumor, classified by gender, age, histologic type, anatomical position, and location based on vertebral segment, was analyzed to provide a descriptive result. Data were analyzed using SPSS version 25.0 for Windows.

Results: A total of 125 patients were identified with the mean age of patients being 43.95 ± 15.28 years old and a slight predominance of males (52.00%). Schwannoma (26.40%) and meningioma (24.80%) were the two most common histological types of tumors. Most of the tumor was intradural extramedullary (47.20%) and at the level of thoracic vertebrae (46.80%). The histologic type of the tumors was found to be associated with the patient's age and the tumor's anatomical position.

Conclusion: The incidence of spinal cord tumors in Dr. Kariadi Hospital, Semarang, is dominated by meningioma and schwannoma, mostly located at the thoracic level with an intradural extramedullary position. There is a significant association between the histological type of tumor and the patient's age and the location of the tumor.

Keywords: Spinal Cord Tumor, Meningioma, Schwannoma, Histopathology.


INTRODUCTION

Primary spinal cord tumors (SCT) are a rare and challenging disease, accounting for only 4% to 8% of all primary central nervous system lesions.1 Primary SCT are categorized as either intramedullary or extramedullary depending on the mass's position concerning the spinal cord parenchyma and its cell of origin (arising from either intrinsic or extrinsic cells to the spinal cord). Intradural extramedullary spinal cord tumors (IMSC) account for up to 58% of all primary SCT and 2% to 8.5% of all primary central nervous system tumors in the adult and pediatric population.1 The extramedullary SCT is further subdivided into intradural and extradural (i.e., develops within or outside, respectively, the fibrous dural covering of the spinal cord; while remaining extrinsic to the spinal cord itself).

In contrast to intracranial tumors, there is no known correlation between tumor grade and age at diagnosis in primary SCT. In the United States, between 850 and 1700 adult primary spinal cord tumors are discovered annually.4 Currently, numerous population-based epidemiological studies of primary SCT have been carried out in the United States, Europe, and Japan. However, the reported frequency of primary SCT differs between research due to changes in population size and various tumor categories. In addition, there is additional evidence that race impacts the prevalence of spinal cord tumors.

Presenting symptoms may vary based on the spinal cord region and associated radiographic findings. Clinical presentations generally include sensorimotor deficits, myelopathy, proprioceptive deficits, and localized cervical back pain disorders. More aggressive tumors could produce symptoms in a shorter time. In the last two decades, there have been significant advances in the development of imaging technology, microsurgical techniques, neurophysiological monitoring, intraoperative devices, and an increasing number of studies focused on determining optimal adjuvant therapy regimens. However, managing this tumor is still challenging and exhibits a high risk for morbidity and mortality.5,6

Controlling the impact of spinal cord tumor surgery on morbidity, mortality, and social-economic aspects will be more successful if various risk factors for spinal cord tumors can be identified. For this reason, research on the epidemiology of
spinal cord tumor surgery, especially in Semarang and Indonesia in general, is essential for outpatients and inpatients. Therefore, this study aims to review the incidence of primary spinal cord tumors in Dr. Kariadi Hospital, Semarang, address the frequency of each tumor classified by gender, age, histologic type, anatomical position, and location based on vertebral segments, and explore the association between the tumor and the patient’s characteristics.

METHODS
Study Design and Data Collection
This is a retrospective descriptive study to identify the epidemiology of spinal cord tumors at Kariadi General Hospital, Semarang. The samples in this study were acquired using the purposive sampling method, as we reviewed and analyzed data from the medical records of patients with SCT at Dr. RSUP Kariadi Semarang, Central Java, from 2019 to 2022. The Institutional Ethics Committee approved the research. A total of 125 patients with SCT were identified. All patients diagnosed with spinal cord tumors from 2019-2022 admitted to Kariadi general hospital were included in this study. Patients who refused surgical treatment and had incomplete medical records were excluded from the study.

Information including age, sex, histologic type, vertebral height and anatomical location were collected and utilized in the descriptive analysis.

