Day of Surgery Impacts Outcome: Rehabilitation Utilization on Hospital Length of Stay in Patients Undergoing Elective Meningioma Resection

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■ OBJECTIVE/BACKGROUND: **Meningiomas account for approximately one third of all brain tumors in the United States. In high-volume medical centers, the average length of stay (LOS) for a patient is 6.8 days compared with 8.8 days in low-volume centers with median total admission charges equaling approximately $55,000. To our knowledge, few studies have evaluated day of surgery and its effect on hospital LOS. Our primary goal was to analyze patient outcome as a direct result of surgical date, as well as to characterize the individual variables that may impact their hospital course, early access to rehabilitation, and long-term functional status.**

■ METHODS: **A retrospective database was generated for cranial meningioma patients who underwent elective surgical resection at our institution over a 3-year study period (2011–2014). Inclusion criteria included any patient who underwent elective meningioma resection and was discharged either home or to a rehabilitation facility with at least 6 months of follow-up. Exclusion criteria included any patient who was not discharged after resection (i.e., expired). Each patient's medical record was evaluated for a subset of demographics and clinical variables. Given that patients who undergo surgical resection of meningiomas have a national median LOS of 6 days, we subdivided the patients into 2 cohorts: early discharge (LOS < 3) and late discharge (LOS ≥ 3). Statistical analysis was performed using SPSS 21.0 to assess the significance of the results.**

■ RESULTS: **We identified 139 (25 male, 114 female) meningioma patients who underwent surgical resection. Seventy of these patients had surgery during the early week (defined as Monday–Wednesday), and 69 had surgery in the later week (Thursday–Friday). The median age for both early and late groups was 58, and the median diameter of the tumor was 3.1 cm and 3.3 cm, respectively. Overall, 55% of the patients had public insurance and 43% had private insurance, with no significant variation between the early and late groups. The median LOS for the early and late populations was 3 and 4 days, respectively. Physical therapy recommendations for rehabilitation facility were made in 26% of early-week patients and in 42% of late-week patients. Additionally, we found a statistically significant decreased LOS (<3 days) in those patients who underwent surgery during the early week (Monday–Wednesday), as opposed to those who received surgery in the later week (Thursday, Friday) ($P = 0.045$, Mann-Whitney test).**

■ CONCLUSION: **Day of surgery may play a significant role in LOS for meningioma patients. Clinicians should remain aware of those factors that may delay optimal patient discharge and early access to rehabilitation facilities. Further studies will need to be performed to assess the social variables that may affect LOS, as well as the financial implications for such extended hospital courses.**

INTRODUCTION

Meningiomas are benign brain tumors with a high relative incidence, accounting for approximately one third of all brain tumors (35.8%) in the United States with an estimated incidence of 97.5/100,000.[1] The median age of diagnosis

Key words
- Early discharge
- Length of stay
- Meningioma
- Rehabilitation
- Socioeconomics

Abbreviations and Acronyms
ICU: Intensive care unit
LOS: Length of stay
PT: Physical therapy

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is 65 with 70% of hospital admissions from meningiomas being women.[1,2] Between 2001 and 2010, the meningioma annual case-volume increased by 40% with the number of surgical resections increasing by 66%.[2] A similar trend was seen between 1988 and 2000.[3] Approximately two thirds of patients admitted to the hospital for a diagnosis of meningioma undergo same-day surgery, eventually accumulating significant costs over their length of stay (LOS).[2]

In high-volume medical centers, defined as hospitals where more than 50 craniotomies for brain tumor resection are completed each year, the average LOS for a patient is 6.8 days compared with 8.8 days in low-volume centers, where hospitals complete fewer than 50 craniotomies per year.[4] Patients who underwent surgical resection of meningiomas had a median LOS of 6 days, with the median total admission charges equaling $55,349. Following hospital discharge from meningioma surgery, 67% of patients were released to home or self-care, 21.5% to a skilled nursing facility, and 9.2% to home health care.[2] Notably, however, more than 80% of central nervous system tumor patients require some form of rehabilitation.

