Factors influencing the need for post operative ventilation in patients with aneurysmal subarachnoid hemorrhage

Sandeep Bohara[1], Amit Thapa[2]
[1,2]Kathmandu Medical College Teaching Hospital (KMCTH)

Date of submission: 21st November 2022 Date of acceptance: 13th February 2023 Date of publication: 30th March 2023

Abstract

Introduction: Patients with aneurysmal subarachnoid hemorrhage (aSAH) frequently require monitoring, however planned ventilatory support may not be necessary in the post-operative period. In resource constraints scenarios, reserving an intensive care unit (ICU) bed and ventilator may lead to problems like delay in surgery and definite care. With this study, we aim to identify the factors that influence the need for post-operative ventilation in patients with aSAH.

Methods and Materials: A retrospective study over a period of six years of patients who underwent surgical clipping of aneurysm and were not intubated pre-operatively was conducted. Aneurysm was confirmed by Digital Subtraction Angiography (DSA) or Computerized Tomographic Angiography (CTA). Demographic data and clinico-radiological factors like Hunt and Hess grade, Modified Fischers Grade and aneurysm location were collected.

Results: Of the 62 patients identified in the study period, 17 patients were excluded as they were intubated in the preoperative period. Of the 45 patients included, there were 15 male patients. Of these only 23 (51.11%) patients failed to be successfully extubated. Clinical factors such as Hunt and Hess score ≥ 3 (p value<0.001), WFNS grade ≥ 3 (p value<0.001) and intraoperative blood loss ≥ 425 ml (p value=0.001) were associated with higher chances of failure to extubate. Presenting GCS score of ≥ 14 (p value<0.001) had higher chances of extubation postoperatively. However, radiological factors like Modified Fischers Grade and aneurysm location had no significant association.

Conclusion: The demand for post-operative ICU and ventilatory support in aneurysmal SAH is over estimated. Simple clinical factors can better predict the need for post-operative ventilation and reduce the burden of reserving ICU bed.

Key words: Aneurysm, Clipping, Subarachnoid Haemorrhage, Ventilation

Access this article online
Website: https://www.nepjol.info/index.php/NJN
DOI: https://doi.org/10.3126/njn.v20i1.49698
HOW TO CITE
Bohara S, Thapa A. Factors influencing the need for post operative ventilation in patients with aneurysmal subarachnoid hemorrhage. NJNS. 2023;20(1):63-67.

Address for correspondence:
Sandeep Bohara
Kathmandu Medical College Teaching Hospital (KMCTH)
Sinamangal-9, Kathmandu
Tel: +977 9841221577
Fax: +97714477921
E-mail: sandeepbohara@gmail.com

ISSN: 1813-1948 (Print), 1813-1956 (Online)

Introduction

Patients with aneurysmal subarachnoid haemorrhage (aSAH) frequently require monitoring and ventilatory support. This is more often required in the post-operative period in patients with poorer grades. The numbers of specialized ICUs such as neurosurgery ICU are limited in most developing countries.[1,2] Most of the hospitals in the developing countries like ours rely on a central ICU that caters to all surgical and medical sub-specialties.[3,4] Patients with aSAH are often admitted to ICU and are cared for by a multidisciplinary team consisting of intensivists and neurosurgeons. Typically, an ICU bed with standby ventilator is reserved for those patients who have been planned for craniotomy and clipping of aneurysm and this happens even for those patients who did not require ventilator in the pre-operative period.[5] Waiting for an ICU bed or standby ventilator may lead to delay in surgery and definitive care for these patients. Also, reserving beds for the duration of surgery prevent any subsequent patient who is in similar need from availing the ICU bed. In developing country like ours, this places an additional financial burden on the patient.[6] Through this study, we wanted to evaluate the frequency of post-operative ventilatory requirement in patients with aSAH and to identify predictive factors that might influence the need of post-operative ventilation in similar patients undergoing surgery.

