

Surgical Management of Aneurysmal Subarachnoid Haemorrhage in the Punjab Institute of Neuroscience (PINS) Decade and Need of Shunt for Hydrocephalus

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ABSTRACT

Objective: Aneurysmal Subarachnoid Haemorrhage management is improving with the passage of time with the advancement of Microsurgery but still mortality is relatively high in the natural history of disease. The main stay of this gap is noted from the time of ictus to the time of presentation in the tertiary care centers. Management of Hydrocephalus was also studied in this study.

Material and Methods: This is a prospective study conducted at PINS LGH Lahore. We studied a total of 50 cases in a period of July 2015 to July 2017.

Results: Twenty nine (58.00%) were female and 21 (42.00%) male, the male to female ratio remained 1:1.5. The affected age group was mostly younger one in there productive years. Maximum patient were noted in 4th decade, equal incidence was seen in 5th and 6th decade of life. CT scan was done as initial investigation while CT angiogram and four vessels angiogram were used as definitive investigations. Grading of patient was done using the WFNS grade and 29 cases were found in good grades (58.00%). Maximum Aneurysm were founded at A.com artery 24 cases (45.00%) followed by 22 cases of middle cerebral artery (MCA) (41.00%). We predicted the vasospasm using the fisher grades and found 21 cases (42.00%) in Fisher Grade II, in grade III & IV there was 17 and 12 cases (24.00%) respectively. Surgical outcome of post clipping was analyzed by Glasgow outcome scale and 41 cases (82.00%) were present in Grade IV and V. We found in post-operative management that patent within older age had high chance to develop hydrocephalus and V-P shunt was required in 9 cases out of 28 in group of 55 – 65 years. While in younger group (52.00%) 20 – 49 years. 22 (19.00%) cases needed V-P shunt . relatively aggressive approach was used toward CSF diversion procedure in pre-clipping period 26% patient underwent ventriculoperitoneal V-P shunt (n+12). Triple therapy started in all the case post operatively to avoid vasospasm. Post-operative CT-scan was done on 1st post-operative day.

Conclusion: Patients in Older Age group had higher tendency to be shunt dependent 32% vs. 19%; p-value = 0.04 (Chi Sq. test) (Table 3 & 4).

Key Words: Aneurysmal Subarachnoid Haemorrhage, Clipping of aneurysm.

Abbreviations: CSF: Cerebrospinal Fluid. CT: Computed Tomography. DCI: Delayed Cerebral Ischemia. MCA: Middle Cerebral Artery.

INTRODUCTION

Management of Subarachnoid hemorrhage is still a challenge although lot of advancement has made in the treatment alogrithm. Introduction of coiling raised a debate regarding the decision about the treatment

modality.¹ Although coiling has shifted the treatment paradigm² to relatively less invasive side. Phobia of patients to get operated with open craniotomy played a role in final decision of treatment modality where the two modalities carry the equal risk and benefits. As we

