

Semi-Sitting Position in Posterior Fossa and Pineal Region Surgery: Single-Center Experience

Posterior Fossa ve Pineal Bölge Cerrahisinde Yarı Oturur Pozisyon: Tek Merkezli Deneyim

Serkan CİVLAN¹ , Nevzat Doğukan ERBEK¹ , Berk Burak BERKER² , Rasim ASAR¹ ,
Emrah EGEMEN¹ , Turan EVRAN³ , Mehmet Erdal COŞKUN¹ 

¹Pamukkale University, School of Medicine, Department of Neurosurgery, Denizli, Türkiye

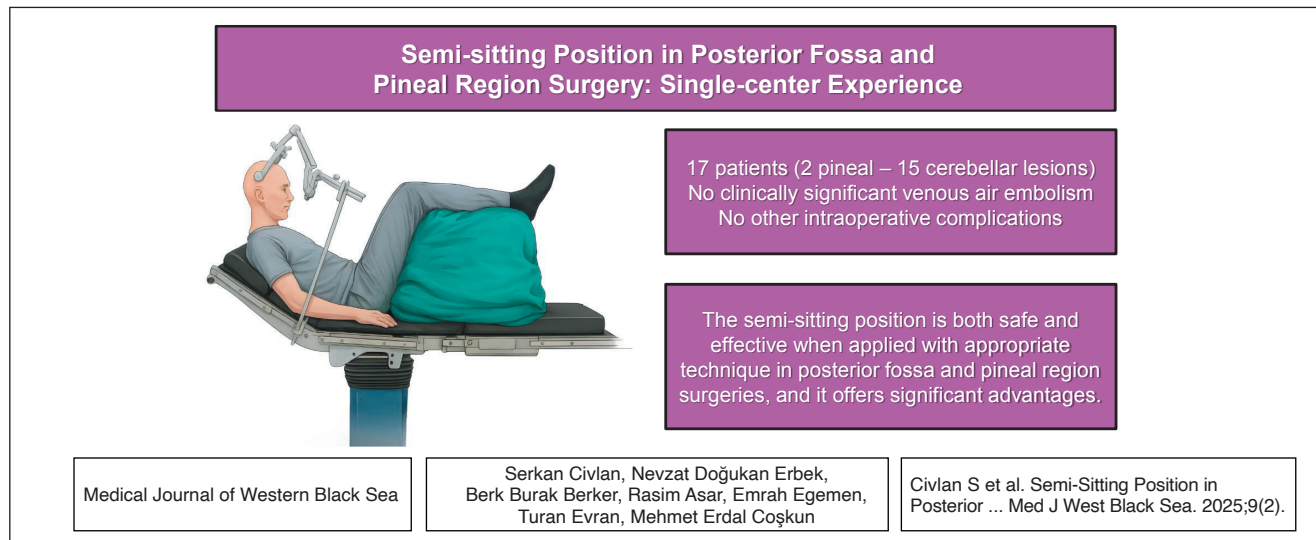
²Hatay Education and Research Hospital, Department of Neurosurgery, Hatay, Türkiye

³Pamukkale University, School of Medicine, Department of Anesthesiology and Reanimation, Denizli, Türkiye

ORCID ID: Serkan Civlan 0000-0001-8915-8186, Nevzat Doğukan Erbek 0009-0001-1995-5611, Berk Burak Berker 0009-0007-9178-3758, Rasim Asar 0009-0000-4116-5678, Emrah Egemen 0000-0003-4930-4577, Turan Evran 0000-0003-4768-3622, Mehmet Erdal Coşkun 0000-0002-2816-0722

Cite this article as: Civlan S et al. Semi-sitting position in posterior fossa and pineal region surgery: single-center experience. Med J West Black Sea. 2025;9(2): 285-292.

GRAPHICAL ABSTRACT



ABSTRACT

Aim: The semi-sitting position for intracranial surgery provides substantial surgical advantages, including improved gravitational drainage of cerebrospinal fluid and venous blood, clearer visualization, reduced intracranial pressure, and minimized cerebellar retraction. Although historically associated with complications such as venous air embolism, recent advancements in anesthetic management and intraoperative monitoring have markedly enhanced its safety profile.

Material and Methods: We retrospectively analyzed 17 consecutive intracranial surgeries performed in the semi-sitting position at a single center between 2019 and 2024 by a senior neurosurgeon. Patient demographics, lesion characteristics, surgical details, and outcomes were reviewed. Preoperative cardiac evaluation excluded patients with significant right-to-left intracardiac shunts. Continuous end-tidal CO₂ monitoring was used intraoperatively to detect venous air embolism.

