The sitting Position in Neurosurgery: A Clinical Study in 132 Cases

Alam S[1], Hossain ATMM[2], Amin MR[3], Rahman A[4], Uddin ANW[5], Islam KMT[6], Obaida ASMA[7], Chowdhury RU[8]

Abstract:

Objective: *Sitting position for operations in Neurosurgery provides an excellent visualization because of slack of brain due to gravity drainage of CSF and blood. In this study advantages and disadvantages of sitting position in different neurosurgical operations are evaluated.*

Materials and methods: *From January 2008 to December 2015 total 132 cases underwent neurosurgical procedure in sitting position. Physical characteristics including patient age, sex, size of the tumorand histological diagnosis were collected. The post operative images were studied to see the extent of tumor removal and early detection of complications.*

Result: *Allmost all patients required per operative C.V. line or peripheral inserted central venous line, precordial doppler sound, $ETCO_2$, O_2saturation and close monitoring of blood pressure. Venous air embolism were detected in two cases (6.66%).Total tumor removal was possible in 92 (69.7%) cases and subtotal in 25 (18.94%) cases. There were 7 (5.30%) mortality in 132 cases, four case from CP angle tumor and two case from petroclival meningioma and another from pineal region tumour. There were pneumocephalus in all most all cases and post operative new facial paresis in 20 (15.15 %) cases. 5th nerve palsy developed in 3 (2.27 %) cases. Temporary lower cranial nerve palsy developed in 2 cases. Post operative tumor bed hematoma developed in 4 (13.33%) cases. Most of the patient have good outcome (GOS 5).*

Conclusion: *Sitting position can be safely done with good preoperative physiological, per operative close monitoring of the patient regarding blood pressure, $ETCO_2$and oxygen saturation. However postoperative complication like tumor bed hematoma, pneumocephalus, cranial nerve palsy have to be bring in mind.*

Bang. J Neurosurgery 2015; 4(2): 50-55

Introduction:

The use of the sitting or semisitting position for patients undergoing posterior fossa and or cervical spine surgery facilitates easy surgical access but presents a physiological challenges for the anaesthetist[1]. This patient position provides optimum access to midline, paramedian and cerebellopontine lesions it also improves cerebral venous drainage, lowers intracranial pressure (ICP) and promotes gravity drainage of blood and cerebral spinal fluid (CSF)[2,3].Complications related to the use of this position include haemodynamic instability, venous air embolism (VAE),embolism related hypoxia and or hypotension, with the possibility of paradoxical air embolism, pneumocephalus, quadriplegia and compressive peripheral neuropathy[1,2,3]. Alternative positions for surgical access to the posterior fossa and the cervical spine include the prone, park bench, lateral positions. Prolonged neurosurgical procedures with pin fixation of the head in semisitting positions necessitate extensive patient monitoring to ensure cardiorespiratory homeostasis[1,2,3].

The objective of this study is to provide a risk-benefit analysis of the present day use of the sitting position for patients undergoing CP angle, midline posterior fossa and cervical spine surgery.

Since 1913 when the first surgery with the patient in sitting position was performed, the debate concerning

1. Shamsul Alam, Assistant Professor, Department of Neurosurgery, BSM Medical University, Dhaka.
2. ATM Mosharef Hossain, Professor, Department of Neurosurgery, BSM Medical University, Dhaka.
3. Md. Rezaul Amin, Assistant Professor, Department of Neurosurgery, BSM Medical University, Dhaka.
4. Asifur Rahman, Assistant Professor, Department of Neurosurgery, BSM Medical University, Dhaka.
5. A.N. Wakil Uddin, Research Assistant, Department of Neurosurgery, BSM Medical University, Dhaka.
6. K.M.Tarikul Islam, Assistant Professor, Department of Neurosurgery, BSM Medical University, Dhaka.
7. A.S.M. AbuObaida, Medical Officer, Department of Neurosurgery, BSM Medical University, Dhaka.
8. Lt. Col. Rukun Uddin Chowdhury, Combined Military Hospital, Dhaka,

Address of Correspondence: Dr. Shamsul Alam, Assistant professor, Department of Neurosurgery, B.S.M. Medical University, Shahbag, Dhaka-1000. Cell# 01715421229 Email: dr_shamsul@hotmail.com

this positioning has continued. The sitting position is thought to be best for surgical access to Cerebello Pontine Angle, midline and paramedian posterior fossa or to posteriorly located parietal lesions[4]. Gravity facilitates drainage of blood and other fluids and an optimal view over the pathology is possible with lowered intracranial pressure and increased venous return[1,2,3,4].