Methods and Materials

We conducted a retrospective cohort study in our hospital over time period 2016-2021 AD. All patients who underwent microsurgical clipping of aneurysm were included in the study. Patients who were intubated in the pre-operative period due to low Glasgow Coma Scale (GCS), presence of other neurosurgical condition apart from intracranial aneurysm, presence of similar episode earlier or coiling of any intracranial aneurysm done earlier and patients who did not have required details were excluded from the study. All patients with diagnosis of intracranial aneurysm were admitted in the high care in Department of Neurosurgery. The diagnosis of SAH was based on positive findings on admission Computed Tomography (CT) scan head. Aneurysm was confirmed by Digital Subtraction Angiography (DSA) or Computerized Tomographic Angiography (CTA). The plan of management was decided by attending consultant as per department protocol. The patients who underwent surgical management with clipping of aneurysm were included in the study. Post-operatively the patients were managed as per the institutional protocol independent of the study. Demographic data in terms of age, sex, post-ictal day to surgery, comorbid conditions, duration of post-operative ventilation, duration of hospital stay and mode of admission were collected. Similarly, clinico-radiological factors such as pre-operative GCS, Hunt and Hess grade, World Federation of Neurosurgical Societies (WFNS) grade, Modified Fischer's grade and the location of aneurysm were collected. In surgical factors, information on type of surgery and intraoperative blood loss were collected. The patients were also followed up clinically with the help of modified Rankins Scale (mRS) and Glasgow Outcome Scale (GOS) at the time of discharge, one month, six months and one-year post-operative period. The data was analyzed with the help of SPSS version 21. Association between the various demographic, clinical-radiological and operative factors and the need for postoperative ventilation was determined using Spearman's correlation test. ROC curve was used to determine the cut off score of clinic-radiological factors with area under curve to determine its significance. p value< 0.05 was considered as significant. Ethical approval was taken from the institutional ethical committee.

Results

There was a total of 62 patients over a period of six years, of which 17 patients were excluded from the study as they were already intubated in the pre-operative period. 45 patients were included in the study comprising of 15 (33%) male patients and 30 (67%) female patients. The majority of the patients were in the age group of 51-60 years with 15 (33%) patients. The mean age of the population was 52.95 +/- 11.17 years with a maximum age of 80 years and minimum age of 29 years. The mean pre-operative GCS was 13 with a maximum GCS of 15 and a minimum GCS of nine. The mean duration of post-operative ventilation was 2.66 +/- 3.53 days and mean duration of overall hospital stay was 16.48 +/- 7.18 days. 22 (49%) patients were successfully extubated in the post-operative period. However, 23 (51%) patients could not be extubated in the immediate post-operative period. Of the 23 patients who required post-operative ventilation, eight (35%) patients were ventilated due to long duration of surgery, five (22%) patients on the advice of anaesthesia team, three (13%) patients had excessive intra-operative bleeding (>500 ml), three (13%) patients had intra-operative brain swelling and four (17%) patients had intra-operative blood pressure fluctuation (Figure 1).

While analysing the demographic factors, none of the factors were found to have significant association with need for post-operative ventilation. Using ROC curve, pre-operative GCS <14 (p=0.001), Hunt and Hess >=3 (p=0.001) and WFNS grade >=2 (p=0.001) were found to have significant association with the need for post-operative ventilation. With respect to surgical factors, intra-operative blood loss >=425 ml (p=0.001) was found to have significant association with the need for post-operative ventilation (Table 1).

There were six mortalities in our study of which four patients had required postoperative ventilation. Of these, one patient had anterior cerebral artery (ACA) territory infarction with septic shock. Apart from these no other neurological related death was seen.

We also tried to define the association between post-operative ventilatory requirement and outcome of patient as measured with mRS and GOS score. Nominal by interval with Eta value statistical tool was used. Moderately significant association between the post-operative ventilatory requirement and functional outcome of the patient at discharge, one month, six months and one year post-operative period was seen using the mRS score. Similar association was seen when functional outcome of the patient was evaluated using GOS score in the same time period. There was strong significant association between post-operative ventilatory requirement and the total duration of ICU stay with the patients who required immediate post-operative ventilation required more duration of ICU stay (Eta value=0.947).

In the multivariate analysis of the patients intubated in the post-operative period on the anaesthesia advice for association between the pre-operative factors and the need for post-operative ventilation (Table 2), none of the pre-operative factors had significant association with need for postoperative ventilation implying that the subgroup of patients ventilated on anaesthesia advice could have actually been extubated.

However, in the subgroup of patients who were kept intubated in the post-operative period due to long duration of surgery, factors like the pre-operative GCS, Hunt and Hess score and intra-operative blood loss had significant association with the need for post-operative ventilation (Table 3). Thus, implying that patients ventilated due to long duration of surgery had significant association with the preoperative factors.