Results: Pathologies included diverse intracranial lesions in the cerebellum and pineal region. Gross total resection was achieved in 15 cases (88%). No clinically significant VAE or other intraoperative complications were detected, and no postoperative neurological deficits occurred. Our series supports the growing body of evidence that semi-sitting position is both safe and effective when applied with appropriate technique and perioperative protocols. Despite limitations related to retrospective design, small sample size, and the absence of highly sensitive monitoring tools, our findings are consistent with recent literature reporting low rates of serious complications.

Conclusion: The semi-sitting position remains a viable and advantageous surgical approach for selected intracranial procedures, offering excellent surgical exposure and favorable clinical outcomes with minimal complication rates. Further prospective studies with larger cohorts and comparative controls are recommended to reinforce these findings.

Keywords: Semi-sitting position, Posterior fossa surgery, Craniotomy, Air embolism

GRAFIKSEL ÖZET



ÖZ

Amaç: İntrakraniyal cerrahide yarı oturur pozisyon; beyin omurilik sıvısı ve venöz kanın yerçekimiyle daha iyi drenajı, daha net görüş alanı, azalmış intrakraniyal basınç ve minimal serebellar retraksiyon gibi önemli cerrahi avantajlar sağlar. Tarihsel olarak venöz hava embolisi gibi komplikasyonlarla ilişkilendirilmiş olsa da, anestezi yönetimi ve intraoperatif izlemedeki son gelişmeler bu pozisyonun güvenliğini belirgin şekilde artırmıştır.

Gereç ve Yöntemler: 2019 ile 2024 yılları arasında, deneyimli bir beyin cerrahı tarafından tek bir merkezde yarı oturur pozisyonda gerçekleştirilen ardışık 17 intrakraniyal cerrahi olgusu retrospektif olarak analiz edildi. Hastaların demografik verileri, lezyon özellikleri, cerrahi ayrıntılar ve klinik sonuçları incelendi. Preoperatif kardiyak değerlendirme ile belirgin sağdan sola intrakardiyak şant dışlandı. İntraoperatif olarak venöz hava embolisini saptamak amacıyla sürekli end-tidal CO₂ monitörizasyonu kullanıldı.

Bulgular: Lezyonlar serebellum ve pineal bölgede yer alan çeşitli intrakraniyal patolojileri kapsamaktaydı. On beş olguda (%88) total rezeksiyon sağlandı. Hiçbir olguda klinik olarak anlamlı venöz hava embolisi ya da diğer intraoperatif komplikasyon gözlenmedi ve hiçbir hastada postoperatif nörolojik defisit gelişmedi. Bulgularımız, uygun cerrahi teknik ve perioperatif protokollerle uygulandığında yarı oturur pozisyonun güvenli ve etkili olduğunu gösteren güncel literatürü desteklemektedir. Retrospektif tasarım, küçük örneklem hacmi ve yüksek duyarlılıklı izlem araçlarının kullanılmamış olması gibi sınırlılıklar bulunsada, elde edilen veriler ciddi komplikasyon oranlarının düşük olduğunu bildiren son çalışmalarla uyumludur.

Sonuç: Yarı oturur pozisyon, seçilmiş intrakraniyal cerrahilerde güvenli ve avantajlı bir cerrahi yaklaşım olarak öne çıkmakta; üstün cerrahi görüş alanı ve düşük komplikasyon oranları ile olumlu klinik sonuçlar sunmaktadır. Bu bulguların güçlendirilmesi için daha büyük hasta serilerini içeren, karşılaştırmalı ve ileriye dönük çalışmalar önerilmektedir.

Anahtar Sözcükler: Yarı oturur pozisyon, Posterior fossa cerrahisi, Kraniyotomi, Hava embolisi

INTRODUCTION

The sitting position, first introduced by De Martel in 1931 for posterior fossa surgeries, has since evolved through multiple refinements into the modern semi-sitting position to enhance safety and reduce the risk of complications such as venous air embolism (VAE) (1). This position provides several technical advantages over supine and prone alternatives. These include superior gravitational drainage of cerebrospinal fluid and venous blood, which leads to a cleaner operative field and reduced intracranial pressure (2-10). The effect of gravity also creates a natural corridor between the cerebellum and tentorium, minimizing the need for mechanical cerebellar retraction and enabling safer bimanual microsurgical dissection (2-8). The upright orientation of the semi-sitting position provides better anatomical alignment by offering a direct, unobstructed view of deep midline and posterior fossa structures (4-6,11). It also allows the anesthesiologist direct access to the patient's face and easier manipulation of the chest wall (2-4,9).