Air embolism can occur during any surgical procedure in which the operative site is 5 cm or higher above the right atrium[4].

The higher chance of venous air embolism occur in the presence of persistent foramen ovale (PFO)[5].In patient with PFO surgical opening of veins can lead to a paradoxical air embolism with critical cerebral and cardio-pulmonary complication.PFO have found in 28%of adult patients using transoesophageal echocardiography as diagnostic procedure[5]. Doppler ultrasound is the most sensitive noninvasive monitor, and is commonly used in sitting position. The monitor uses ultrahigh frequency sound waves (usually between 2 and 3 megahertz) to measure blood flow velocity and changes in blood density. This information is converted to a characteristic sound[5,6].

Transesophageal echocardiography is more sensitive than Doppler ultrasound, and is also more invasive and technically more difficult to place and to interpret. It does, however, allow determination of the volume of air aspirated. Transesophageal echocardiography will also show air passing through a patent foramen ovale into the left atrium and into the systemic circulation[5,6,7].

Monitoring of End-tidal carbon dioxide is commonly used, widely available, and sensitive. It is highly sensitive but not specific for air embolism. It becomes low at the begaining of venous air embolism. However hyperventilation, low cardiac output, other types of emboli, and COPD(Chronic Abstractive Pulmonary Disease) can also decrease $ETCO_2$ (End-tidal Carbon dioxide)[7,8].

The least sensitive monitor is the pericardial or esophageal stethoscope. A “millwheel murmur” indicates a massive air embolism. When a millwheel murmur is heard, cardiovascular collapse is imminent[7,8].

A multiorifice central venous catheter should be placed in patients at risk of air embolism. The optimal site for the tip of the catheter is at the SVC-RA junction. If an embolus occurs, air can be aspirated through the catheter before it enters the pulmonary circulation[5,6,7,8].

Treatment of air embolism is largely supportive. The surgeon should be informed as soon as the diagnosis is made. N_2O diffuses into air bubbles faster than nitrogen can diffuse out, and increases the size of the bubble. If N_2O is used, it should be discontinued when an air embolism occurs. FiO_2(fraction of inspired O_2) should be increased to 1.0. The surgeon should flood the surgical field with fluids while open veins are cauterized or exposed bony emissary vein is waxed. If significant amounts of air have entered the circulation, the jugular veins should be manually occluded. This will prevent additional air from being entrained while the surgeons obtain hemostasis. The blood pressure should be supported with fluid and vasopressors[8].

Controversy surrounds the use of the sitting position for neurosurgery, regarding the risk of venous air embolus (VAE) and its sequelae. The reported incidence of VAE in adults undergoing neurosurgery in the sitting position varies from 7 to 50%[8].

Methods and Materials:

From January 2008 to March 2016 total 132 cases underwent neurosurgical procedure in sitting position. Physical characteristics including patient age, weight, and histological diagnosis were collected. The post operative notes were studied together with the follow up notes to document any unexpected neurological sequelae. All most all patients required C.V. line or peripheral inserted central venous catheter, precordial Doppler sound, $ETCO_2$, O_2 saturation and close monitoring of blood pressure. Routine use of normal saline irrigation to the operation field, regular use of bone wax to the bone emissary vein, bilateral jugular vein compression before starting of dural incision to locate the transverse and sigmoid sinus and minimum cautery to the tumour bed. To achieve hemostasis we raise the blood pressure 20mm of hg above the pre induction blood pressure and again bilateral jugular vein compression to exclude any venous bleeding before closure of dura.

