American Journal of
Oral Medicine and Radiology

ISSN - 2394-7721

www.mcmed.us/journal/ajomr

Research Article

STUDIES ON WHETHER CENTRAL VENOUS CATHETERS ARE BENEFICIAL DURING ELECTIVE BRAIN SURGERY

Nagaraju M [1]*, Veluru Srinivasulu[2]

[1]Associate Professor, General Surgery, Sri lakshminarayana Institute of medical sciences, Pondicherry, India.
[2]Associate Professor, General Surgery, Indira medical college and hospitals, Chennai, Tamil Nadu, India.

ABSTRACT

Clinical outcomes after elective supratentorial intracranial surgeries may be improved by using central venous catheters (CVC). A two-arm, single-center retrospective study compared elective intracranial surgeries carried out with and without CVCs. Standard procedures for anesthesia were modified, ultimately eliminating the requirement for CVCs for supratentorial surgery. The primary outcome was the number of peri-operative adverse events (AEs). Researchers studied the data of 621 patients (301 who had a CVC and 320 who did not). There were similarities in the patient profiles of both study groups. During the study, 132 adverse events were reported (81 in the CVC group compared to 51 in the control group) that involved neurological, neurosurgical, cardiovascular, and mortality concerns. Patients with CVC have nearly twice the number of AEs as those without (OR adjusted = 1.98; 95 percent confidence interval [1.28-3.06]; p 0.002). In 1.0 percent of the cases, complications such as pneumothorax and arterial malpuncture occurred. Treatment time in the ICU for CVC patients was 22 (19;24) hours, compared to 21 (19;24) hours (p = 0.413). There was also no difference between the groups' length of hospital stay (9 (7;13) vs. 8 (7;11) days, p = 0.210). A considerable difference was found between the CVC and normal groups in the number of minutes needed for ventilation (350 (300; 440) vs. 335 (281;405) minutes, and induction time (40 (35;50) vs 30 (25;35) minutes, p = 0.001. There was no difference in inflammation markers or antibiotic therapy postoperatively. Retrospective analysis of our data shows that patients with CVCs have no significant advantages over patients without any CVCs during elective neurosurgical procedures.

Key words:- OSMF- Oral submucous fibrosis, I.P.- Indian pharmaceutical, IU- International unit, W/V- Weight/ volume.

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Home page: http://www.mcmed.us/journal/ajomr	Quick Response code

Received:25.01.2021	**Revised**:12.02.2021	**Accepted**:15.02.2021

INTRODUCTION

In the United States, more than five million central venous catheters (CVC) are implanted each year. [1] Catecholamine infusion, intravenous medicine delivery, parenteral nourishment, blood sample collection, and central venous pressure monitoring are all made easier by

Corresponding Author

Nagaraju M

CVCs. In addition, CVCs are utilized to measure transpulmonary thermodilution.

[2] In order to avoid additional risks and consequences, every CVC implantation requires clear medical justifications. CVC insertion with ultrasound, however, has significantly reduced problems and increased safety. There are many dangers and negative consequences associated with CVCs. All of the following types of vascular complications are possible: venous damage, arterial puncture / cannulation, bleeding, haematomas, and haemathoraxes. Aside from pneumothoraces and pneumomediastinum, other possible

adverse reactions include tracheal damage and nerve damage (e.g., phrenic nerve). In addition to thrombosis and thrombophlebitis, we must also consider arrhythmia, cardiac arrest, and ventricular perforation tamponade. Another common consequence of catheter use is bloodstream infections that can lead to sepsis, septic shock, and even death. The findings led to efforts to develop less invasive alternatives for obtaining blood samples, administering medicines, and monitoring a patient's hemodynamics without using a CVC. Several scholars have predicted that CVCs will be rendered obsolete in the future. Clinical facilities have different anaesthetic care for patients undergoing elective cerebral supratentorial surgery, since no uniform recommendations or criteria have been created. A continuous arterial line is used for continuous monitoring of blood pressure during intracranial surgeries done under general anesthesia. Alternatively, the use of central venous lines is debatable [11–14] because they are unclear as to whether they are clinically effective for patients having brain surgery. AEs (adverse events) that occurred during or after surgery were the primary endpoints of the study, which were attained by comparing the two groups. In addition, secondary objectives included procedures adverse events and length of hospital stay. ICU staff also assessed inflammatory markers (CRP and leukocytes) during the stay. Further, the duration of anaesthesia induction time, total time spent in the ICU, and other peri-operative times were calculated

