Outcome of aneurysmal subarachnoid hemorrhage using Ogilvy and Carter grading system after clipping
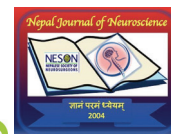
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Abstract

Aneurysmal subarachnoid hemorrhage is a major cause of death and disability. Scales that have been used to prognosticate patients with subarachnoid hemorrhage are Hunt and Hess scale, World Federation of Neurosurgical Societies scale, Fischer grading system. But these scales aren't inclusive enough to account for all factors related with prognosis of the disease. So Ogilvy and Carter scale has been developed to account for all of these factors.

This study has been done to evaluate the effectiveness of Ogilvy and Carter Score in prognosticating patients with aneurysmal subarachnoid hemorrhage. This is a prospective analytical study conducted at National Academy of Medical Sciences, National Neurosurgical Referral Center, Bir Hospital, Kathmandu, Nepal.

Fifty patients with aneurysmal subarachnoid hemorrhage were included. Hunt and Hess score 1-3 is independently associated with favourable GOS. (p value- 0.000013). Aneurysm size less than or equal to 10 mm is independently associated with favourable GOS. (p value-0.003575). Similarly age less than 50 years was independently associated with favourable GOS. (p value- 0.01354). The incidence of vasospasm, hydrocephalus, electrolyte imbalance, myocardial infarction and pulmonary edema were higher in patients with Hunt and Hess score > 2, aneurysm size > 10 mm, age >50 years and Fischer score >2. Higher Ogilvy and carter score was associated with unfavourable GOS at 6 months (p value- 0.002).

In conclusion Ogilvy and Carter scale can serve as a useful for prognosticating patients with aneurysmal subarachnoid hemorrhage.

Key words: Ogilvy Carter score, Subarachnoid hemorrhage, Prognosis

Introduction

Aneurysmal subarachnoid hemorrhage (aSAH) is a serious neurosurgical condition. About 6-8% of all strokes are caused by SAH from ruptured berry aneurysms.[1] Approximately 50% of patients suffering from aSAH will die, 15% of them will become severely disabled, and only 20–35% will return to normal life and activities.[2]

The history, physical examination, computed tomography (CT) scan without contrast, lumbar puncture, CT angiography (CTA) of the brain can rule out SAH with greater than 99% sensitivity.[3] Current treatment recommendations involve management in an intensive care unit setting followed by either endovascular coiling or surgical clipping. The blood pressure is maintained with consideration of the patient's neurologic status, and additional medical management is directed towards the prevention and treatment of complications.[4] Surgical treatment to prevent rebleeding consists of clipping the ruptured berry aneurysm. Endovascular treatment is an increasingly practiced alternative to surgical clipping.[5]

Various grading systems have been described to predict the morbidity and mortality in a patient with ruptured aneurysmal subarachnoid hemorrhage.[6] The most commonly used systems in clinical setting are the Hunt and Hess scale, World Federation of Neurosurgical Societies (WFNS) scale and Fischer scale. But all these scales have different pros and cons. Taken individually they are unable to predict the outcomes in patients with aSAH.[6] Ogilvy and Carter score is another grading system

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which combines different important features of each of the above mentioned scores and tries to be a holistic system for grading patients with aSAH. So it could serve as a more useful grading score. [7]

Aneurysmal SAH is a common condition managed by the department of neurosurgery, National neurological referral center, National Academy of Medical Sciences, Bir Hospital. WFNS, Hunt and Hess and Fischer's scale are commonly used at the center also. But there has been no study regarding the usefulness of Ogilvy and Carter system in our patient population. This study will try to assess the usefulness of this score in our patients with ruptured aSAH.

Grade is determined by the sum of points: grade 5 has the worst prognosis and 0 has the best prognosis.[7]

Methodology

This was a prospective observational study conducted at the Department of Neurosurgery, National Neurosurgical Referral Center, Bir Hospital. Approval was taken from the Institutional Review Board, National Academy of Medical Sciences.