Although semi-sitting position has been historically controversial due to the risk of position-related complications – most notably VAE – as well as tension pneumocephalus and hemodynamic instability, recent evidence indicates that with modern monitoring and anesthetic management, the semi-sitting position can be employed safely (3,4,10,12). Large contemporary series have reported low rates of serious complications when this position is used in appropriately selected patients (4,5,13). Here, we present a single center case series of 17 intracranial surgeries performed in the semi-sitting position between 2019 and 2024. We describe the patient characteristics, surgical outcomes, and complications, and we discuss these findings in the context of current literature on the use of the semi-sitting position in intracranial surgery. This study aimed to examine the outcomes of semi-sitting positioning in posterior fossa and pineal region surgeries, hypothesizing that clinically significant VAE rates are low when modern perioperative protocols are followed.

MATERIALS and METHODS

This retrospective cohort includes all consecutive intracranial operations performed in the semi-sitting position between 2019–2024 by a single surgeon. Patients with a hemodynamically relevant right-to-left shunt on preoperative echocardiography were excluded from undergoing semi-sitting surgery and thus are not part of the operated cohort described. No other exclusion criteria were applied. Patient ages ranged from 8 to 73 years (mean 52.2 years). Pathologies included 10 metastatic tumors, 1 diffuse glioma, 1 glioblastoma, 1 hemangioblastoma, 1 intracranial abscess, 1 germ cell tumor, 1 medulloblastoma, and 1 meningioma. Patient demographics, pathology, lesion location relative to

the tentorium, and surgical approach details are summarized in Table 1.

All patients underwent preoperative echocardiographic evaluation by a senior cardiologist. No patients were found to have right-to-left cardiac shunts. Therefore, no patients were excluded from undergoing surgery in the semi-sitting position due to cardiac findings.

After induction of general anesthesia and endotracheal intubation, a central venous catheter was placed in all cases, with its tip positioned in the right atrium to allow air aspiration in the event of a VAE. Tip position was confirmed fluoroscopically in the operating room prior to draping.

All patients were incrementally positioned into the semi-sitting posture with neck flexion maintained to an extent that does not impede jugular venous return and head fixation using a Mayfield three-pin head clamp. The final alignment was standardized with the trunk elevated approximately 25–35° from horizontal. A large bolster supported the posterior thighs and calves, elevating the legs to promote venous return and maintain a slight positive venous pressure in the upper body. All pressure points were padded, and the bolster was secured to prevent migration. The position is illustrated in Figure 1.

After surgical site preparation and sterile draping, a linear or curvilinear skin incision was made in the midline or paramedian suboccipital region, depending on tumor localization. Scalp and suboccipital muscles were dissected using monopolar cautery. Bilateral suboccipital or paramedian craniotomy was performed using a Midas drill and Kerrison rongeurs, following burr hole creation. The dura was incised in a linear, Y-, or semicircular fashion and suspended with silk sutures. Cerebrospinal fluid (CSF) was drained from the cisterna magna to facilitate cerebellar relaxation. Microsurgical tumor excision was performed under the operating microscope using the paramedian supracerebellar infratentorial approach in all cases. Frozen and permanent pathology samples were obtained. Internal debulking and resection were achieved using bipolar cautery, suction, and ultrasonic aspirator. All vermian bridging veins were preserved. Following tumor removal, the cavity was irrigated with saline and lined with hemostatic agents. Watertight dural closure was achieved either primarily or using autologous galeal grafts. The bone flap was replaced and secured using silk sutures or titanium miniplates and screws. All anatomical layers were closed appropriately. Patients were transferred to the neurosurgical intensive care unit, either extubated or intubated based on intraoperative status.

Intraoperative monitoring included continuous end-tidal CO₂ (ETCO₂) capnography. A sudden drop of 2 mm Hg or more in ETCO₂ was accepted as suggestive of VAE. Precordial Doppler ultrasonography or transesophageal echocardiography (TEE) was not utilized.

Table 1. Patient demographics, pathology, lesion location relative to the tentorium, and surgical approach details.

