SciMedCentral

JSM Neurosurgery and Spine

Short Communication

Clinical and Cost Results of Endovascular Treatment in Compar-ison with Surgery for Aneurismatic Subarachnoid Hemorrhage (Asah) in a Paired Series

Angel Horcajadas[1]*, Isabel Ortiz[2]*, Majed Katati[1], Ana Jorques[1], and Gonzalo Olivares[1]

[1]*Consultant of Neurosurgery, University Hospital Virgen de las Nieves, Spain*
[2]*Resident of Neurosurgery, University Hospital Virgen de las Nieves, Spain*

***Corresponding author**
Angel Horcajadas, Consultant of Neurosurgery, University Hospital Virgen de las Nieves, Cuesta del Pino 65, casa 29, Granada, 18008, Spain, Tel: 34653610410; Email: angel.horcajadas@gmail.com

Submitted: 28 September 2017

Accepted: 20 October 2017

Published: 23 October 2017

Keywords
- Subarachnoid hemorrhage
- Cost effectiveness
- Coil
- Brain aneurysm

Abstract

Object: To evaluate the clinical and angiographic results as well as the costs of surgical treatment against endo-vascular treatment in a SAH in a paired series of patients.

Methods: A retrospective study of a series of 78 SAH patients treated endovascularly (EV) or surgically (SC) and paired according to age, Hunt-Hess scale at admission, Fischer grade, aneurysm localization and follow-up time. A descriptive study was performed, as well as clinical results (Glasgow Outcome Scale, GOS, at 6 months), angiographic data (occlusion classification) and economic costs in each of the groups.

Results: The mean age was 51.4 years (25-82) with a female predominance (7:10). The mean follow-up time was 37.3 months. Glasgow Outcome Scale (GOS) at 6 months was favorable (4-5) in 69.7% of the cases (bet-ter in the SC group). The average length of stay (ALOS) was 36.3 days (slightly higher in the EV group). Complete occlusion of the aneurysm was obtained in 80.0% of the patients in SC series and 47.3% in the EV series. 18.4% of the EV patients required retreatment. Costs of the SC treatment were slightly higher than the EV costs for the first admission (0.2% higher) but EV costs are considerably higher when the costs of follow-up and retreatment were added (13.4% more). The factors that made EV treatment more expensive were the costs of embolization material and retreatment.

Conclusions: SC and EV treatment have similar clinical results; however SC treatment has greater stability and lower costs. Adequate selection of patients for treatment modality could save costs.

INTRODUCTION

A SAH is a significant cause of death and disability in patients at working-age, with an incidence of 6-12 cases per 100,000 inhabitants in the Western world [1].

Since the introduction of the coils, endovascular treatment has been gaining ground against surgical treatment in an exponential way [2]. This is mainly as a result of the publication of the ISAT study (International Subarachnoid Aneurysm Trial) in 2002 [3], where it was concluded that endovascular treatment was superior to surgical treatment for SAH, in terms of morbidity and mortality. These conclusions have been questioned in subsequent publications [1,4-6], and in fact, the results of both treatments are considered similar, with EV being less invasive but also less stable. The location and morphology of the aneurysm influence the clinical and angiographic results of each treatment, so, in general, it is difficult to attribute an advantage to one of the therapeutic modalities [6]. Retreatment rates in the EV series are around 20.0%, rates considerably greater than the surgical series (less than 1.0%), and rebleeding (even the very late ones) are more frequent in the endovascular than in the surgical series, which leads to long follow-ups. Current trends indicate a progressive increasing use of endovascular treatment, in parallel with the development of new devices and embolization materials. Indeed, an argument against endovascular treatment could be the high cost of the embolization material compared to the surgical material, and in this sense, several published works try to elucidate the cost of one treatment option over the other [7-18]. In general hospitalization related to surgical treatment is higher, but in most publications the total cost of the patient is compensated for by the high cost of embolization materials. These differences are greater when expenses related to follow-up and retreatments are included.

In the present study, two groups of patients (one endovascular and one surgical) were selected from a general series by age, clinical characteristics and follow-up time, and the results of each series were analyzed based on clinical, angiographic and cost results.