Neuroradiography examination
Every patient underwent a standard MRI exam. Radiologist made the neuro radiographic diagnosis. Anatomical location and spinal height were used as neuroimaging characteristics for epidemiological analysis.

Histopathological Examination
An institutional anatomical pathologist made all pathological diagnoses. Hematoxylin and eosin staining and other standard histochemical and immunohistochemical analyses were performed on all samples. The neoplasms are categorized and classified according to criteria set out by the World Health Organization.

Statistical Analysis
The basic aspects of the data are described using descriptive statistics. A descriptive analysis was performed and the result was addressed in means and frequencies. Bivariate analysis was conducted using Pearson’s Chi-Square test to analyze the association between the tumor and the patient’s characteristics. Analysis was performed using SPSS version 25.0 for Windows.

RESULTS
The mean age of the subjects was 43.95 ± 15.28 years old. Analysis per age group showed that there were 7 (5.60%) patients aged <18 years, 35 (28.00%) patients aged 18-39 years, 60 (48.00%) patients aged 40-59 years, and 23 (18.40%) of patients aged > 60 years. Based on gender, there were 65 (52.00%) male and 60 (48.00%) female patients. Most tumors in this study were in the thoracic segment about 61 patients, 48.80%, followed by cervical (22 patients, 17.60%), lumbar & thoracolumbar with 12 (9.60%) patients each, and the rest in the cervicothoracic and sacral levels, with 6 (4.80%) & 4 (3.20%) respectively. There were 8 (6.4%) patients with unspecified tumor locations. Based on the location, most of the tumors were found as intradural extramedullary tumors in about 59 patients (47.20%), followed by intradural 17 patients (13.60%), and extradural & intramedullary with 16 (12.80%) each. There were 16 (12.80%) patients with unspecified tumor locations (Table 1).

Schwannoma (26.40%) and meningioma (24.80%) are the two most frequently encountered tumor histologies in spinal surgery patients. Analysis by sex showed that Schwannoma was found more in males (17 patients) than females (16 patients). Meningioma had a higher incidence in females (27 patients) than in males (1 patient). The Chi-Square test showed a significant relationship between tumor histology and the patient’s gender (p <0.05) (Figure 1). Analysis was also conducted regarding the histologic type of spinal cord tumor based on age groups and location. The histologic type of the tumor was found to be associated with the patient’s age and location (Figures 2 and 3).

DISCUSSION
The incidence of primary spinal cord tumors varies widely. Several studies have shown significant differences in the prevalence of nerve sheath cell tumors (schwannomas and neurofibromas) and meningiomas, the most common primary spinal tumors. In Asian countries, the prevalence of nerve sheath cell tumors was more dominant. Wu et al. (2014) studied 102 cases in Taiwan and showed that the prevalence of nerve sheath cell tumors was more dominant (55.0%) than meningioma (15.7%), and this prevalence trend was particularly observed in East Asia. However, in contrast to the observed differences in studies located in Western countries, meningioma prevalence rates equal or even exceed those of neurofibromas and schwannomas. In line with these studies, the results of our study did not show a contrasting difference between the prevalence of neurofibroma-schwannoma and meningioma. As many as 28% of patients in this study had neurofibroma and meningioma tumor histology, whereas 24.8% had meningioma tumor histology.

This study reported a more predominant incidence of spinal cord tumors in males (52%) and females (48%) with a mean age of 44. Hirano et al. (2012) reported similar results in Japan, with the prevalence of men (55.6%) and women (44.4%) but with an average patient age of 52.4 years. Nerve sheath cell tumors (neurofibroma and schwannoma) were the most common primary spinal tumors encountered in this study, with no significant differences between males and females. However, the ratio of men to women in the prevalence of meningioma in this study was dominated by women. Previous studies have shown that the proportion of males to females in cases of primary spinal tumors varies depending on the location of the study. This study found a significant relationship between gender and tumor histological type, which aligns with a study by Preston-Martin in the United States (US), who reported that both men and women could develop spinal cord tumors with an equal overall incidence. However, specific tumor types are known to have a predisposition, such as a meningioma, which tends to be in


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females, and ependymoma in males. This study found the incidence of both tumors to be consistent with a previously reported sex predominance. Another study by Westwick and Shamji in the US found that there was a significant difference in incidence between genders, with a higher frequency in women with a ratio of about 3:1 to 4:1. This study found a higher frequency predominance pattern with a ratio of around 7:1, almost similar to the study by Engelhard et al., who found a ratio of 6:1. This difference could be due to the role of hormonal effects in women. Previous studies have identified the expression of progesterone and estrogen hormones is associated with the gross classification of meningioma as a prognostic indicator.