Case #	Sex	Age (y)	Pathology	Lesion Site	Tentorial Third	Skin Incision	Craniotomy
1	M	70	Lung adenocarcinoma metastasis	Cerebellar	Anterior 1/3	Midline	Bilateral suboccipital
2	M	61	Lung adenocarcinoma metastasis	Cerebellar	Middle 1/3	Paramedian	Paramedian
3	M	51	Medulloblastoma	Cerebellar	Middle 1/3	Midline	Bilateral suboccipital
4	M	63	Malignant epithelial tumor metastasis	Cerebellar	Posterior 1/3	Midline	Bilateral suboccipital
5	F	63	Ovarian serous carcinoma metastasis	Cerebellar	Middle 1/3	Paramedian	Paramedian
6	M	67	Lung adenocarcinoma metastasis	Cerebellar	Posterior 1/3	Midline	Bilateral suboccipital
7	F	68	Lung adenocarcinoma metastasis	Cerebellar	Posterior 1/3	Paramedian	Paramedian
8	M	11	Germ cell / embryonal tumor	Cerebellar	Anterior 1/3	Midline	Bilateral suboccipital
9	F	41	Hemangioblastoma	Cerebellar	Middle 1/3	Paramedian	Paramedian
10	M	8	Diffuse midline glioma	Pineal region	N/A	Midline	Bilateral suboccipital
11	F	50	Breast carcinoma metastasis	Cerebellar	Anterior 1/3	Midline	Bilateral suboccipital
12	F	48	Meningioma, transitional type	Cerebellar	Anterior 1/3	Midline	Bilateral suboccipital
13	M	51	Abscess	Cerebellar	Middle 1/3	Midline	Paramedian
14	M	73	Colon adenocarcinoma metastasis	Cerebellar	Middle 1/3	Paramedian	Paramedian
15	M	60	Malignant epithelial tumor metastasis	Cerebellar	Anterior 1/3	Midline	Paramedian
16	M	50	Small-cell lung carcinoma metastasis	Cerebellar	Middle 1/3	Midline	Bilateral suboccipital
17	F	52	Glioblastoma	Pineal region	N/A	Midline	Bilateral suboccipital



Figure 1: Illustration of the semi-sitting patient position employed in this study. The image was generated with the assistance of AI (ChatGPT o3) based on a real photograph of co-author N.D.E. demonstrating the position in the operating room, and was subsequently edited by the authors.

Postoperatively, patients were observed in a neuro-intensive care setting with head elevation, and all underwent cranial CT within 2 hours and contrast-enhanced cranial MRI within 24 hours.

We retrospectively reviewed patient demographic data, lesion pathology and location, surgical duration, and intraoperative as well as postoperative events. Key outcomes of interest included the occurrence of VAE, intraoperative complications, extent of tumor resection, postoperative neurological deficits, and other morbidities. This study was conducted with institutional review board approval, and all patients provided informed consent for surgery in the semi-sitting position after detailed counseling on its risks and benefits.

Statistical Analysis

Given the retrospective design and limited sample size ($n = 17$) of this single-center study, statistical analysis was primarily descriptive. Continuous variables, such as patient age and operative duration, were summarized as mean $\pm$ standard deviation (SD). Categorical data, including patient demographics, lesion pathology, lesion location, extent of tumor resection, and complication rates, were presented as frequencies and percentages. Due to the small and heterogeneous nature of the patient cohort, formal statistical comparisons were not conducted. Descriptive data review was performed using SPSS software version 22.0 (IBM Corp., Chicago, IL, USA) to support interpretation of clinical outcomes in the context of existing literature.

Findings

A total of 17 patients underwent intracranial procedures in the semi-sitting position during the study period. Ten patients (58.8%) had metastatic brain tumors, there was 1 patient (5.9%) each with diffuse infiltrative glioma, glioblastoma multiforme, hemangioblastoma, germ cell tumor, medulloblastoma, abscess and meningioma. Lesions were located in the cerebellum in 15 patients, while 2 patients had lesions in the pineal region. All surgeries were completed in the semi-sitting position as planned, without requiring intraoperative conversion to prone or lateral positioning. The mean operative time was 234 ± 35 minutes.

Postoperative MRI confirmed gross total resection in 15 of 17 cases (88%). Two patients (12%) had subtotal resection. The first was a bilateral cerebellar metastases from a squamous cell lung carcinoma. While the right-sided lesion was removed, the left-sided component—adjacent to the brainstem—was intentionally left partially resected to avoid neurological injury. The second was a glioblastoma in the pineal region. Although gross total resection was attempted, postoperative MRI demonstrated residual tumor.

No episodes of VAE were detected in any patient, based on end-tidal CO_2 monitoring, intraoperative and postoperative

clinical evaluation, and postoperative CT or MRI imaging. Thus, the incidence of clinically significant VAE in our series was 0%. No other intraoperative adverse events were observed.

In all patients, vermian bridging veins were preserved. In six cases, selected cerebellar hemispheric tentorial bridging veins that interfered with surgical access were sacrificed to facilitate tumor resection. No postoperative neurological deficits were observed, and follow-up MRI revealed no venous infarction or edema attributable to these sacrifices.