MATERIAL AND METHODS

From a series of patients diagnosed with SAH and treated surgically or endovascularly at a single center between the years 2010 and 2015, we selected paired cases based on the most important prognostic factors such as age, Hunt-Hess scale at admission and Fischer's grade (Table 1). The location of the aneurysm (anterior and posterior circulation) and its size, as well as the follow-up time were also taken into account. The election of the treatment was made on the basis of the ISAT criteria, so that the endovascular treatment was chosen if both treatments were suitable. The results measured in GOS scale at 6 months, the hospital stay (ICU and ward days), costs of treatment and retreatment (number of coils, stents, guide catheters, balloons, craniotomy, clips, etc.) and expenses related to the follow-up of these patients (routine arteriographies and MRI angiography) were evaluated. The costs of hospitalization, procedures and materials were obtained from hospital sources (Table 2). The follow-up of the surgically intervened patients differed from the embolized ones. Generally, those patients intervened for a cerebral aneurysm underwent a routine arteriography during the first admission, without requiring other standardized tests. An arteriography at 6 months and another one at 12 months were performed in embolized patients with an annual MIR angiography if the treatment was considered stable, for a minimum period of 5 years. If recanalisation was observed, patients were scheduled

Table 1: Characteristics of paired cases.

		FU	Age	G	HH	Fisher	Loc	Size
1	SC	61	54	M	1	2	ACoA	11
	EV	33	65	M	1	2	ACoA	5,5
2	SC	67	58	M	1	4	MCA	4,5
	EV	71	47	M	1	4	MCA	11,8
3	SC	71	34	M	1	2	MCA	3
	EV	76	39	M	1	2	ICA	6,6
4	SC	54	54	M	1	3	PICA	4,8
	EV	74	51	M	1	3	MCA	8
5	SC	34	58	M	1	2	MCA	3,7
	EV	74	52	M	1	2	MCA	5
6	SC	38	29	M	1	3	ICA	8
	EV	35	40	H	1	3	ACoA	4,4
7	SC	65	25	H	2	4	MCA	2
	EV	60	58	M	2	4	MCA	5
8	SC	59	40	M	2	1	PICA	8
	EV	22	36	H	2	1	ACoA	7
9	SC	54	48	H	2	1	MCA	2
	EV	74	48	M	2	1	ACoA	3
10	SC	48	48	M	2	1	ACoA	21
	EV	24	49	H	2	1	ICA	2,5
11	SC	47	53	M	2	2	MCA	3,3
	EV	20	54	M	2	2	MCA	4,3
12	SC	55	67	M	2	3	ACoA	8
	EV	45	71	H	2	3	ACoA	5
13	SC	36	37	M	2	3	MCA	3
	EV	25	26	H	2	3	MCA	3
14	SC	13	66	M	2	3	ACoA	1,9
	EV	13	53	H	2	3	ACoA	7,5
15	SC	43	43	M	2	3	PICA	3
	EV	65	38	M	2	3	CoP	5
16	SC	63	66	M	2	3	ACoA	2,5
	EV	52	69	M	2	3	MCA	4
17	SC	26	52	M	2	3	MCA	4,6
	EV	42	54	M	2	3	MCA	5,8
18	SC	7	55	H	2	4	MCA	5,5
	EV	13	56	M	2	4	ACoA	5
19	SC	59	42	M	2	4	MCA	7
	EV	12	50	H	2	4	ACoA	5
20	SC	70	32	H	2	4	ACoA	1,5
	EV	73	42	H	2	4	ACoA	18
21	SC	62	41	M	3	2	MCA	2
	EV	20	44	M	3	3	MCA	5,5
22	SC	75	52	H	3	4	MCA	9
	EV	75	59	H	3	4	ACoA	6
23	SC	75	54	M	3	4	MCA	5,8
	EV	38	63	M	3	4	MCA	4
24	SC	73	43	M	3	4	MCA	6
	EV	20	44	M	3	4	MCA	6,8
25	SC	70	77	M	3	4	MCA	10
	EV	43	78	M	3	4	ACP	5
26	SC	29	64	H	3	4	MCA	4
	EV	25	63	M	3	4	MCA	7
27	SC	25	81	M	3	4	MCA	6
	EV	63	82	H	3	4	CoP	2,5
28	SC	21	67	M	3	4	MCA	5
	EV	62	65	M	3	4	MCA	10
29	SC	34	67	M	3	4	PICA	2,5
	EV	40	65	H	3	4	ACoA	4,5
30	SC	67	45	H	4	3	MCA	10
	EV	27	50	M	4	3	ACA	4
31	SC	78	47	M	4	4	MCA	16,2
	EV	42	49	M	4	4	ICA	3
32	SC	70	52	H	4	4	MCA	4,2
	EV	69	52	M	4	4	CoP	5
33	SC	70	43	H	4	4	MCA	3
	EV	61	36	M	4	4	ACoA	13
34	SC	70	42	M	4	4	MCA	11
	EV	16	38	M	4	4	MCA	14
35	SC	55	58	H	4	4	MCA	7
	EV	37	47	M	4	4	MCA	4,2
36	SC	69	38	H	5	4	MCA	11
	EV	35	44	M	5	3	CoP	4,7
37	SC	42	51	H	5	4	MCA	5
	EV	68	57	M	5	4	MCA	18
38	SC	24	46	M	5	4	ACA	5,6
	EV	26	59	M	5	4	ACA	6,8