know that Aneurysm difficult to clip are also difficult to coil and vice versa therefore one cannot deny the presence of competent surgical team informed and around when coiling is under process. Now in the era of Guideline³ the Surgical management started from arrival of patient to the emergency, post ictus followed by the emergency management up till definite diagnosis and then definitive treatment with clipping or coiling. Intraoperatively the better outcome is ensured with the help of advance techniques like Microsurgical dissection, Hypotensive anesthesia⁴ specially during the dissection around the aneurysm and final preparation of clipping, Hypothermia to reduced the metabolism during surgery, Use of Doppler probe⁵ to ensure per-operative patency of the distal vascular after application of clip^{6,7} to the neck of aneurysm and indocyanine green video angiography (ICG-VA) application during surgery that will help not only in the per-operative correction of the clip⁸ but also to check the complete exclusion of the aneurysm during the surgery along with clear state of the distal vasculature and perforator patency. This procedure is quiet effective and comparable to the gold standard intraoperative angiography or post-operative angiogram and help are better results. (ICG-VA) is a marvoluos tool yet. It could not totally replace the use of intra-operative angiography or post-operative angiogram.⁹ In this study we analyzed all the patients managed of Aneurysmal SAH was analyzed in Neurosurgical unit III from July 2015 to July 2017. A total no. of patient treated by clipping was 50. The basic purpose of study was to securitize that where we are standing right now regarding the management of clipping of Aneurysm in tertiary care unit of Pakistan. All the cases with Aneurysmal SAH were included. Exclusion criteria include all unruptured aneurysms, patient with WFNS grade 5 and patient with significant systemic disease, serous coagulation dysfunction, organ failure syndromic aneurysms. Drug addiction related aneurysms were also excluded from study. All the post ictus patients were admitted in Neurosurgery unit III of LGH in ICU. Initially all patients were managed conservatively followed by detail history, examination, and evaluation after stability, the patient routine investigation like CBC, CRP, ESR, RFT, PT, APTT, INR, LFT and Screening of Hepatitis was done. CT scan was obtained on arrival to see extend of bleed any evidence of developing vasospasm hydrocephalus. Patient was graded using WFNS system and then patient was prepared for surgery. Intraoperative pterional flap is made and sylvian fissure dissection is done, Aneurysm expo-

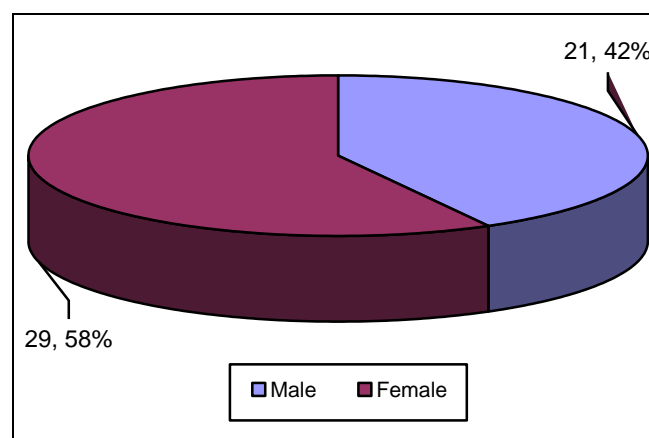
sed and definitive measure to exclude it from circulation. Patient was shifted to ICU and after 1 – 2 hrs. post-surgery shifted back to ward. Triple H therapy started in all the cases post operatively. Post-operative CT-scan was done on 1st day. Any new GCS deterioration greater than 2 was evaluated with CT brain. Suspected Delayed Cerebral Ischemia DCI was further evaluated with CTA/DSA if required. Results of all the patients were measured and presented in this paper.

MATERIAL AND METHODS

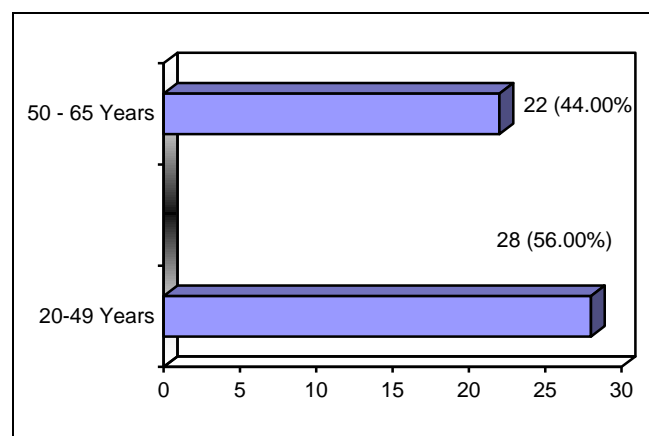
This is a prospective study conducted at PINS LGH Lahore. A total of 50 cases were recorded in a period of July 2015 to July 2017.

RESULTS

29 were female and 21 male, the male to female rate recorded 1:1.5 (Graph 1).



Graph 1: Gender Distribution.



Graph 2: Age Distribution.