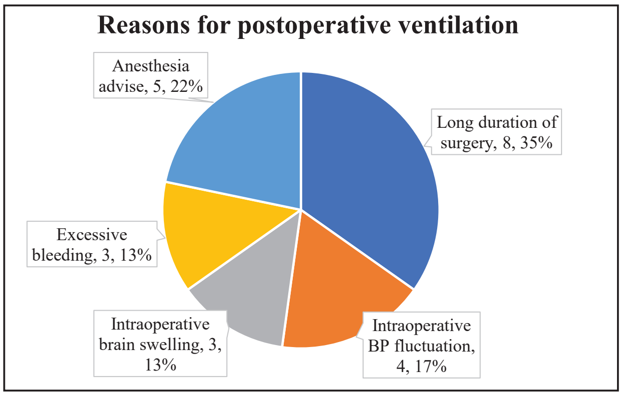

Figure 1: Reasons for need for post-operative ventilation

Variable		Patients included	Patients who failed extubation postoperatively	p value
Age	>=49	27	14 (51.85%)	0.903
	<49	18	9 (50%)	
Sex	Male	15	8 (53.33%)	0.833
	Female	30	15 (50%)	
Admission type	Emergency	39	22 (56.41%)	0.07
	Elective	6	1 (16.66%)	
Comorbidity	Yes	17	10 (58.82%)	0.420
	No	28	13 (46.42%)	
Preop GCS	>=14	25	3 (12%)	0.001
	<14	20	20 (100%)	
Hunt and Hess Score	>=3	20	16 (80%)	0.001
	<3	25	7 (28%)	
WFNS Grade	>=2	28	22 (78.57%)	0.001
	<2	17	1 (5.88%)	
Intraoperative blood loss	>=425 ml	24	18 (75%)	0.001
	<425 ml	21	5 (23.8%)	

Table 1: Demographic, clinical and intraoperative factors and its association with the need for postoperative ventilation

S. No.	Variable	No of patients	Chi square coefficient	p value
1	Preop GCS	5	0.958	0.328
2	Hunt and Hess Score	5	2.795	0.095
3	WFNS Score	5	0.29	0.590
4	Intraoperative blood loss	3	1.252	0.263

Table 2: Multivariate analysis: Association between the factors and reason for postoperative ventilation (Anaesthesia advice)

S. No.	Variable	No of patients	Chi square coefficient	p value
1	Preop GCS	5	6.46	0.011
2	Hunt and Hess Score	1	18.86	0.0001
3	WFNS Score	7	1.96	0.161
4	Intraoperative blood loss	6	16.66	0.002

Table 3: Multivariate analysis: Association between the factors and reason for postoperative ventilation (Long duration of surgery)

Discussion

Hospitals in developing countries like ours have limited number of ICU beds and ventilator primarily due to lack of funds.[7-9] Most of these institutions do not have dedicated intensive care unit for neurosurgery. Many surgeries are delayed due to non-availability of ICU bed or ventilator. In these settings, acquiring or reserving a bed in the ICU for a patient requiring surgical clipping can at times take days leading to delay in definitive care. In addition, there is risk of re-bleed, morbidity and/or mortality. Alternatively, these patients may need to be transferred to another hospital which carries its own risks in addition to the loss of valuable time.[10–12] Forty nine percent of the patients in our study did not require ventilator in the postoperative period, but all patients had ventilator reserved prior to surgery which shows the overuse of this process. In these settings, preoperative factors that predict the need for ventilator in post operative period may help to reduce the overestimate of ICU bed and ventilator, thus avoiding the delay in surgery.

Level of consciousness is a good prognostic factor in determining the outcome of patient.[13–15] Our study showed that the clinical factors like preop GCS, Hunt and Hess score and WFNS score were good predictors for the need of ventilator postoperatively. Siddiqui U et al also showed similar result with Hunt and Hess grade ≥ 4 and WFNS score ≥ 4 predicting the need for ventilator.[5] Rosengart et al have shown the association of high Fisher grade with a statistically compelling risk for extubation failure, whereas aneurysmal size and location did not have any significant effect in their study.[16] Whereas, Siddiqui U et al have found the risk of extubation failure high in patients with Acom/ACA aneurysm. However, in our study, the factors like state of rupture of aneurysm, modified Fischer's grade and location of aneurysm did not show significant association with need for postoperative ventilation.