The general objective of this study was to predict the outcome of aneurysmal subarachnoid hemorrhage using Ogilvy and Carter grading system and the specific objectives were to correlate Ogilvy and Carter grading system with outcome of patients with aneurysmal subarachnoid hemorrhage, to compare Ogilvy and Carter grading system with Hunt and Hess grading system, WFNS score and Fischer Score for predicting outcome of patients with aneurysmal subarachnoid hemorrhage. The inclusion criteria were diagnosis of aSAH and cerebral aneurysms established by a CT angiography, patient age > 18 years. The exclusion criteria were concomitant or recent acute myocardial infarction, recent surgery (≤30 days) prior to the event, unruptured cerebral aneurysm

Age, sex, duration of symptoms, other demographic data, personal history including smoking, hypertension and drug abuse, associated systemic diseases as hypertension or diabetes mellitus, Hunt & Hess grade, Fischer grade, WFNS grade at admission were noted in a prospective database. Patients' diagnosis was done using a standard protocol of history, examination, non contrast computed tomography, CTA, Digital subtraction angiography in selected cases. Ogilvy and Carter score was calculated based upon the Hunt and Hess, Fischer score, patient's age, aneurysm size and location of aneurysm. Sample size calculated was 50.

A uniform management protocol was followed for all patients, which included intensive care unit admission, urinary bladder catheterization, placement of arterial line and central venous line, intubation in patients with poor GCS, baseline fluid intake of 40 ml/kg/day, tablet Nimodipine 60 mg 4 hourly orally or through nasogastric tube, laxative use, cardiovascular monitoring, and maintenance electrolyte homeostasis. Antiepileptic medications was used only in patients with documented seizure.

Patients underwent craniotomy and microsurgical clipping as treatment of choice in our center. Good grade patients were taken up for clipping within 72 hours of ictus if they presented early. Poor grade and the patients who present after 72 hours of ictus were stabilized and subsequently underwent surgery after 10 days when the vasospasm settled and the clinical grade of the patient improved. Besides placement of external ventricular drain was done in patients with hydrocephalus.

All patients undergoing surgery had intraoperative indocyanine green examination for confirming the obliteration of aneurysm and patency of major vessels. Post operatively patients were managed in intensive care unit and subsequently transferred to ward. Non contrast CT head was done on the first post operative day. Complications such as electrolyte imbalance, hydrocephalus, vasospasm were monitored. Nimodipine was continued for 21 days post operatively.

Postoperatively patients underwent cerebral CT angiography at first follow up. New Neurological Deficits (NND), not due to other causes based on clinico-radiological findings were used as a surrogate measure of clinical vasospasm.

Patients undergoing surgery who develop NND without radiological evidence of infarcts were put on hypertension and hemodilution therapy. The patients would be started on enteral feeds within 24 hours of surgery. The enteral feeding was continued irrespective of NND as long as the alimentary function was good. The outcome assessment included development of NND, new infarcts in imaging after presentation (irrespective of NND), Glasgow Outcome Scale at discharge and mortality. Favorable neurological outcome were defined as GOS 1-3 and unfavorable outcome as GOS 4-5.

Interim analysis of data was performed every 3 months. Final data analysis was done upon completion of the study. The data were entered into the computer using SPSS v 22 and Microsoft Excel software. Frequency and percentage distribution were used to analyze the demographic data of patients with aneurysmal SAH. Results were presented in tables, graphs and diagrams. Chi square test was used for categorical data.

Results

Fifty patients with aneurysmal subarachnoid hemorrhage were included in the study. They were managed with surgical clipping. Age group 51-60 had the largest number of patients 20 (40%) followed by 61- 70

(n-15, 30%). The number of females were 35 (70%) and the number of males were 15 (30%). The most common locations of aneurysms were middle cerebral artery (18/36 %), anterior communicating artery (16/32 %), Internal cerebral artery/posterior communicating artery (14/28 %) followed by distal anterior cerebral artery (2/4 %). The number of smokers were 40 (80%) and non smokers were 10 (20%). Forty two (84%) of patients were hypertensive. 24(53%) of patients consumed alcohol. 7 (12%) of patients had multiple aneurysms. 34 (68%) of patients presented within 1-3 days of ictus. Twenty seven (54 %) of patients presented with Hunt and Hess Score 1, 13 (26%) of patients presented with Hunt and Hess score 2. Forty (80 %) patients had Fischer score 3. Multiple aneurysms were present in 6 (12 %) of patients. Thirty three (66 %) of patients presented within ictal days 1-3 and 12 (24 %) of patients presented within ictal days 4-10.

Hunt and Hess score 1-3 is independently associated with favourable GOS. (p value- 0.000013). Aneurysm size less than or equal to 10 mm is independently associated with favourable GOS. (p value-0.003575). Similarly age less than 50 years was independently associated with favourable GOS. (p value- 0.01354). The incidence of vasospasm, hydrocephalus, electrolyte imbalance, myocardial infaraction and pulmonary edema were higher in patients with Hunt and Hess score > 2, aneurysm size > 10 mm, age >50 years and Fischer score >2.