This female 29.58% predominance is already proven in different institutional studies, age affected mostly was the younger age group with max patient case on 4 decay, of the equal incidence was seen in 5th and 6th decay of life. Max. Cases suffered in their productive age group (Graph 2). CT scan was done in all the cases on arrival and standard cerebral 4 vessel angiography was performed. Grading of patient was done using the WFNS grade and 26 patients (52.00%) were found in grade I, 9 patient (18.00%) were found in grade II, 11 cases (22%), was present in grade III while only 4 cases were recorded in grade IV (08.00%) (Table 1). A total of 54 aneurysms were clipped in 50 patients showing 2 cases of Multiple aneurysm (04.00%) Max. Aneurysm was founded at A.com artery 24 cases (44.44%) followed by 22 cases of MCA (40.74%), P.com artery was involved in 5

Table 1: WFNS Grades of Patients on Arrival.

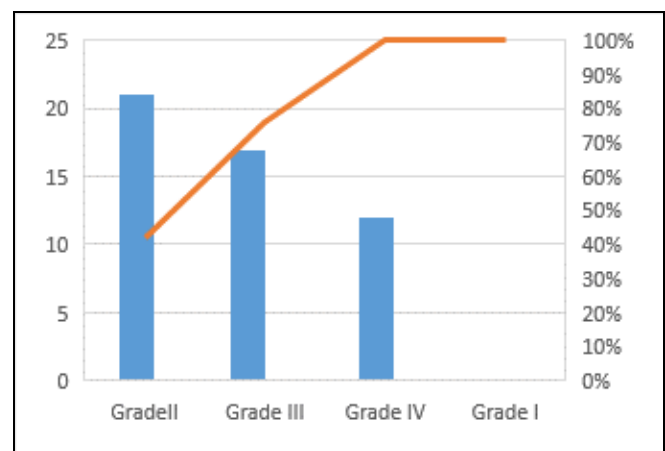
WFNS Grade	No. of Patients	Percentage
Grade I	26	52.00%
Grade II	09	18.00%
Grade III	11	22.00%
Grade IV	04	08.00%
Grade V	0	00.00%
Total	50	100.00%

cases (09.25%) and 3 cases (05.55%) of ICA bifurcation were noted (Table 2). We predicted the vasospasm using the fisher grades where we found 21 cases (42.00%) in Fisher Grade II, in grade III & IV

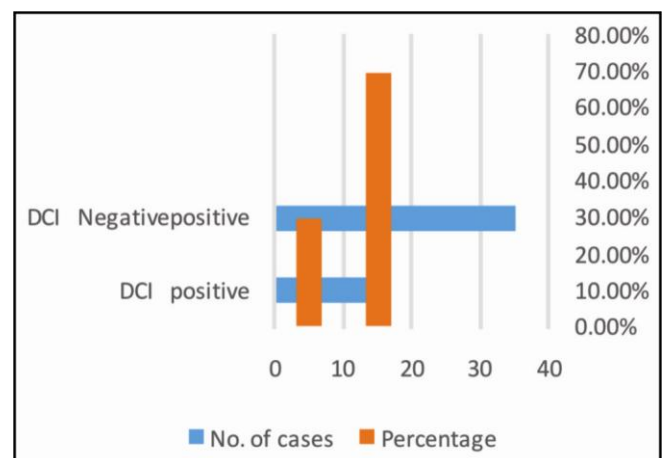
Table 2: Location of Aneurysm. Total No. of Aneurysm 54 in 50 Patients.