METHODS AND MATERIALS

Patient variables such as gender, age, body mass index, and relevant co-morbidities were screened from anaesthesia data. As an in-house data management tool, Dräger's Integrated Care Manager (Release 9.1, Lübeck, Germany) and Siemens Healthcare's SoarianTM Clinicals (Release 4.01, SP08) were employed to obtain information about ICU treatments and other pertinent measurements. A spreadsheet was used to plot the data (Microsoft Excel 2010) for statistical analysis.

Qualifications

Participants must be 18 or older, have an ASA I-IV score, be scheduled for elective intracranial supratentorial surgery, and be scheduled for an ICU stay following surgery

AEs that occur during and after surgery

A predetermined list of peri-operative problems was available prior to the start of the trial. In order to evaluate peri-operative complications, we assessed anesthesia data, daily examination protocols, and any other electronic ICU documents. Additionally, we examined the adverse events reported by patients on a neurological, neurosurgical, or cardiovascular level. Pneumothorax, arterial malpuncture, and failed / repeated venous punctures during preoperative CVC placement have been identified as procedural adverse events. Monitoring of critical care and anaesthesia has been addressed in these circumstances. The institutional guidelines were followed when preparing patients for elective supratentorial surgery. There are, however, a few cases in which certain types of cancer (e.g., high-grade gliomas) received large doses of steroids before surgery. The participants in this trial did not experience severe coagulopathy (untreated) or required anticoagulation therapy perioperatively. In all cases of elective supratentorial surgery, institutional guidelines were followed. During the anaesthesia procedure, Remifentanil (0.2-0.55 g/kg/min/Supentanil 0.2-0.5 g/kg) or Sufentanil (0.2-0.55 g/kg) and Propofol (1.5-2.5 mg/kg) were used. As an alternative to rocuronium (0.6–1 mg/kg) for the purpose of endotracheal intubation, rocuronium was also used. Propofol and remifentanil were administered intravenously in order to maintain anaesthesia (6- 8 mg/kg/h and 0.2-0.5 g/kg/min, respectively). The patient was ventilated using the Primus® (Dräger) ventilation device following endotracheal intubation. As part of standard monitoring, we made use of electrocardiograms with three leads, oscillometric blood pressure monitoring, side-stream capnography, pulse oximetry, and continuous invasive blood pressure monitoring. It was left up to the anaesthesiologist to determine how the CVC was installed as part of the study period. After the area was cleansed, the vein was punctured. An incision was made into the skin, and a hollow needle was inserted until the blood could be withdrawn. A guide wire was inserted into a hollow needle once the needle's position was established (color and flow of blood or ultrasound imaging). A dilating device was inserted after the needle was removed, followed by the triluminal non-heparin-coated central venous line passing over the guidewire and being removed. An aspiration test was performed on all lumens. Further, venous pressure was measured prior to the administration of medications in order to ensure that the catheter was properly inserted. A 0.9 percent saline solution was used to flush the catheter and all of its lumens were sealed with caps. Sterilized bandages were applied to the puncture site and sewn to the catheter. The post-operative chest x-ray was taken following a subclavian or internal jugular vein puncture to ensure that the catheter was successfully placed and to rule out complications such as haematomas or pneumothoraces. In the observation period, the central venous catheters did not require heparin to maintain their patency. Patients were included after they were admitted to the intensive care unit. The patient was administered low molecular weight heparin six hours after the operation to prevent thromboembolism. The patient was then transferred to a peripheral ward based on in-house standard operating procedures based on her stable respiratory and circulatory conditions (without catecholamine support) as well as her stable neurological condition without any signs of

deterioration. A third requirement is that patients have normal laboratory results and are in a reasonable amount of pain (NRS 3).