Abbreviations: SC: Surgical Clipping; EV: Endovascular; FU: Follow-Up; G: Gender, HH: Hunt-Hess; Loc: Location; ACoA: Anterior Communicating Artery; MCA: Middle Cerebral Artery; ICA: Internal Carotid Artery; PICA: Posteroinferior Cerebellar Artery; ACA: Anterior Cerebral Artery.

Table 2: Cost guide.

ITEM	PRICE (€)
ICU day	1.300
Ward day	650
Craniotomy *	3.600
Embolization **	1.300
Brain angiography	700
NMR angiography	600
Surgical clip	200
Coil	900
Catheter Guide	200
Balloon	1.000
Stent	5.300
Flow diverter	11.000

* Craniotomy includes costs of surgery time, human resources and materials for craniotomy, excluding clips
** Embolization includes costs of angiography, anesthesia and human resources

for a new treatment, restarting the cycle of arteriographies and NMR angiography.

RESULTS

From a series of 231 patients with SAH between 2010 and 2015, 76 paired cases were extracted (38 EV treated and 38 SC treated).

The mean age was 51.4 years (25-82) with a female predominance (7:10). At admission, 52.6% of the patients had a Hunt-Hess grade of 1 or 2 and 54.0% reached the grade 4 in the Fischer scale. In regards to location, 55.3% of the aneurysms were located on the middle cerebral artery (MCA) and 25.0% on the anterior communicant (ACoA). The mean size of the aneurysms was 6.4 mms. The mean follow-up time was 48.5 months (7-78 months), which was higher in the SC group compared to the EV group (52.1 versus 44.9 months, respectively) (Figure 1).

Intraventricular hemorrhage occurs in 46.3% of patients, more frequently in the EV group (47.1% versus 42.5%). 30.1% of SAH patients developed hydrocephalus with more cases in the EV group (33.3% versus 25,5%), difference that is not statistically significant. Most of these hydrocephalies were resolved with external drainage and only 23.2% required the implementation of a Ventriculoperitoneal shunt.

The result of the GOS scale measured at 6 months was favorable (4-5) in 69.7% of the cases, with a better outcome in the SC group than in the EV group (78.9% versus 60.5%, respectively). The mean ALOS was 34.0 days (of which 8.7 days were in the ICU), and this was slightly higher in the SC group (3.6 days more). Angiographic results (evaluated at six months in the EV group and after surgery in SC group) showed complete occlusion in 80% of the control arteriograms performed in the SC series and 47.3% in the EV series (Figure 2). 18.4% percent of EV patients required retreatment, with these aneurysms being larger in size (mean of 8.8 mm versus the average of 6.6 mm). The total average cost per patient was € 35.648, of which 93% corresponds to the initial treatment and the rest to follow-up and retreatment's.

The total expenditure was considerably higher in the EV group (24.0% higher) due to material costs and especially from expenses related to follow-up and retreatments. The cost of follow-up constituted 0.4% of total expenditure in the SC group and 6.4% of the total cost in the EV group. The retreatment's, absent in SC group, represented 5.9% of total expenditure. Although ALOS is lower in EV patients, the first hospitalization expense was similar in both groups (€33.267 in SC versus €33.209 in EV) because the cost of the embolization material made the EV procedure more expensive. Subsequently, expenses related to follow-up and retreatment increased more than € 4.500 per patient in the EV group (Figure 3).

DISCUSSION

The ISAT study was a milestone in the management of intracranial aneurysmal pathology [3]. According to results, obtained from a very large prospective multicenter study (2.143 patients), the morbimortality of the SC treatment versus the EV treatment advised the latter as the first treatment option. After its initial impact, subsequent studies [1,4-7] indicated various factors influencing the series (e.g. selection of surgeons, selection of cases, and the stratification of results). Another study (using the same series), by the same author was published 5 years later showing that the supposed advantage of EV treatment was