Aneurysm Location	No. of Patients	Percentage
A com Artery	24	45.00%
MCA	22	41.00%
P com Artery	05	08.00%
ICA bifurcation	03	05.55%
Multiple Aneurysms	02	04.00%

there was 17 (34.00%) and 12 cases (24.00%) respectively, while there was no patient in grade I (Graph 3). A total of 15 cases (30.00%) developed DCI (Graph 4). These cases are further evaluated and managed with standard measures of Triple H therapy and nimodipine. Relatively aggressive approach was used toward CSF diversion procedures and in pre-clipping period 26% patient underwent V-P shunt (n+12). Patients with poor initial grade and persistent static GCS were evaluated clinically and radiologically for any evidence of developing hydrocephalus and immediate v-p shunt was employed; the reason for this aggressive management was high EVD infection risk, scarcity of trained staff per patient in ICU and only 2 elective list per unit per week available. In our study we found that out of 13 cases that needed CSF diversion procedure 9 cases (69.23%) were related to older age group ranging from 50 years to 65 years of age while 4 cases (30.76%) were related to younger age



Graph 3: Fisher's Grade.



Graph 4: DCI in Series.

group ranging from 20 years to 49 years. This indicates that older age group. Patients in Older Age group had higher tendency to be shunt dependent 32% vs. 19%; p-value=0.04 (Chi Sq. test) (Table 3 & 4).

Table 3: *Pre-clipping VP Shunt.*

CSF Diversion	No. of Patients	Percentage
VP Shunt Inserted	13	26.00%
VP Shunt not needed	37	74.00%

Table 4: *VP Shunt and Age Distribution.*

Age Group	VP Shunt Inserted	VP Shunt Not Inserted
20 – 49 years	04 (19.00%)	18 (81.00%)
50 – 65 years	09 (32.00%)	19 (68.00%)

Surgical outcome of post clipping was analyzed by Glasgow outcome scale and 41 cases (82.00%) was present in Grade IV and V, that excellent results, while 9 cases were present in grade III and below (18.00%). (Table 5).

Table 5: *Surgical Outcome Using GOS.*

WFNS Grade at Admission	GOS \geq 4 at F/U (n = 41)	GOS \leq 3 at F/U (n = 9)
Grade I & II (n = 35)	32	3
Grade II & III (n = 15)	9	6
Total	41 (82%)	9 (18%)

DISCUSSION

Aneurysmal Subarachnoid haemorrhage is a widely studied subject in Neurosurgery still the management of this entity show a relatively high fatality rates.¹ It is a matter of fact that the advancement in neurovascular surgery has taken a giant leap in the last few decades even then the gap 2 is present some-where in the management chain that is not allowing to decrease in the mortality of the disease process as expected. The incidence of ruptured aneurysmal subarachnoid worldwide is 9/100000/year cases of a SAH, although in USA this no varies to 6-16/100000/year in different states while it reaches upto 21.8/100000/year in the study conduc-

ted in Indiana 4 that shows a quiet deviation from the international available statistics. This also denotes the effect of factors like high smoking and obesity over the disease in the region of Indiana.¹⁰ This incidence is more in female gender as compared to male and sex related variations were studied by Hamdan et.al.¹¹ And they found that a SAH is common in relatively older age group in females they further found that incidence of bilateral aneurysms, Multiple aneurysm and more frequency of distribution at ICA bifurcation and MCA was found. The lower incidence of aneurysms at AComA as compared to male was noted in this study as well. However no significant difference was found related to gender regarding risk factors, vasospasm and surgical outcome.

Miss Diagnosis of the Aneurysm may occur if the patient was seen initially in the secondary care level with minor clinical symptoms, good HHS or WFNS grade, clear CT Scan with lower Fischer's grade. These initially Misdx cases has higher rate of mortality due to rebleed although rebleeding rate is not more.¹² Grading of the a SAH haemorrhage is done with Hunt and Hess Scale or WFNS grading system is used to classify the patients. In our study we employed the WFNS grading system and categorize the grade I and grade II in good grade patients while Grade III and IV were grouped in poor grade patients. Although it is a fact that new grading system with the name of SAH score has also evolved in the literature claiming to be more accurate and comprehensive in measuring the mortality of the a SAH as compared to widely used WFNS Scale and HHS grading system.¹³ In our study 35 cases were included in good grade (70.00%), while 15 cases were found in bad grade (30.00%). Regarding location of Aneurysm and their distribution along the circle of will as there is a wide difference in range of frequency of occurrence but our study results are comparable with Roessler K.¹⁴ As Acom A 24 cases (44.44%) bears the burden at no. 1 followed by MCA 22 cases (40.74%) while the incidence of multiple aneurysm remained 2 cases (04.00%). The results of location are quiet different in Hongkong Chinese population that is more in the region of P cam artery followed by Acom artery while the incidence of multiple aneurysms remained 17% in this study by Lai-HP1, Cheng KM et.al.¹⁵ which is lower than the western population but comparable with Japanese population. Vasospasm always play an important role in the mortality and morbidity of a SAH and its prediction is possible using the Fishers grading greater the fishers grade greater the chances of developing the complicat-