Internal acoustic meatus was drilling most of the cases of acoustic schwannomas. We didnot use facial nerve monitor to trace out the location of facial nerve because of its nonavailability in our institute. We did routine practice of raising the blood pressure before closing the dura and bilateral jugular vein compression to check the operative side bleeding. Drilled Internal acoustic meatus was filled by subcutaneous fat. Fibrin glue were used in some cases to make the the dural closure water tight. In some cases we used acrylic bone cementto close the lateral suboccipital craniectomy defect followed suboccipital muscle and subcutaneous tissue and skin closure.

Results:

Most of the patients were in the range between 25 and 65 years, (median 40, average 45) (Table I) Among them 64 (48.48%) were male and 68 (51.51%) were female (Table II).

Table-I

Shows distribution of age group.(n=132)

Age	No. of Patient
20-30	39 (29.55 %)
31-40	40 (30.30 %)
41-50	25 (18.94 %)
51-60	20 (15.15 %)
61-70	8 (6.06 %)
Total	132

Table-II

Shows distribution of sex group(n=132)

Sex	No. of Patient
Male	64 (48.48 %)
Female	68 (51.51 %)
Total	132

Most of the patients presented with headache and vomiting, (87 patients) followed by ataxia in 38 cases, deafness in 32 cases, facial weakness in 9 patients, quardriparesis were seen in 3 cases. (Table III).

Table-III

Shows distribution of presentation(n=132)

Presentation	No. of Patient
Headache	87 (65.91%)
Vomiting	87 (65.91%)
Deafness	32 (24.24%)
Facial Weakness	9 (6.82%)
Ataxia	38 (28.79%)
Quardriparesis	3 (2.27%)
Total	132

Among 132 cases c.p. angle tumor were 70.45% petroclival meningioma were 14.39%, foramen lesions were 6.06 %, pineal region tumor were 5.30%, upper cervical schawnnoma 3.80 %.(table IV).

Table-IV

Location of Lesions(n=132)

Location	No. of Patients
Cerebellopontine angle	93 (70.45%)
Petroclival Meningioma	19 (14.39%)
Foramen Magnum Schwannoma	4 (3.03%)
Foramen Magnum Meningioma	4 (3.03%)
Pineal Region Tumour	7 (5.30%)
Upper cervical Schawnnoma	5 (3.80%)
Total	132

Gross total tumor removal was possible in 92 (69.7 %) cases (figure 1,2,) and subtotal removal in 25 (18.94 %) cases (figure3,4) and partial removal in 2 (6.66%) cases.

Facial nerve preservation could possible in 20 cases(15.15%) and not possible in 8 cases(45%) out of cases of 18 C.P. angle tumor.

There were 7 (5.30 %) mortalitie in 132 cases, among them four cases from C.P. angle tumor, two case from petroclival meningioma and another from pineal region tumor. There were pneumocephalus in almost all cases and post operative new facial paresis in 20 (15.15%) cases. 5th nerve palsy developed in

Fig.-1: *Shows preoperative picture of vestibular Schwannoma.*

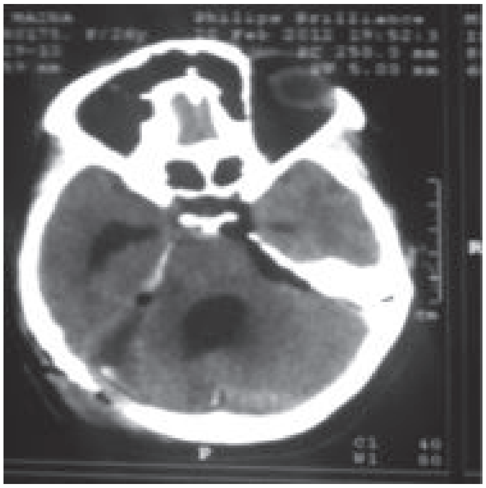

Fig.-2: *Shows post operative picture of vestibular Schwannoma showing no residual tumour.*