Based on age groups, the highest prevalence of spinal tumors was found in the 40-59 years (48.00%) and 18-39 years (28.00%). In line with the study of Hirano et al., the prevalence of spinal tumors in Japan was highest in patients aged 50-59 years and 60-69 years. Duong et al. (2012) reported that aged 50-59 years had the highest prevalence of spinal tumors in the US based on an analysis of the Surveillance, Epidemiology, and End Results (SEER) database. Analysis revealed several age peaks in frequency among the various tumor types. Overall, there was a gradual increase in incidence parallel with increasing age. The highest incidence was found in the 40-59 year age group and then decreased at 60 and over. This finding contrasts with Duong et al., who reported a peak incidence at 70 to 79 years old. Meanwhile, Bhat et al., reported an increase in the incidence of spinal cord tumors in Indian patients over 60 years. Moreover, the lowest incidence of spinal cord tumors was found in the age group of children under 18 years, which is in line with the results by Schellinger et al. Patil et al also found that of 19,017 patients in the US who underwent resection for spinal cord tumors, 9% were younger than 18 years. Based on the type of histology, there are several age-specific patterns. This study found the highest incidence of schwannoma in the age range of 40 to 59 years. In several previous studies, the average schwannoma was reported in the age range of 60 to 75 years. In comparison, meningioma tumors have a higher incidence in the age group of 40 to 59 years. These results are similar to a study by Park et al., who found the peak incidence of meningioma in the US ranged from 40 to 70 years of age. The difference in the incidence seen could be due to the number of samples used and studies that
prevalence of spinal tumor locations from each study is the thoracic level with the location of intradural extramedullary.\textsuperscript{9,11,17} The significant relationship between histological type and tumor location is the basis for the classification system of spinal cord tumors based on their anatomical location. About 47.2\% of spinal cord tumors in this study were found intradural extramedullary, which is lower than a study by Albanese and Platania in Italy, who reported that extramedullary intradural tumors make up 2/3 of all spinal cord neoplasms, Bhat et al., who reported 68.73\% of extramedullary intradural tumors in patients with spinal cord tumors in India, and Rasras and Kiani who reported as much as 70\% of all intradural lesions.\textsuperscript{18,22,23} Intramedullary tumors in this study were found to be 12.8\%, which is slightly higher than the study by Tihan et al., in the US, who stated that intramedullary tumors are rare tumors that are only found as much as 5-10\% of all intradural lesions.\textsuperscript{24} The variation found between this study and previous studies could be due to the smaller sample size and differences in population size.\textsuperscript{25,27}

Our findings should be considered in light of several limitations. We did not account for reporting different management in patients (surgical or conservative) and its outcomes in these patients. This finding is strictly limited to presenting some of the available data descriptively about spinal cord tumor patients in Dr. Kariadi General Hospital. We hope future studies are considered to further analyze the correlation between spinal cord tumor type, location, and others mentioned by this study, with every management strategy in patients related to the outcome (functional and quality of life) in spinal cord tumor patients.

\section*{CONCLUSION}

In conclusion, the incidence of spinal tumors in Dr. Kariadi Hospital is dominated by meningioma and schwannoma. The most common location and position are at the thoracic level with an intradural extramedullary position. There is a significant association between the histological type of tumor and the patient’s age and location.


Mulyadi R, Islam AA, Murta B, Tammase J, Hatta M, Firdaus M. Diagnostic yield of the combined Magnetic Resonance Imaging and Magnetic Resonance Spectroscopy to predict...