ions related to vasospasm resulting in poor prognosis. The Delayed Cerebral Ischemia (DCI) is a major factor that was initially predicted by using the Fischer grades or Modified Fischer grading system but in the recent studies it is seen that DCI is even better predicted if multiple factors are considered and these factors includes age, modified Fischer grade and location of the aneurysm.¹⁶ It is also claimed that the risk stratification is even better done for DCI using the Vasogaurd score. According to study by de Oliveira Manoel AL, Jaja BN¹⁷ it is concluded that patients with Vasogaurd green score has the lowest chance to develop DCI while it is 3 fold increased in Vasogaurd Red patients. Development of DCI in our series in 15 cases (30.00%) was in accordance with the predictive value of Fischer grading system. Most of the patient arrived late in the tertiary care center and usually they are in the time period of vasospasm when reached our center therefore none of the case was operated in ultra early or early time period. Most of the cases were operated in the late intermediate or late coarse of their natural history. Prophylactic nimodipine is given to all the patients to prevent the vasospasm and it is managed¹⁸ with standard Protocol. There is no study that give us recommendation regarding the perfect timing of surgery in a SAH rather in most of the studies it is concluded that surgical outcome is not dependent on the timing of surgery rather it is more dependent upon the good grade of patient at the time of arrival in the hospital. Although some studies suggested that early surgery in bad grade patient will result in relatively better outcome¹⁹ and another study emphasize that early surgery results in short hospital stay of the patient.²⁰ Both of the studies however conclude that timing of surgery is still an unsettled issue, surgical outcome and complications are not significantly affected by the timing of surgery and main contributing factor towards the better outcome and less surgical complications are age of patient, grade of patient at time of presentation, site and size of aneurysm.^{19,20} Thirteen patients (26.00%) developed Hydrocephalus and VP Shunt was inserted prior to clipping to manage the Hydrocephalus. We remained less tolerant regarding the management of hydrocephalus keeping in view more chances of prolonged EVD getting infected prior to definitive procedure, less no. of ICU nurses and only 2 elective lists available to operate such cases. It is also observed in our study that older group was more prone to develop Hydrocephalus as compared to younger age group 32% Vs 19%. In a study by Vinas Rios JM and Sanchez-Aguilar M. et al, the predictor of developing

hydrocephalus were analyzed and they concluded the vasospasm and presence of blood in the ventricular system as the two main factors in the same study authors emphasize to insert the VP Shunt in < 7 days after ictus.²¹ Jabbarli R, Bohrer AM advocated in their study to use CHES score for early prediction of shunt dependency in patients of a SAH.²² In our study the overall surgical outcome was Good in 41 cases (82.00%) according to GOS in grade IV and V which bad outcome was noted in 8 cases (16.00%) while mortality remained 1 (02.00%). This result is comparable with international studies carried out by different workers in USA,²³ Italy²⁴ and India.²⁵ The predictor of good surgical out come and bad surgical outcome was also found to be the same as in the studies done by Pegoli M, Mandrekar J. et al²⁶ and Rahmanian A., Derakhshan N. et. al²⁷ respectively.