Analytical statistics

(SPSS Inc., Chicago, IL, USA) was used to analyze the data. Kolmogorov-Smirnov test with Lilliefors correction is used to look for deviations from a normal distribution of data. A mean (SD) was reported for parameters considered to obey the normal distribution assumption, or otherwise as a median (25th;75th percentile). Data was presented as percentages and relative frequencies for categorical data. Whenever unrejected normality was encountered, the student's t-test was conducted (CVC vs. non-CVC) to compare continuous data between groups. Mann-Whitney U was also conducted as a secondary method. The association between categorical variables and the group variable (CVC and non-CVC) was analyzed using Pearson's 2-test. After adjusting for age and BMI, gender, ASA score, and co-morbidities, a binary logistic regression analysis was used to assess the primary outcome (peri-operative AEs) as a function of CVC. Based on the four "relevant pre-existing conditions" discussed here, a cumulative score was generated with values from [0, 4]. We present a comparison of AEs in CVC patients versus non-CVC patients, in addition to the adjusted odds ratio (OR) with a 95% confidence interval (CI). p0.05 was deemed statistically significant.

Results

Characteristics of Patients

621 patients were evaluated retrospectively in this study (301 with CVC and 320 without CVC). Various patient characteristics are detailed in Table 1, including age, gender, BMI, co-morbidity.

In continuous data, the mean (SD) and median (25th percentile; 75th percentile) are displayed according to the kind of distribution. For categorical data (frequency), the percentage value is given. Patients have the same characteristics with respect to the majority of the previously indicated characteristics. A significant difference was found between groups according to the ASA classification (p = 0.008). Table 2 lists all elective supratentorial procedures performed on patients (e.g., brain surgery for meningioma and glioma, brain metastasis).

Endpoints, both primary and secondary

Our primary outcome data (peri-operative adverse events, Table 3) shows a higher rate of adverse events in the CVC group (81 adverse events in the CVC group vs. 51 adverse events in the non-CVC group (301 CVC patients vs. 320 non-CVC patients). In a summary of all observed perioperative adverse events, there is already a difference between the two groups. More than one AE was recorded in some cases, according to the data. In contrast, 42/320 non-CVC participants experienced at least one adverse event, while 69/301 (22.9%) CVC patients suffered from at least one adverse event. A patient who has CVC compared to one with non-CVC has nearly twice as many chances of experiencing an AE (ORadjusted = 1.98; 95 percent CI = [1.28, 3.06]; p = 0.002).

A frequency report presents data as percentage (percentage of patients per group). ICU treatment time, a secondary endpoint, was not significantly different between the two groups (22 (19;24) vs. 21 (19;24), p = 0.413). In addition, other endpoint measurements like the time spent in the ICU, or the length of time spent in surgery did not show any significant differences (Table 4).

Continual data are based on means (SDs) and medians (75%;5%) whereas categorical data's frequency is expressed in percentages (percentage of patients per group).

The post-operative antibiotic treatment, inflammation markers (CRPs and leukocytes), and hospital stay were not affected by the surgery (Table 4). The group without CVC had an in-hospital mortality of 0.32 percent (2 patients) due to a complex and challenging post-operative course. One patient developed a pulmonary embolism after undergoing a routine surgical meningioma resection, resulting in unconsciousness, bradycardia, and hypotension. Her condition was a result of Cardiopulmonary Resuscitation (CPR), which was required immediately. Following successful resuscitation of the patient, a continuous intravenous catheter was placed. Nevertheless, a cCT scan revealed severe hypoxic and ischemic damage to the brain despite successful resuscitation. After suffering an irreparable brain injury, the patient did not recover fully.