No postoperative complications attributable to the surgical procedure were identified. At the time of discharge, no patient exhibited a decline in Glasgow Coma Scale (GCS) score. No newly developed transient or permanent neurological deficits were observed. Postoperative CT scans in most patients revealed small, expected subdural air collections; however, none progressed to tension pneumocephalus or required decompression. Additionally, there were no cases of cerebrospinal fluid leakage or wound-related complications.

DISCUSSION

In the semisitting position, a paramedian approach allows access not only to cerebellar tumors adjacent to the tentorial surface and tentorial lesions, but also to the posterior incisural space, including the pineal region, tectum, thalamus, and posterior mediobasal temporal area (11,14). The gravitational effect facilitates cerebellar relaxation without the need for rigid retractors, thereby reducing the risk of neural injury. Additionally, gravity-assisted venous drainage contributes to a clearer surgical field during tumor resection (2-10).

Despite these numerous benefits, the semi-sitting position has been historically controversial due to significant safety concerns, primarily the risk of VAE. Other potential complications include tension pneumocephalus, hemodynamic instability and peripheral nerve injury (3,4,10,12,15). However, recent advancements in modern monitoring and anesthetic management it can now be employed safely.

Although VAE is detected relatively frequently in upright craniotomies, clinically significant events are uncommon. Contemporary series suggest that, with modern anesthesia protocols and monitoring, semi-sitting (and even full sitting) craniotomies carry acceptably low risk. The reported incidence of VAE in the semi-sitting position varies widely across the literature, ranging from 0% to as high as 82.6% (2,13). This substantial variability is largely attributable to differences in the sensitivity of monitoring methods and the diagnostic criteria employed across studies. For instance, TEE is considered the most sensitive method which can lead to higher reported incidences (2,16). In contrast, end-tidal CO_2 (ETCO_2) monitoring, while offering lower sensitivity, is

less invasive and is generally considered sufficient for detecting clinically significant events (13). In Saladino et al.'s large series of 425 semi-sitting craniotomies, intraoperative VAE was detected in 90 cases (21%) but no patient suffered a new postoperative deficit attributable to the position (4). Likewise, in 1,792 sitting-position cases Himes et al. found an overall sitting-related complication rate of only 1.45%. Clinically significant VAE (with hemodynamic impact) occurred in just 1.06% of cases. Suboccipital craniotomies had the highest VAE rate (2.7%) but even these seldom led to permanent injury (17). In Hurth et al.'s recent series of 1,000 semi-sitting cases, VAE was very frequently detected by TEE (in 51.4% of patients) but only 10.2% had measurable end-tidal CO₂ changes. Importantly, no patient in that series experienced any permanent neurologic deficit or death due to VAE (18). Similarly Feigl et al. reported that in 200 semi-sitting operations (52 with patent foramen ovale), only a very small fraction (<2%) had high-grade VAE by TEE and none had hemodynamic collapse or new deficits (5). Although the rate of venous air embolism may appear moderately high with the use of sensitive detection methods, clinically significant events remain rare and acceptable.

The current series reports a 0% incidence of clinically significant VAE, based on continuous ETCO₂ monitoring, intraoperative and postoperative clinical evaluation, and postoperative CT/MRI imaging. This could be explained by the absence of intraoperative TEE monitoring. The reliance solely on ETCO₂ monitoring, without the more sensitive TEE or precordial doppler, might suggest an underestimation of the true incidence of any VAE. However, the study explicitly aimed to detect clinically significant VAE, for which ETCO₂ is generally considered an adequate and practical monitoring tool, especially when complemented by clinical and imaging follow-up. This indicates that even if microbubbles or small air emboli occurred (which might go undetected by ETCO₂), they did not reach a threshold of clinical relevance or hemodynamic impact in this patient cohort. This aligns with prior reports that, under a standardized protocol, semi-sitting surgery can be performed with minimal risk of air embolism injury.

Paradoxical air embolism (PAE) is another feared complication associated with venous air embolism, particularly in patients with an unrecognized intracardiac right-to-left shunt. The reported incidence of PAE neurosurgical procedures in the semi-sitting position ranges between 0% and 14% (7,19). Preoperative screening for patent foramen ovale (PFO) is crucial for patient selection to mitigate the risk of PAE. If a PFO with a hemodynamically relevant right-to-left shunt is identified, it has traditionally been considered a contraindication for the semi-sitting position. In such cases, alternative positions like prone or lateral are typically chosen (7). However, recent literature suggests that in expe-

rienced centers with standardized protocols, neurosurgery in the semi-sitting position can be feasible with acceptable risk even in patients with PFO (5,7). The presented series reports that all patients underwent preoperative echocardiographic evaluation by a senior cardiologist, and no patients were found to have right-to-left cardiac shunts; therefore, no patients were excluded due to cardiac findings. Consequently, no episodes of PAE were detected in this series.