RECOMMENDATIONS

Where we stand? Answer of this question is to some extant is satisfactory because the modern surgical techniques are already adopted in our tertiary care centers to manage the Aneurysmal Subarachnoid Haemorrhage. Both coiling and Clipping are available and final decision about the management of the disease is made by the collective wisdom of Neurologist, Neurosurgeon and interventional radiologist. In this study we analyzed the result of surgical management only and the results are quiet promising when compared to international studies. We have further plan to equip the theater with the ICG-VA and Doppler probes in the coming future.

The main gap in our management is in the late arrival of the cases to tertiary care center. Ultra early surgery and early surgery is near to impossible in present circumstance due to lake of availability of definitive investigations and surgical equipment on emergency basis. These cases are only possible in elective list on priority basis.

Many of the patients already have started the period of vasospasm and Hydrocephalus therefore management of these entity became priority rather than direct clipping of aneurysm.

Although CT Scan are available in secondary care centers but non availability of Expertise leads to possible Misdiagnosis they may contribute to increased rate of rebleed before arriving to the tertiary care center.

Better referral system or using the modern communication methods may help the primary emergency

team available in the periphery to consult the on call consultant in the tertiary care center to get opinion and transport the patient and if emergency vascular theater are made available in future then it will be possible to perform early surgery in these cases.

Although many things are improved in the management of aneurysmal Subarachnoid Haemorrhage, there is still a lot to do to fill the gaps in the Management chain that can reduce the morbidity and mortality from this neurovascular dilemma for better outcome.

CONCLUSION

Patient is older age group had higher tendency to be shunted as compared to younger age patient whenever hydrocephalus develops, VP Shunt should be done earlier. Patients in Older Age group had higher tendency to be shunt dependent 32% vs. 19%; p-value = 0.04 (Chi Sq. test) (Table 3 & 4).