A bifrontal glioblastoma resection was performed on the second patient. The preoperative cCT scan revealed a modest supratentorial herniation due to a little midline deviation. During the procedure, there were no difficulties, and the patient was quickly extubated. Due to abrupt hemiplegia, the patient required an emergency cCT. The scan revealed significant frontal cortical haemorrhage as well as extensive supratentorial cerebral edoema. As a result, there was a significant midline displacement, which resulted in lateral ventricle compression. Probes were used to measure ICP after the patient was re-intubated. Because of the enormous increase in intracranial pressure (>100 mmHg), the patient was eventually diagnosed as brain dead. A CVC was implanted to protect the patient's organs as much as possible during the ICU stay, in order to facilitate any potential organ donations.

Complications associated with CVC access

The internal jugular vein was shown to be the preferred location for CVC placement in 79.1% of cases, compared to 17.9% for the external jugular vein, 2.0%

for the femoral vein, and 1.0 percent for the femoral artery (subclavian vein). CVC-related complications included arterial malpuncture (2 patients, 0.7%) and failed venous puncture (27 patients, 9.0%). A pneumothorax was reported in one patient (0.3 percent) (Table 5).

Table 1: Characteristics of the patients.

Characteristics			
Population	Patients with CVC (n = 301)	Patients without CVC (n = 320)	P
Male or Female	141/158	143/188	0.587
Year of Birth	57 (47;75)	57 (45;58)	0.665
Weight (kg/m2)	25.7% (26.7%; 28.7%)	22.4% (22.4;28.1)	0.857
Existing conditions relevant to the case			
Cardiomyopathy	11.5% (31)	9.4% (31)	0.659
Hypotension	102.3%		0.857
Diabetic mellitus,	24 (8%)	18.6%	0.332
Infections (asthma, COPD)	35.1%	(9.7%)	0.444

Table 2: Transcranial supratentorial surgery in patients.

	Total 301 patients (CVC).	A total of 320 patients did not undergo CVC.	P
Supranational Neurosurgery			0.727
Gliomas	(87) 28.9%	(95) 29.7%	
lymphoma	46.7% (133)	129.7%	
Cauvaria	(1); 4.3%	of 1,9% (6)	
Resection of multiple lobes of the hippocampi	13.4%	(3) 11.4%	
Tumors	(54) 17.9%	(72%) 22.5%	
Malformation of the aorta	(1) 4.5%	of 1.0%	
Hypoplasia	2.7%	2.6%	
Abscesses/cysts	= 0.1%	(1%)	
Cancer	1.3%	of the population (1)	
Cancer		3.0%	
Adenomas of the pituitary	0	1.3%	

The data is expressed as a percentage (frequency).

Table 3: AEs postoperatively.

	A total of 301 patients had CVC	While 320 patients did not.
Medical and surgical complications occurred in 81 patients.		
Patients had visual disturbances.	12 (4%) patients died.	Six (1%) patients were blind.
disorders of the motor system	47 (15%)	16 (20 (6%)
Sensory deficiencies	2 (6%)	1,9 (%)
Unable to hear	0	of 1 (0,33%)

	A total of 301 patients had CVC	While 320 patients did not.
Apraxia	5 (1.7%)	1 (3.3%)
right hemisphere syndrome and frontal lobe disorders	0.39%	(0,33%)
impaired consciousness and intracranial pressure	1 (0,33%)	4 (1,33%)
Angioplasty	0.7 (0.2%)	0.3 (0.3%)
Epilepsy	(0.3%)	0
GERS	0	(0,33%)
Hyperglycemia/Edema perifocal	(4/12%)	3 (0.7%)
Pneumocele	1 (0.3%)	1%
PostBleeding postoperatively	1 (0.3%)	Two (0.6%)
bleeding-related reoperations	0	(0,68%)
complications related to the heart		
were hemodynamically unstable	0	1 (0.3%)
Embolus pulmonaire	0	1 (0.3%)
Deaths	0	2 (0.6%)
of the 132 overall AEs	81	51

Table 4: Clinical outcomes, treatment, and laboratory results differ from one another.