Higher Ogilvy and carter score was associated with unfavourable GOS at 6 months (p value- 0.002).

Description	Points
Hunt and Hess grade >3	1
Fischer score >2	1
Aneurysm size > 10 mm	1
Patient age > 50 year	1
Giant (≥25 mm) posterior circulation lesion	1

Table 1: Ogilvy and Carter Combination Scale

		GOS favourable	GOS unfavourable	Vaso-spasm	Electrolyte imbalance	hydrocephalus	Pulmonary edema	Myocardial infarction	Clinical significance
Hunt and Hess grade < or equal to 3	40	35	5	3	3	6	2	2	P value- 0.000013
Hunt and Hess grade >3	10	2	8	6	2	4	3	3	
Fischer score >2	50	37	13	9	5	10	5	5	Not applicable
Fischer score <2	0								
Aneurysm size < or equal to 10 mm	21	20	1	2	2	4	1	1	P value = 0.003575
Aneurysm size > 10 mm	29	17	12	5	3	6	4	4	
Patient age <50 year	16	14	2	1	0	2	0	0	P value- 0.01354
Patient age >50 year	34	23	11	8	5	8	5	5	

Table 2: Various components of Ogilvy and Carter Score and complications of aneurysmal subarachnoid hemorrhage

	Number	GOS favourable	GOS unfavourable	Significance
Oglivy carter score 0-2	31	29	2	
Ogilvy carter score 3	10	5	5	P value- 0.002
Ogilvy carter score 4	9	3	6	

Table 3: Ogilvy and Carter Score and GOS

DISCUSSION

Multiple grading systems have been described to assess the outcomes of patients with ruptured aneurysmal subarachnoid hemorrhage. These include Hunt and Hess system, Fischer system, WFNS system. All these systems aren't comprehensive enough to predict the outcomes. These systems have pros and cons.

Ogilvy and Carter developed this system to address these factors. It considers clinical as well as other factors which impact the outcome of ruptured aneurysmal subarachnoid hemorrhage.

This study evaluated the usefulness of Ogilvy Carter in patients with aneurysmal subarachnoid hemorrhage at NNRC, NAMS, Bir hospital.

In the original article by Ogilvy and Carter published in neurosurgery in 1998, patient and lesion specific factors suspected to be associated with outcome in aneurysm operation were included. Factors included were Hunt and Hess score, Fischer score, age, aneurysm size and location of aneurysm in posterior circulation. They concluded that each of these scores were independently and strongly associated with outcome at 1 year. It was concluded that the new grading system is easy to apply and comprehensive.

This study also showed individual correlation between Hunt and Hess grade, Fischer score, age, aneurysm size with the outcome. Hunt and Hess score 1-3 was independently associated with favourable GOS. (p value- 0.000013). Aneurysm size less than or equal to 10 mm was independently associated with favourable GOS. (p value-0.003575). Similarly age less than 50 years was independently associated with favourable GOS. (p value- 0.01354). The incidence of vasospasm, hydrocephalus, electrolyte imbalance, myocardial infaraction and pulmonary edema were higher in patients with Hunt and Hess score > 2, aneurysm size > 10 mm, age >50 years and Fischer score >2. Similarly higher Ogilvy and carter score was associated with unfavourable GOS at 6 months (p value- 0.002).

Posterior circulation aneurysm couldn't be evaluated because all the aneurysms presenting in the basilar artery were sent for endovascular treatment. This is one of the pitfalls of the study as no posterior circulation aneurysm was included.

Study published by Cavanagh et al.[12] in Journal of Neuroscience in 2002 did a critical review of grading scales used in the management of aneurysmal subarachnoid hemorrhage and found Ogilvy and Carter score to be superior to commonly used grading scales such as Hunt and Hess grading system, Fischer score, WFNS system.

Similarly a study published by Rosen et. al.[13] in 2005 regarding different grading scales used in aneurysmal subarachnoid hemorrhage showed that Ogilvy and Carter grading system is superior to other grading systems. The basic advantage of this grade was that it gave equal weight to all factors.

Similarly a study by A Lagares[14] published in 2005 showed that Ogilvy and Carter score to be superior to other systems for predicting the complications and outcome after surgical treatment of aneurysmal subarachnoid hemorrhage.