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REFERENCES

1. Li ZQ, Wang QH et al. Outcomes of endovascular coiling versus surgical clipping in the treatment of ruptured intracranial aneurysms. *J Int Med Res.* 2012; 40 (6): 2145-51.
2. Ayling OG, Ibrahim GM. Et al. Operative complications and differences in outcome after clipping and coiling of ruptured intracranial aneurysms. *J Neurosurg.* 2015 Sep; 123 (3): 621-8. (R-3).
3. Connolly ES Jr, Rabinstein AA et al. Guidelines for the management of aneurysmal subarachnoid hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke.* 2012 Jun; 43 (6): 1711-37.
4. D'Souza S. Aneurysmal Subarachnoid Hemorrhage. *J Neurosurg Anesthesiol.* 2015 Jul; 27 (3): 222-40.
5. Hui PJ, Yan YH et al. Intraoperative microvascular Doppler monitoring in intracranial aneurysm surgery. *Chin Med J (Engl).* 2013 Jul; 126 (13): 2424-9.
6. Akdemir H, Oktem IS et al. Intraoperative microvascular Doppler sonography in aneurysm surgery. *Minim Invasive Neurosurg.* 2006 Oct; 49 (5): 312-6.
7. Marchese E, Albanese A, et al. Intraoperative microvascular Doppler in intracranial aneurysm surgery. *Surg Neurol.* 2005 Apr; 63 (4): 336-42; Discussion 342.
8. Roessler K, Krawagna M, et al. Essentials in intra-operative indocyanine green video angiography assessment for intracranial aneurysm surgery: conclusions from 295 consecutively clipped aneurysms and review of the literature. *Neurosurg Focus.* 2014 Feb; 36 (2): E7.
9. Washington CW, Zipfel GJ, et al. Comparing indocyanine green video angiography to the gold standard of intraoperative digital subtraction angiography used in aneurysm surgery. *J Neurosurg.* 2013 Feb; 118 (2): 420-7.
10. Ziemba-Davis M, Bohnstedt BN, et al. Incidence, epidemiology, and treatment of aneurysmal subarachnoid hemorrhage in 12 midwest communities. *J Stroke Cerebrovasc Dis.* 2014 May-Jun; 23 (5): 1073-82.
11. Hamdan AI, Barnes J, Mitchell P. Subarachnoid hemorrhage and the female sex: analysis of risk factors, aneurysm characteristics, and outcomes. *J Neurosurg.* 2014 Dec; 121 (6): 1367-73.
12. Oh SY, Lim YC et al. Initial misdiagnosis of aneurysmal subarachnoid hemorrhage: associating factors and its prognosis. *Acta Neurochir (Wien).* 2018 Jun; 160 (6): 1105-1-12) 113.
13. Naval NS, Kowalski RG et al. The SAH Score: a comprehensive communication tool. *J Stroke Cerebrovasc Dis.* 2014 May-Jun; 23 (5): 902-9.
14. Roessler K, Cejna M, Zachenhofer I. Aneurysmatic sub-arachnoidal haemorrhage: incidence and location of small ruptured cerebral aneurysms – a retrospective population-based study. *Wien Klin Wochenschr.* 2011 Jul; 123 (13-14): 444-9. [Indexed for MEDLINE] Free full text doi: 10.1007/s00508-011-1598-z. Epub 2011 Jun 22.
15. Lai HP, Cheng KM et al. Size, location, and multiplicity of ruptured intracranial aneurysms in the Hong Kong Chinese population with subarachnoid haemorrhage. *Hong Kong Med J.* 2009 Aug; 15 (4): 262-6.
16. Lee H, Perry JJ et al. Clinical prediction of delayed cerebral ischemia in aneurysmal subarachnoid hemorrhage. *J Neurosurg.* 2018 Jun. 8: 1-8.
17. de Oliveira Manoel Jaja BN, et al. The VASOGRADE: A Simple Grading Scale for Prediction of Delayed Cerebral Ischemia after Subarachnoid Hemorrhage. *Stroke.* 2015 Jul; 46 (7): 1826-31.
18. Dusick JR, Gonzalez NR et al. Management of arterial vasospasm following aneurysmal subarachnoid hemorrhage. *Semin Neurol.* 2013 Nov; 33 (5): 488-97.
19. Nieuwkamp DJ, de Gans K et al. Timing of aneurysm surgery in subarachnoid haemorrhage - an observational study in The Netherlands. *Acta Neurochir (Wien).* 2005 Aug; 147 (8): 815-21.
20. Golchin N, Ramak Hashem SM, et al. Timing of surgery for aneurysmal subarachnoid hemorrhage. *Acta Med Iran.* 2012; 50 (5): 300-4.
21. Vinas Rios JM, Sanchez-Aguilar M et al. Predictors of hydrocephalus as a complication of non-traumatic sub-

- arachnoid hemorrhage: a retrospective observational cohort study in 107 patients. *Patient Saf Surg.* 2018 May 22; 12: 13.
22. Jabbarli R, Bohrer AM, et al. The CHES score: a simple tool for early prediction of shunt dependency after aneurysmal subarachnoid hemorrhage. *Eur J Neurol.* 2016 May; 23 (5): 912-8.
 23. Krisht AF, Gomez J, Partington S. Outcome of surgical clipping of unruptured aneurysms as it compares with 10 year non clipping survival period. *Neurosurgery*, 2006 Feb; 58 (2): 207-16; Discussion 207-16.
 24. Grasso G, Perra G. Surgical management of ruptured small cerebral aneurysm: Outcome and surgical notes. *Surg Neurol Int.* 2015 Dec. 8; 6: 185.
 25. Nayak MT, Kamath V, Outcome of intracranial aneurysm clipping: analysis of first 35 cases. *IJAM.* 2017 Feb; 2 (2): 88-93.
 26. Pegoli M, Mandrekar J et al. Predictors of excellent functional outcome in aneurysmal subarachnoid hemorrhage. *J Neurosurg.* 2015 Feb; 122 (2): 414-8.
 27. Rahmanian A, Derakhshan N, et al. Risk Factors for Unfavorable Outcome in Aneurysmal Subarachnoid Hemorrhage Revisited; Odds and Ends. *Bull Emerg Trauma.* 2018 Apr; 6 (2): 133-140.

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