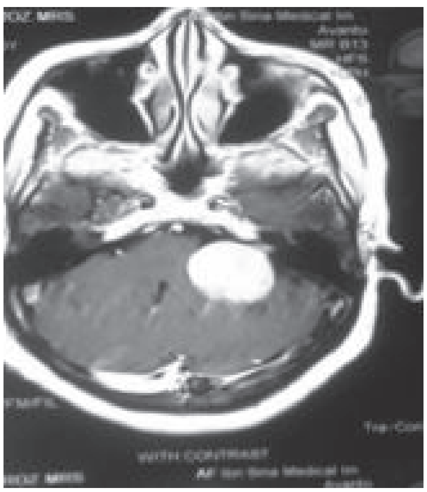

Fig.-3: *Shows preoperative picture of vestibular Schwannoma.*

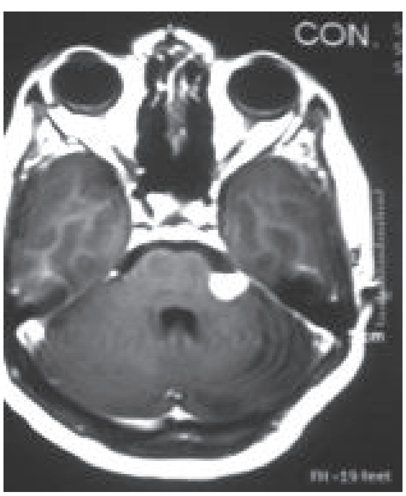

Fig.-4: *Shows late postoperative picture of vestibular Schwannoma showing small residual tumour.*

3(2.27%) cases, lower cranial nerve palsy developed in 2 cases (6.6%).Post operative tumor bed haematoma developed in5 (3.78%) cases. 2 cases had to undergo urgent re-exploration and hematoma evacuation. Most of the patient had good outcome (GOS 5) (Table V).

Fig.-5: *Front view of sitting position with head fixation by 4 pin head fixator and precordial Doppler.*

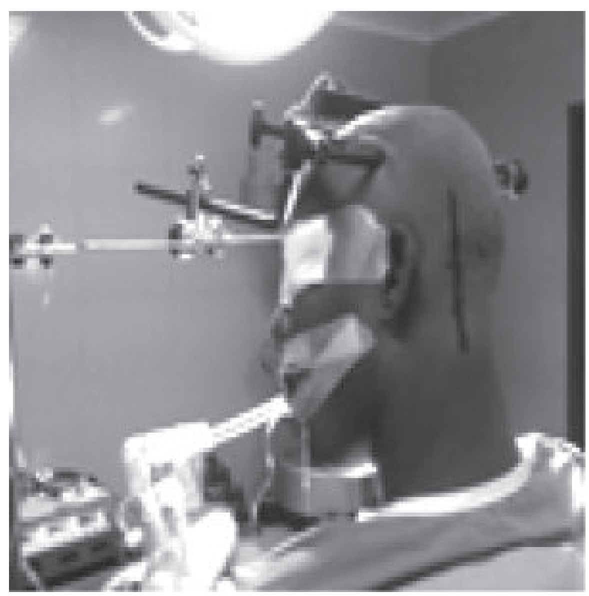

Fig.-6: *Back view of sitting position.*

Pressure on cervical cord related to a preexisting spondylitic bar at the midcervical level[9].