Venous air embolism risk is also influenced by technical factors such as the angle of elevation. Türe et al. studied head angles in semi-sitting craniotomies and found that raising the head above ~30° dramatically increased VAE incidence. At 30° elevation only 8% of patients had clinically important VAE, whereas at higher angles the rate rose to 50%. They concluded that a 30° semi-sitting elevation with meticulous positioning is safe for neurosurgery (3). Later in their study, Kurihara et al. proposed that the head elevation angle causing clinically important VAE in patients undergoing neurosurgery in the semi-sitting position was estimated to be 35.7° (20). In our practice, we similarly limit elevation of the head to a 35 degree.

Tension Pneumocephalus is another potential concern with upright positioning. In our experience no patient developed clinically significant tension pneumocephalus. This is concordant with recent analyses showing that although postoperative intracranial air is almost universal after sitting craniotomy, tension pneumocephalus requiring intervention is rare (15,21). Machetanz et al. examined 429 semi-sitting vestibular schwannoma surgeries and found radiographic pneumocephalus in 96% of cases, with a mean volume of ~40 mL. Only 14 patients (3.3%) developed symptomatic tension pneumocephalus, all of which were relieved by simple twist-drill air evacuation, with no sequelae. No patient in the supine cohort (n=111) needed such treatment (15). Thus, although semi-sitting surgery predicts larger intracranial air collections, tension pneumocephalus is uncommon and easily managed. The current series reports that postoperative CT scans in most patients revealed small, expected subdural air collections, but none progressed to clinically significant tension pneumocephalus or required decompression. This aligns favorably with literature indicating that while pneumocephalus is common, symptomatic tension pneumocephalus is rare.

The current series achieved gross total resection in 15 of 17 cases (88%). However, given the small and heterogeneous nature of this cohort (comprising a wide variety of lesions with only a few cases per pathology) calculating an aggregate gross total resection rate and comparing it directly with large homogeneous series in the literature may not allow for statistically meaningful comparison. Nevertheless, it is noteworthy that among the two cases with subtotal resection, one was a deliberate partial resection to preserve

brainstem integrity in a case of bilateral cerebellar metastases, and the second was a glioblastoma in the pineal region where gross total resection is inherently challenging. Taking these factors into account, the gross total resection rate in this series can be regarded as a highly successful surgical outcome. This suggests that the semi-sitting position, when utilized by an experienced surgeon, facilitates optimal tumor visualization and access, thereby enabling aggressive yet safe resection. The high rate of gross total resection provides practical support for the theoretical surgical advantages attributed to the semi-sitting position.

Limitations

This study has several limitations that warrant consideration. It is a retrospective, single-center case series with a small sample size (n=17). This limits the generalizability of our findings and precludes robust statistical analysis and direct comparison with larger, more homogeneous cohorts in the literature. The heterogeneity of pathologies included further complicates meaningful statistical comparisons of outcomes like gross total resection rates across different lesion types.

VAE detection was based solely on end-tidal CO₂ monitoring, without the use of more sensitive modalities such as transesophageal echocardiography or precordial Doppler ultrasonography, which may have led to underestimation of subclinical VAE events. While ETCO₂ is considered adequate for detecting clinically significant VAE, less severe or transient VAE events may have gone undetected. Because patients with relevant PFO were excluded before surgery, our results apply to PFO-negative candidates and may not generalize to unselected populations.

The absence of a control group prevents a direct comparison of outcomes and complications attributable specifically to the semi-sitting position versus other surgical approaches. This makes it challenging to definitively ascertain the unique benefits or risks associated with the semi-sitting position from this series alone.

Finally, the study was conducted by a single senior neurosurgeon, which, while ensuring consistency in surgical technique, limits the external validity of the findings to other surgeons and institutions with varying levels of experience and protocols.

Acknowledgments

No acknowledgments were declared for this study

Author Contributions

Serkan Civlan, **Emrah Egemen**, and **Mehmet Erdal Coskun** contributed to the conception of the study. The design was developed by **Serkan Civlan**, **Nevzat Doğukan Erbek**, and **Berk Burak Berker**. **Nevzat Doğukan Erbek**, **Rasim Asar**, **Emrah Egemen**, and **Turan Evran** were responsible for data collection or pro-

cessing. The analysis and interpretation of data were performed by **Serkan Civlan**, **Nevzat Doğukan Erbek**, **Berk Burak Berker**, and **Rasim Asar**. Literature research was conducted by **Nevzat Doğukan Erbek** and **Turan Evran**. The manuscript was written by **Serkan Civlan**, **Nevzat Doğukan Erbek**, and **Berk Burak Berker**. Final approval of the manuscript was provided by **Serkan Civlan** and **Mehmet Erdal Coskun**.