Abbreviations

Aneurysmal subarachnoid hemorrhage (aSAH)
CT angiography (CTA)
Glasgow Coma Scale (GCS)
Glasgow Outcome Scale (GOS)
New Neurological Deficits (NND)
World Federation of Neurosurgical Societies (WFNS)

Competing interest

The authors have no competing interest in publication of this article.

Limitations of the study

The major limitations of this study are a small sample size, shorter follow up duration of the patients. Besides only surgically treated patients are included in this scale which can introduce a potential bias. Another limitation is that only the initial Hunt and Hess grade was used for calculation if it improved after surgery.

Conclusion

Ogilvy and Carter score may be a useful score for predicting outcome in ruptured aneurysmal subrachnoid hemorrhage patients post surgery.

References

1. Mozaffarian D, et al. Heart disease and stroke statistics–2015.update: a report from the American Heart Association. Circulation.2015;131:e29 e322. https://doi.org/10.1161/cir.0000000000000152

2. Pritchard C, et al. Psychosocial outcomes for patients and carers after aneurysmal subarachnoid haemorrhage. Br J Neurosurg.2001;15:456-463. https://doi.org/10.1080/02688690120097679

3. van Gijn J, Rinkel GJ. Subarachnoid haemorrhage: diagnosis, causes and management. Brain. 2001;124:249-278. https://doi.org/10.1093/brain/124.2.249

4. Connolly ES, Jr, Rabinstein AA, Carhuanpoma JR, Derdeyn CP, Dion J, Higashida RT, et al. Guidelines for the management of aneurysmal subarachnoid hemorrhage: a guideline for healthcare professionals from the American Heart Association/ American Stroke Assocation. Stroke. 2012;43:1711–1737. https://doi.org/10.1161/str.0b013e3182587839

5. Molyneux AJ, Kerr RS, Yu LM, Clarke M, Sneade M, Yarnold JA, et al. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised comparison of effects on survival, dependency, seizures, rebleeding, subgroups, and aneurysm occlusion. Lancet. 2005;366:809–817. https://doi.org/10.1016/s0140-6736(05)67214-5

6. Rosen DS, Macdonald RL. Subarachnoid hemorrhage grading scales: a systematic review. Neurocritical care. 2(2):110-8. 2005. https://doi.org/10.1385/ncc:2:2:110

7. Ogilvy CS, Carter BS. A proposed comprehensive grading system to predict outcome for surgical management of intracranial aneurysms. Neurosurgery. 42(5):959-68; discussion 968-70. 1998. https://doi.org/10.1097/00006123-199805000-00001

8. Hunt WE, Kosnik EJ. Timing and perioperative care in intracranial aneurysm surgery. Clin Neurosurg 1974;21:79–89 https://doi.org/10.1093/neurosurgery/21.cn_suppl_1.79

9. Clinical grading and outcome after early surgery in aneurysmal subarachnoid hemorrhage. AUHirai S, Ono J, Yamaura A SONeurosurgery. 1996;39(3):441. https://doi.org/10.1097/00006123-199609000-00002

10. David S. Rosen, M.D., R. Loch Macdonald, M.D., Ph.D., Grading of Subarachnoid Hemorrhage: Modification of the World Federation of Neurosurgical Societies Scale on the Basis of Data for a Large Series of Patients, Neurosurgery, Volume 54, Issue 3, March 2004, Pages 566–576, https://doi.org/10.1227/01.neu.0000108862.32404.a5

11. van Smeden M, Moons KG, de Groot JA, et al. Sample size for binary logistic prediction models: Beyond events per variable criteria. Statistical Methods in Medical Research. 2019;28(8):2455-2474. https://doi.org/10.1177%2F0962280218784726

12. Cavanagh, Stephen J., and Vickie L. Gordon. "Grading scales used in the management of aneurysmal subarachnoid hemorrhage: a critical review." Journal of Neuroscience Nursing, vol. 34, no. 6, Dec. 2002, pp. 288+. Gale Academic OneFile,link.gale.com/apps/doc/A95909316/AONE?u=anon~ce978655&sid=googleScholar&xid=c9ae8ed8. Accessed 14 July 2022.

13. David S. Rosen; R. Loch MacDonald (2005). Subarachnoid hemorrhage grading scales. , 2(2), 110–118. doi:10.1385/ncc:2:2:110

14. A. Lagares; P. A. Gómez; J. F. Alen; R. D. Lobato; J. J. Rivas; R. Alday; J. Campollo; A. G. de la Camara (2005). A comparison of different grading scales for predicting outcome after subarachnoid haemorrhage., 147(1), 5–16. doi:10.1007/s00701-004-0417-y