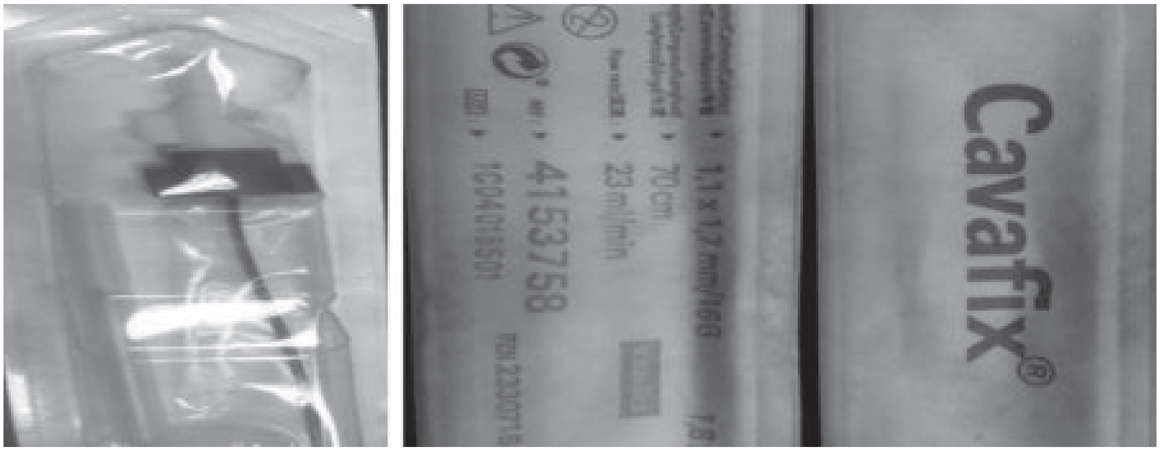

Fig.-7: *Shows pheripheral inserted central venous catheter(Cavafix).*

Table-V

Complications of sitting position(n=132)

Complication	No of Patient
Facial nerve palsy	49 (37.12%)
5^{th} nerve palsy	34 (25.76%)
Lower nerve palsy	18 (13.64%)
Hematoma	12(9.09%)
Hydrocephalus	8 (6.06%)
Cerebellar swelling	6 (4.54%)
Venous air embolism	2 (1.52%)
Pseudomeningocle	3 (2.27%)
Cervical cord injury	Nil
Total	132

Discussion:

For many neurosurgeons the sitting position (figure5&6) offers the advantages of optimal surgical exposure, better anatomic orientation, improved cerebral venous drainage, lower intracranial pressure, and enhanced gravity drainage of blood and cerebrospinal fluid[7]. Because life threatening complications can occur during neurosurgery in the sitting position hence caution is advocated in almost all patients including patients with a patent foramen ovale, arthrosclerotic cardiovascular disease, severe hypertension or cervical stenosis[7,8].

Cervical cord injury is one of the most serious complications after surgery in sitting position. In 1980, Hitselberger and House reported five cases of midcervical quadriplegia after acoustic tumor resection performed with the patient in the sitting position. They suggested that acute diffuse infraction was caused by direct prolonged.[9]

The highest concern is the risk of VAE and its sequel.Although there are several published reports of the incidence of VAE in the sitting of adults, there are no large series that look at the incidence of VAE in children. The reported incidence as detected by transoesophageal Doppler ultra sonography in adults ranges from 7 to 50%. In another study its incidence is 35%.[10]

In our study venous air embolism occurred in 2 patients (6.6%), which is still lower than other the previous reports. We believe that the care taken while positioning the patient and the meticulous prevention of bleeding from surgically opened venous vessels& bony emissary vein were responsible for the lower air embolism rate[10].

For quick detection and management we have routinely used precordial Doppler and cavafix (peripheral inserted central venous line (figure-7).

The effect of an air embolus depends both upon the rate and volume of air introduced into the circulation. The capacity of the lung to filter micro bubbles of air from the venous circulation is exceeded when gas enters the circulatory system at a rate greater than 0.30 ml/kg per minute in a canine model; infusions at greater rates generally result in arterial emboli and tissue ischemia[11].

Large, rapid boluses of air are tolerated less well than slow infusions of small amounts of air. It is estimated that 300 to 500 ml of gas introduced at a rate of 100 ml/sec is a fatal dose for humans[11].

When air enters the veins, it travels to the right side of the heart, and then to the lungs.

This can cause the vessels of the lung to constrict, raising the pressure in the right side of the heart. If the pressure rises high enough in a patient who is one of the 20% to 30% of the population with a patent foramen ovale the gas bubble can then travel to the left side of the heart, and on to the brain or coronary arteries. Such bubbles are responsible for the most serious of gas embolic symptoms[12].