Conflicts of Interest

The authors have no conflict of interest in this study.

Financial Support

There was no financial support in our study.

Ethical Approval

The study was conducted in accordance with the rules of the Declaration of Helsinki and approved by the Ethics Committee of Pamukkale University (09.07.2025/E-60116787-020-719081). The figure depicts a co-author with written consent. It was created from a staged photograph with assistance from ChatGPT o3 and edited by the authors. No patient data were used.

Review Process

Extremely and externally peer-reviewed.

REFERENCES

1. De Martel T. Surgical treatment of cerebral tumors. Technical considerations. *Surg Gynecol Obstet*. 1931;52:381–385.
2. Tufegdzic B, Lamperti M, Siyam A, Roser F. Air-embolism in the semi-sitting position for craniotomy: A narrative review with emphasis on a single centers experience. *Clin Neurol Neurosurg*. 2021 Oct;209:106904. doi: 10.1016/j.clineuro.2021.106904. Epub 2021 Aug 27. PMID: 34482115.
3. Türe H, Harput MV, Bekiroğlu N, Keskin Ö, Köner Ö, Türe U. Effect of the degree of head elevation on the incidence and severity of venous air embolism in cranial neurosurgical procedures with patients in the semisitting position. *J Neurosurg*. 2018 May;128(5):1560-1569. doi: 10.3171/2017.1.JNS162489. Epub 2017 Jul 14. PMID: 28707996.
4. Saladino A, Lamperti M, Mangraviti A, Legnani FG, Prada FU, Casali C, Caputi L, Borrelli P, DiMeco F. The semisitting position: analysis of the risks and surgical outcomes in a contemporary series of 425 adult patients undergoing cranial surgery. *J Neurosurg*. 2017 Oct;127(4):867-876. doi: 10.3171/2016.8.JNS16719. Epub 2016 Dec 16. PMID: 27982770.
5. Feigl GC, Decker K, Wurms M, Krischek B, Ritz R, Unertl K, Tatagiba M. Neurosurgical procedures in the semisitting position: evaluation of the risk of paradoxical venous air embolism in patients with a patent foramen ovale. *World Neurosurg*. 2014 Jan;81(1):159-64. doi: 10.1016/j.wneu.2013.01.003. Epub 2013 Jan 4. PMID: 23295634.
6. Hermann EJ, Hatipoglu Majernik G, Scheinichen D, Al-Afif S, Heissler HE, Palmaers T, Krauss JK. Resection of posterior fossa tumors in the semi-sitting position in children younger than 4 years of age. *Childs Nerv Syst*. 2023 Jan;39(1):159-167. doi: 10.1007/s00381-022-05725-y. Epub 2022 Nov 9. PMID: 36348035; PMCID: PMC9968679.