	CVC patients (n = 301)	vs. not-having CVC patients (n = 320).	P
Time spent in the ICU (hours).	2nd (19th;24th).	19 (19;24).	4.131.
(Minutes)	344 (300)	291,405, 335	0.003
Time on ICU ventilation	80 (148)	76 (139) 95	0.150
Time spent inducing anaesthesia in minutes	35 to 50	25 to 35	<0.001
Surgical time in minutes	(135;228)	(130;215)	0.433
Treatment with antibiotics after surgery	30 (10%)	7 (7.2%)	0.169
days spent in the hospital	(8;13)	7 (7;10)	0.210
CVC and postoperative instrumentation	0	(0,99%)	0.092
CRP when admitted to the ICU	4;4	(0,04)	0.133
mm/L of CRP at day 1	1(7:30)	17 (7:30)	0.903
mg/dl CRP day 2	80.89 (60.9)	65.9 (57.5)	0.097
[mg/l] CRP	66.9 (46.7)	79.6 (45.7)	2.27
White Blood Cells at ICU admission	10.2 (4.4)	8.9 (3.8)	1.17
neutrophils at day 1 [n/nl]	9.6 (14.2)	9.8 (14.8)	6.893
white blood cells (n/nl)	13.3 (4.6)	9.5 (12.9)	1.650
white blood cells day 3 [n/nl]	12.5 (4.4)	12.4 (4.5)	1.93

Table 5: Complications associated with CVC placement.

Complications associated with CVC placement.	
CVC placement	
Through the internal jugular vein	79.1% (238).

Complications associated with CVC placement.	
Jugular vein external 154 (2.2%)	54 (17.9%)
Fibula	2 (1%)
Veins of the subclavian artery	1 (1%)
CVC complications	
Caused by arterial malperforation	2 (0,79%)
Malperforations of the veins	9 (9%)
Pleurothorax	0.3 (0.3%)

Frequency of patients in each group is shown as a percent value.

DISCUSSION

The goal of this retrospective study is to evaluate if using CVCs in elective cerebral supratentorial operations gives any therapeutic benefits. A comparison of CVC and non-CVC patients was made in terms of perioperative AEs. In this retrospective study, the findings indicate that CVCs don't benefit patients clinically. In addition, they are nearly twice as likely to experience AEs as patients who do not have CVCs and are undergoing intracranial supratentorial surgeries. In neurosurgery procedures, CVC instrumentation remains a matter of contention at national and international levels. There is currently no evidence that neither refutes nor supports the existence of a benefit for patients who receive a CVC vs those who do not. An arterial catheter [13] is commonly given to patients undergoing cerebral surgery in order to guarantee adequate monitoring of their blood pressure and blood gas analyses. Since the arterial-end-tidal CO2 gradient changes considerably, they are necessary for monitoring arterial CO2 levels. However, different neurosurgical facilities use CVCs in different ways because of their disputed benefits [14]. Traditional fluid management metrics include central venous pressure. There is now a wide consensus that the central venous pressure does not reflect intravascular fluid volume. It is still common to monitor hemodynamics with CVCs, despite that. In addition to facilitating blood sampling for oxygen saturation testing, this equipment makes it easier to monitor patients with pre-existing cardiovascular problems. It may also be feasible to guide transfusions, vasoconstrictor therapy, and hydration therapy in this manner. A retrospective study of CVCs was designed to determine whether they are still an adequate and routine technique for surgical procedures of the cerebral supratentorial region. Neither the length of hospital stays nor overall ventilation times were significantly shortened by using CVCs. The induction time for patients without CVCs is shorter, and the rate of perioperative adverse events is reduced. In CVC patients, peri-operative adverse events are at a higher rate for unknown reasons. It's most likely a combination of factors. To avoid imbalances in research groups based on patient characteristics, no propensity score pair-matching was applied. Instead, we utilised a single regression model modified for several patient factors to estimate the odds ratio with greater precision and less bias. Despite that, there could have been other factors / features that could have played a role in the occurrence of AEs in the cohorts that were not accounted for in the regression model. The disadvantages of central venous lines are evident in the fact that patients with CVCs are twice as likely to experience adverse events as patients without CVCs. A higher rate of bleeding problems, repeated venous punctures, and pneumothorax was observed in the CVC group as well. A longer time of anaesthesia induction and ventilation was also observed for patients with CVCs, showing the additional disadvantages of this condition. Pre-existing cardiovascular and respiratory problems did not differ significantly between the groups. The data analysis was changed to reflect the imbalance in ASA classification between the two groups despite the fact that there were differences between the two groups. If a patient has a glial or meningeal tumour without significant cardiovascular or pulmonary illnesses, they are usually categorized as ASA III since neoplastic conditions are considered "severe systemic diseases." In this circumstance, the presence or absence of systemic cardiopulmonary illnesses has no bearing on the patient's ASA score. Hospitals and doctors might only consider CVC implantation as a relative indication if the ASA score is high (III or higher) or the surgical process is difficult. CVC installation in neurosurgical patients should not be based solely on ASA scores, which are derived mainly from diagnoses of intracranial neurooncology. This is according to the authors of the article. In patients without significant pre-existing cardiovascular problems, peripheral venous lines may be used to administer anesthetics and modest catecholamine doses, regardless of their ASA score. They also have the added benefit of a less invasive device compared to those who receive CVCs. Patients who do not have severe cardiopulmonary pre-existing conditions or who have uneventful intra- and/or post-operative outcomes typically do not need extensive hemodynamic monitoring, such as central venous oxygen saturation (a surrogate parameter for mixed venous oxygen saturation [21] or parenteral nutrition. A CVC installation must be