Some studies have stated relative and absolute contraindications for the sitting position. Alongside age, hypertension and obstructive lung disease, diagnosed PFO is one of them.

In a study by Kwapisz and colleagues the semi sitting position chosen before operation was changed into supine position after diagnosing PFO to avoid complications[12].

Contraindications to use of the operative sitting position:

Absolute:

1. Patent ventriculo- arterial shunt.
2. Right arterial pressure in excess of left arterial pressure.
3. Patent foramen ovale.
4. Cerebral ischemia when upright and awake.

Relative:

1. Extremes of age.
2. Uncontrolled hypertension.
3. Chronic obstructive airway disease.

Certain preexisting conditions may place patients at increased risk of venous air embolism (i.e. presence of a patent ventriculo- arterial shunt, demonstrable pressure gradient from left to right heart or presence of a patent foramen ovale). Patients who experienced cerebral ischemia upright position as a result of cardiovascular and cerebrovascular disease are at increased risk of inadequate cerebral perfusion under anesthesia in the operative sitting position. Relative contraindications may include extremes of age, uncontrolled hypertension or chronic obstructive airway disease12.

Conclusion:

Sitting position can be safely done with good preoperative physiological, per operative close monitoring of the patient regarding blood pressure, $ETCO_2$ and oxygen saturation. However postoperative complication like tumor bed hematoma, pneumocephalus, and cranial nerve palsy have to be bring in mind. Preoperative echocardiography investigation for detection of PFO further reduces the risk to the patient in that knowledge of the presence of PFO will heighten the surgeon's degree of care and focus attention on alternative neurosurgical positions for surgery.

References:

1. Samii M, Matthies C. Management of 1000 vestibular schwannomas (acoustic neuromas): Surgical management and results with an emphasis on complications and how to avoid them. Neurosurgery 1997;40:11-21, discussion 21-3.
2. Yamakami I, Uchino Y, Kobayashi E, Yamaura A, Oka N. Removal of large acoustic neurinomas (vestibular schwannomas) by the retrosigmoid approach with no mortality and minimal morbidity. J Neurol Neurosurg Psychiatry 2004;75:453-8.
3. Martin JT. Neuroanesthetic adjuncts for surgery in the sitting position. I. Introduction and basic equipment. Anesth Analg. 1970 Jul-Aug;49(4):577–587.
4. Millar RA. Neurosurgical anaesthesia in the sitting position. A report of experience with 110 patients using controlled or spontaneous ventilation. Br J Anaesth. 1972 May;44(5):495–505.
5. Tindall GT, Craddock A, Greenfield JC., Jr Effects of the sitting position on blood flow in the internal carotid artery of man during general anesthesia. J Neurosurg. 1967 Apr;26(4):383–389.
6. Michenfelder JD, Miller RH, Gronert GA. Evaluation of an ultrasonic device (Doppler) for the diagnosis of venous air embolism. Anesthesiology. 1972 Feb;36(2):164–167.
7. Maroon JC, Albin MS. Air embolism diagnosed by Doppler ultrasound. Anesth Analg. 1974 May-Jun;53(3):399–402.
8. Munson ES, Merrick HC. Effect of nitrous oxide on venous air embolism. Anesthesiology. 1966 Nov-Dec;27(6):783–787.
9. Hitselberger WE, House WF: A warning regarding the sitting position for acoustic tumor surgery. **Arch Otolaryngol** 106:69, 1980.
10. Bengochea FG, Fernandez JC. The lateral sitting position for operations in the posterior fossa and in the cervical and upper thoracic regions of the spine. J Neurosurg. 1956 Sep;13(5):520–522.
11. Slbin MS, Babinski M, Maroon JC, Jannetta PJ. Anesthetic management of posterior fossa surgery in the sitting position. Acta Anaesthesiol Scand. 1976;20(2):117–128.
12. Kwapisz MM, Deinsberger W, Mueller M, et al. Transesophageal echocardiography as a guide for patient positioning before neurosurgical procedures in semi-sitting position. J Neurosurg Anesthesiol 2004;4:277-81.