In regards to surgical factors, our study found the risk of extubation failure in patients with high blood loss (>=425 ml) (p value=0.001). Post ictal day of surgery and type of surgery had no significant association with need for postoperative ventilation in our study. Various studies in literature have shown surgical factors like the volume of blood loss, brain retraction and the duration of surgery to negatively affect outcome in aSAH patients.[17–20] These patients may need postoperative ventilation.

In our study, five patients were not extubated in the postoperative period on advice of anesthesia. In the multivariate analysis for association between factors and reason for ventilation (anesthesia advice), none of the factors had significant association with the need for postoperative ventilation. So, we can conclude that this subgroup of patients ventilated on advice of anesthesia could actually have been extubated based on the factors mentioned above. Similarly, in another multivariate analysis for association between the factors and postoperative ventilation due to long duration of surgery (> 5 hours), factors such as preoperative GCS, Hunt and Hess score and intraoperative blood loss had significant association. We can thus say that the reason for postoperative ventilation was justified in this subgroup of patients.

We also followed the patients with mRS and GOS score at discharge, one month, six months and one year postoperative period. Moderately significant association was found between the postoperative ventilatory requirement and functional outcome of patients at all time periods as evaluated by mRS and GOS score.

This study has some limitations. Firstly, it is a retrospective study from a single institution. Thus, important confounders relevant to the results may have been missed. Therefore, future studies involving larger population are needed to validate the generalizability of our results. Secondly, angiographic vasospasm was not taken into account which would have an impact in the postoperative course of the patient. However, this study is the first of its kind in Nepal. This study helps to avoid the overestimate of requirement of ICU bed and ventilators for aneurysm clipping patients in developing countries like ours. It sets the precedence for more studies pertaining to this and for further prospective multicenter study.

Conclusion

The demand for post-operative ICU and ventilatory support in aneurysmal SAH is over estimated. Simple clinical and surgical factors can better predict the need for post-operative ventilation and reduce the burden of reserving ICU bed and ventilator.

Acknowledgement

We would like to thank all the people who have directly or indirectly helped us in preparation of this article. We would also like to thank all our patients for their valuable support.

References

1. Kimura M, Koizumi MS, Martins LM. [Characteristics of intensive care units in Sao Paulo]. Rev Esc Enferm USP. 1997 Aug;31(2):304-15. https://doi.org/10.1590/S0080-62341997000200011
2. Degoricija V, Sefer S, Kujundzić-Tiljak M, Gjurasin M. Intensive care units in Croatia: 2001 survey. Croat Med J. 2002 Dec;43(6):713-21.
3. Jayaram R, Ramakrishnan N. Cost of intensive care in India. Indian J Crit Care Med [Internet]. 2008 [cited

2022 Oct 18];12(2):55-61. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2738307/ https://doi.org/10.4103/0972-5229.42558