justified clinically in order to avoid unnecessary risks and complications in today's world, where minimally invasive surgery and overnight ICU stays are frequent practices. Instead of central venous lines, opt for less invasive new approaches that use new instruments. [10] The non-CVC group had two single deaths during the study period. In light of their adverse outcomes and postoperative outcomes, it is most likely that these deaths were not related to lack of CVC instrumentation. Patient 1 had significant brain damage caused by hypoxic ischemic hypoxia. An unproblematic extubation in the ICU followed the straightforward procedure of the second patient. He was pronounced brain dead, most likely because of an increased intracranial pressure. CVCs were inserted in both patients following surgery to aid them through their therapy. The implementation of CVC in complex and challenging patients appears to have a clinical benefit, therefore. It is not appropriate to use it on all patients. For this type of surgical instrumentation, specific indications are needed, though the use of the instrumentation should be individualized, based on a patient's characteristics and other relevant information. There are some drawbacks to this study. As a result of the retrospective study design, the study could not identify important aspects such as peri-operative blood pressure variations. Because changing catecholamine dosage via a peripheral line is slower than changing dosage through a central line, this parameter could have been greater in the non-CVC group. The patients would benefit from consistent and steady blood pressure, so this could be a substantial disadvantage. An analysis of this key characteristic is necessary based on a prospective study. In addition to the confounders that were controlled for, there may be additional confounders due to the retrospective nature of this analysis, such as the diversity of intracranial pathology and the diverse areas of expertise among surgeons. There may have been an impact on multiple peri-operative criteria that determine the risk of AEs. Furthermore, this study was a retrospective analysis. This investigation's results should be viewed with caution due to its design. It would be ideal if we could carry out a cross-over research study through randomised prospective design.

CONCLUSIONS

Elective supratentorial neurosurgery cannot be benefited by CVC use, and our study indicates that CVC usage may even present risks due to adverse events. Patients and cases should be considered individually when deciding whether to insert CVCs.

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Cite this article:
Studies On Whether Central Venous Catheters Are Beneficial During Elective Brain Surgery. *American Journal of Oral Medicine and Radiology*, 2022, 9(1), 1-7.

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