The time period following surgical resection of a brain tumor is critical to the patient's recovery and rehabilitation.[5] Early commencement of rehabilitation has been shown to improve the functional outcome for patients with brain tumors.[6] Rehabilitation is essential to treat both the neurologic deficits that can result from the brain tumor itself and the resection.[5] Specifically, cognitive rehabilitation methods, including exercises in time, spatial, visual, logical, and memory orientations, showed a significant positive effect on performance and cognitive function over those patients who did not receive such cognitive rehabilitation.[7] Discharges to rehabilitation facilities increased between 2001 and 2010 on the basis of a review of the National Inpatient Sample Database, where those patients who were not discharged directly home from meningioma surgery increased from 21% to 33%.[2,3]

The goal of this study was to determine whether the day of week that patients undergo meningioma resection has any effect on a patient's hospital LOS and/or their need for subsequent inpatient acute rehabilitation after hospital discharge. On average, we hypothesize that patients who have meningioma resections earlier in the week have shorter LOSs due to earlier access to physical therapy (PT) and social work consults, as well as greater discharge to home rates. Moreover, those patients who need acute rehabilitation after discharge are able to find accepting facilities faster if their surgery is earlier in the week. In addition to increased access to rehabilitation, most studies show that LOS is the most significant factor to lowering hospital costs per admission.[8-11] This is the first study to investigate such factors.

METHODS

A retrospective database was generated for cranial meningioma patients who underwent surgical resection at our institution (Mount Sinai Hospital, New York, New York, USA) over a 3-year study period (2011–2014). This study was conducted with approval from our Institutional Review Board (HS#: 14-00698/GCO#: 14-1492). The start date of the study was 1 July, 2011, which coincided with the implementation of an electronic medical record in our medical center. Inclusion criteria included any patient who underwent elective primary meningioma resection at our institution and was discharged to either home or to a rehabilitation facility and had a minimum of 6 months of follow-up. Exclusion criteria included any meningioma patients who had their surgeries performed at outside institutions or were not discharged after their procedure (i.e., expired). Each patient's medical record was evaluated for basic demographics including age, gender, medical comorbidities, date of surgery, LOS, and PT recommendations; other important factors that were analyzed included tumor profile and resection volume; insurance status; postoperative steroid, antibiotic, and antiepileptic drug use; presence of edema; postoperative complications; functional status; and 30-day readmission rates (**Tables 1** and **2**). Each variable was placed into a database that was generated in *Microsoft Excel* and stored on a password-protected, encrypted hard drive only accessible by the study personnel. Given the fact that the national median LOS for meningioma resection patients is approximately 6 days at high-volume centers, we subdivided our patient population into 2 cohorts: 1 indicating early discharge (LOS < 3 days) and the other for late discharge (LOS ≥ 3 days).[12] Using SPSS 21.0 (IBM Corporation, Armonk, New York) USA, we performed univariate analysis on these variables

Table 1. Univariate Analysis of Preoperative Variables of Early versus Late Meningioma Patients

Patient Characteristic	Early (n = 70)	Late (n = 69)	*P* value
Sex—number (%)			0.378
Female	55 (79)	59 (86)	
Male	15 (21)	10 (15)	
Age—median (IQR)	58 (46–66)	58 (48–70)	0.476
Diabetes—number (%)	14 (20)	13 (19)	0.863
Hypertension—number (%)	26 (37)	30 (44)	0.492
Hyperlipidemia—number (%)	21 (30)	17 (25)	0.569
Cardiac disease—number (%)	5 (7)	6 (9)	0.764
Obesity (body mass index > 30)—number (%)	16 (23)	11 (16)	0.392
Prior CVA—number (%)	0 (0)	1 (1)	0.496
Insurance—number (%)			0.931
None	1 (1)	1 (1)	
Public	38 (54)	39 (57)	
Private	31 (44)	29 (42)	
Size—median max diameter, cm. (IQR)	3.1 (2.5–4.8)	3.3 (2.5–4.1)	0.659
Midline shift—number (%)	19 (27)	12 (17)	0.222
Preoperative functional limitation—number (%)	8 (11)	8 (12)	0.976