4. Acharya SP. Critical care medicine in Nepal: where are we? International Health [Internet]. 2013 Jun 1 [cited 2022 Oct 18];5(2):92-5. Available from: https://doi.org/10.1093/inthealth/iht010
5. Siddiqui U, Khan MF, Anis SB, Ahmad B, Shamim MS, Mitha R, et al. FACTORS PREDICTING NEED FOR POST-OPERATIVE VENTILATION AFTER MICROSURGICAL CLIPPING OF CEREBRAL ANEURYSMS - A MULTIVARIATE ANALYSIS. 2020;15:9.
6. Yatawatte AB, Wanniarachchi CR, Goonasekara CDA. An audit of state sector intensive care services in Sri Lanka. Ceylon Medical Journal [Internet]. 2011 Aug 15 [cited 2022 Oct 18];49(2):51-4. Available from: http://cmj.sljol.info/articles/abstract/10.4038/cmj.v49i2.3261/. https://doi.org/10.4038/cmj.v49i2.3261
7. Grenvik A, Pinsky MR. Evolution of the intensive care unit as a clinical center and critical care medicine as a discipline. Crit Care Clin. 2009 Jan;25(1):239-50, x. https://doi.org/10.1016/j.ccc.2008.11.001
8. Dünser MW, Bataar O, Tsenddorj G, Lundeg G, Torgersen C, Romand JA, et al. Differences in critical care practice between an industrialized and a developing country. Wien Klin Wochenschr. 2008;120(19-20):600-7. https://doi.org/10.1007/s00508-008-1064-8
9. Adhikari NK, Fowler RA, Bhagwanjee S, Rubenfeld GD. Critical care and the global burden of critical illness in adults. Lancet [Internet]. 2010 [cited 2022 Nov 17];376(9749):1339-46. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7136988/ https://doi.org/10.1016/S0140-6736(10)60446-1
10. Naidech AM, Janjua N, Kreiter KT, Ostapkovich ND, Fitzsimmons BF, Parra A, et al. Predictors and impact of aneurysm rebleeding after subarachnoid hemorrhage. Arch Neurol. 2005 Mar;62(3):410-6. https://doi.org/10.1001/archneur.62.3.410
11. Inagawa T, Kamiya K, Ogasawara H, Yano T. Rebleeding of ruptured intracranial aneurysms in the acute stage. Surg Neurol. 1987 Aug;28(2):93-9. https://doi.org/10.1016/0090-3019(87)90079-6
12. Okazaki T, Kuroda Y. Aneurysmal subarachnoid hemorrhage: intensive care for improving neurological outcome. j intensive care [Internet]. 2018 Dec [cited 2022 Nov 17];6(1):1-8. Available from: https://jintensivecare.biomedcentral.com/articles/10.1186/s40560-018-0297-5 https://doi.org/10.1186/s40560-018-0297-5
13. Deruty R, Pelissou-Guyotat I, Mottolese C, Amat D, Bognar L. Level of consciousness and age as prognostic factors in aneurysmal SAH. Acta Neurochir (Wien). 1995;132(1-3):1-8. https://doi.org/10.1007/BF01404840
14. Hernesniemi J, Vapalahti M, Niskanen M, Tapaninaho A, Kari A, Luukkonen M, et al. One-year outcome in early aneurysm surgery: a 14 years experience. Acta neurochir [Internet]. 1993 Mar 1 [cited 2022 Nov 17];122(1):1-10. Available from: https://doi.org/10.1007/BF01446980 https://doi.org/10.1007/BF01446980
15. Gerber CJ, Lang DA, Neil-Dwyer G, Smith PW. A simple scoring system for accurate prediction of outcome within four days of a subarachnoid haemorrhage. Acta Neurochir (Wien). 1993;122(1-2):11-22. https://doi.org/10.1007/BF01446981
16. Rosengart AJ, Schultheiss KE, Tolentino J, Macdonald RL. Prognostic factors for outcome in patients with aneurysmal subarachnoid hemorrhage. Stroke. 2007 Aug;38(8):2315-21. https://doi.org/10.1161/STROKEAHA.107.484360
17. Doi K, Kawano T, Morioka Y, Fujita Y, Nishimura M. Various irrigation fluids affect postoperative brain edema and cellular damage during experimental neurosurgery in rats. Surg Neurol. 2006 Dec;66(6):565-71; discussion 571-572. https://doi.org/10.1016/j.surneu.2006.06.058
18. Yundt KD, Grubb RL, Diringer MN, Powers WJ. Cerebral hemodynamic and metabolic changes caused by brain retraction after aneurysmal subarachnoid hemorrhage. Neurosurgery. 1997 Mar;40(3):442-50; discussion 450-451. https://doi.org/10.1097/00006123-199703000-00003
19. Shimizu H, Inoue T, Fujimura M, Saito A, Tominaga T. Cerebral Blood Flow After Surgery for Unruptured Cerebral Aneurysms: Effects of Surgical Manipulation and Irrigation Fluid. Neurosurgery [Internet]. 2011 Sep [cited 2022 Nov 8];69(3):677-88. Available from: https://journals.lww.com/neurosurgery/Abstract/2011/09000/Cerebral_Blood_Flow_After_Surgery_for_Unruptured.17.aspx https://doi.org/10.1227/NEU.0b013e3182195509
20. Deogaonkar A, De Georgia M, Mascha E, Todd M, Schubert A, Investigators and the I. Intraoperative Blood Loss is Associated with Worse Outcome after Aneurysmal Subarachnoid Hemorrhage. Journal of Neurosurgical Anesthesiology [Internet]. 2006 Oct [cited 2022 Nov 8];18(4):302-3. Available from: https://journals.lww.com/jnsa/Citation/2006/10000/Intraoperative_Blood_Loss_is_Associated_with_Worse.70.aspx https://doi.org/10.1097/00008506-200610000-00073