7. Klein J, Juratli TA, Weise M, Schackert G. A Systematic Review of the Semi-Sitting Position in Neurosurgical Patients with Patent Foramen Ovale: How Frequent Is Paradoxical Embolism? *World Neurosurg*. 2018 Jul;115:196-200. doi: 10.1016/j.wneu.2018.04.114. Epub 2018 Apr 26. PMID: 29704690.
8. Al-Afif S, Lang JM, Abdalbaki A, Palmaers T, Scheinichen D, Abu-Fares O, Hermann EJ, Krauss JK. The safety and utility of the semi-sitting position for clipping of posterior circulation aneurysms. *Acta Neurochir (Wien)*. 2024 Aug 20;166(1):341. doi: 10.1007/s00701-024-06229-1. PMID: 39160268; PMCID: PMC11333526.
9. Rabelo N, Silva B, Cunha C, Furtado I, Valli D, Filho L, Marchini L, Pereira VHP, Passos GS, Dias L, Tanaka J, Plastina F, Rabelo N. Semi-sitting position in neurosurgery: a review. *Arq Bras Neurocir*. 2016;35(2). doi:10.1055/s-0036-1572507.
10. Karmakar A, Khan M, Saracoglu A, Ergenc M, Hussein MIH, Orompurath M, Saracoglu K, Gangineni K, Kumar N. Craniotomy in semi-sitting position: a 4-year single institution experience [Preprint]. *Res Sq*. 2023. doi:10.21203/rs.3.rs-3821842/v1.
11. Türe U, Harput MV, Kaya AH, Baimedi P, Firat Z, Türe H, Bingöl CA. The paramedian supracerebellar-transtentorial approach to the entire length of the mediobasal temporal region: an anatomical and clinical study. Laboratory investigation. *J Neurosurg*. 2012 Apr;116(4):773-91. doi: 10.3171/2011.12.JNS11791. Epub 2012 Jan 20. PMID: 22264179.
12. Wu X, Wang X, Song G, Li M, Hou C, Chen G, Guo H, Xiao X, Tang J, Lin Q, Bao Y, Liang J. The effects of different surgical positions (semi-sitting and lateral position) on the surgical outcomes of large vestibular schwannoma: study protocol for a randomized controlled trial. *Trials*. 2022 Jun 14;23(1):492. doi: 10.1186/s13063-022-06437-z. PMID: 35701794; PMCID: PMC9194341.
13. Ammirati M, Lamki TT, Shaw AB, Forde B, Nakano I, Mani M. A streamlined protocol for the use of the semi-sitting position in neurosurgery: a report on 48 consecutive procedures. *J Clin Neurosci*. 2013 Jan;20(1):32-4. doi: 10.1016/j.jocn.2012.05.037. Epub 2012 Nov 21. PMID: 23178073; PMCID: PMC3840951.
14. Serra C, Akeret K, Staartjes VE, Ramantani G, Grunwald T, Jokeit H, Bauer J, Kräyenbühl N. Safety of the paramedian supracerebellar-transtentorial approach for selective amygdalohippocampectomy. *Neurosurg Focus*. 2020 Apr 1;48(4):E4. doi: 10.3171/2020.1.FOCUS19909. PMID: 32234984.
15. Machetanz K, Leuze F, Mounts K, Trakolis L, Gugel I, Grimm F, Tatagiba M, Naros G. Occurrence and management of post-operative pneumocephalus using the semi-sitting position in vestibular schwannoma surgery. *Acta Neurochir (Wien)*. 2020 Nov;162(11):2629-2636. doi: 10.1007/s00701-020-04504-5. Epub 2020 Jul 25. PMID: 32712719; PMCID: PMC7550361.
16. Al-Afif S, Elkayekh H, Omer M, Heissler HE, Scheinichen D, Palmaers T, Nakamura M, Hermann EJ, Samii M, Krauss JK. Analysis of risk factors for venous air embolism in the semisitting position and its impact on outcome in a consecutive series of 740 patients. *J Neurosurg*. 2021 Nov 5;137(1):258-265. doi: 10.3171/2021.7.JNS211107. PMID: 34740183.
17. Himes BT, Mallory GW, Abcejo AS, Pasternak J, Atkinson JLD, Meyer FB, Marsh WR, Link MJ, Clarke MJ, Perkins W, Van Gompel JJ. Contemporary analysis of the intraoperative and perioperative complications of neurosurgical procedures performed in the sitting position. *J Neurosurg*. 2017 Jul;127(1):182-188. doi: 10.3171/2016.5.JNS152328. Epub 2016 Aug 5. PMID: 27494821.
18. Hurth H, Ebner FH, Clement E, Naros G, Rosenberger P, Kasper EM, Tatagiba M, Drexler B. The risk of intraoperative venous air embolism from neurosurgical procedures performed in the lounging position: an in-depth analysis of detection, management, and outcomes of 1000 consecutive cases. *J Neurosurg*. 2024 Sep 20;142(3):797-807. doi: 10.3171/2024.5.JNS232449. PMID: 39303312.
19. Fathi AR, Eshtehardi P, Meier B. Patent foramen ovale and neurosurgery in sitting position: a systematic review. *Br J Anaesth*. 2009 May;102(5):588-96. doi: 10.1093/bja/aep063. Epub 2009 Apr 4. PMID: 19346525.
20. Kurihara M, Nishimura S. Estimation of the head elevation angle that causes clinically important venous air embolism in a semi-sitting position for neurosurgery: a retrospective observational study. *Fukushima J Med Sci*. 2020 Aug 4;66(2):67-72. doi: 10.5387/fms.2019-33. Epub 2020 Jun 5. PMID: 32507799; PMCID: PMC7470760.
21. Toung TJ, McPherson RW, Ahn H, Donham RT, Alano J, Long D. Pneumocephalus: effects of patient position on the incidence and location of aerocele after posterior fossa and upper cervical cord surgery. *Anesth Analg*. 1986 Jan;65(1):65-70. PMID: 3455673.