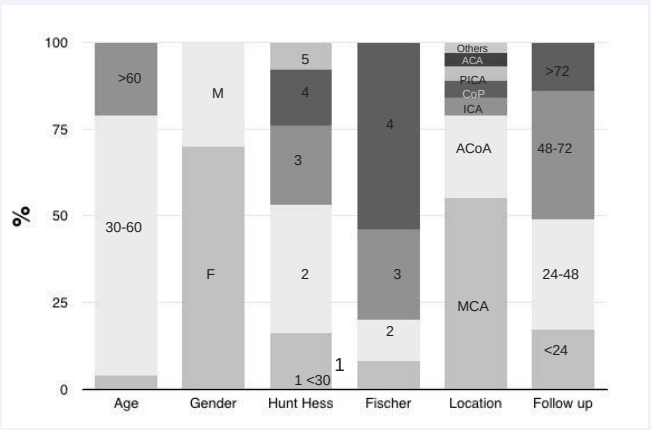

Figure 1 Characteristics of the series.

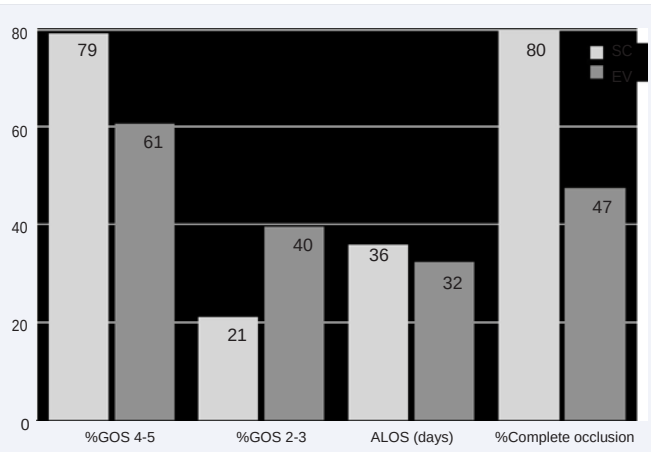

Figure 2 Results.

MEAN COSTS (€)		EV	SC
HOSPITAL STAY	Total	26.256	29.267
	ICU	10.605	11.974
	Ward	15.651	17.293
1st ADMISSION		33.209	33.267
ADMISSION AND FOLLOW UP		35.867	33.409
ADMISSION, FOLLOW UP AND RETREATMENT		37.957	33.409
PROCEDURE		6.953	4.000
PROCEDURE WITH RETREATMENT		8.718	3.810

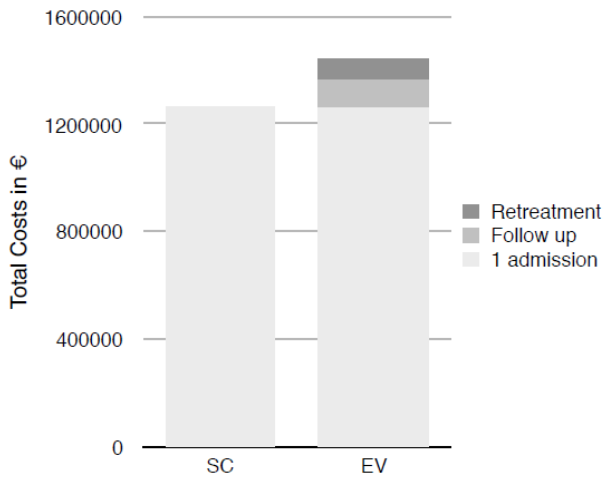

Figure 3 Average expenses.

diluted, which was mainly due to rebleeding and retreatment in the EV group [5]. Rebleeding occurs with certain frequency (0.3 - 2.0%) [3,19-21] and incomplete occlusion is a common phenomenon in EV treatments, with percentages that in the best and most populated series are around 5-20% [6,20,22,23]. Total occlusion in SC cases is more common, and Thorton [24] in a series of almost 1,400 cases reported that only 5.2% of patients did not show adequate clipping of the aneurysm. Incomplete occlusion does not imply the non-resolution of the aneurysm necessarily, but the evolution of the neck remains unpredictable, so that some may grow, some may be reduced and others may remain stable, therefore requiring a prolonged follow-up [25,26], especially when recanalisations have been described very late.

Recanalisation made retreatments relatively frequent when EV treatment is chosen [3,15,18]. Nowadays, it is possible to declare that, in terms of morbimortality, results of both techniques are similar in expert hands, especially at certain locations, for instance anterior circulation [6], with EV techniques being favored due to the less invasive procedure and the SC ones for their long-term stability. Lower stability of the EV treatment causes the follow-up of patients treated by this technique to be more tight and prolonged, with routine arteriographies and serial image tests over long periods of time. To date there is no consensus about how long these patients should be followed. In regards to the cost calculation for this therapeutic modality it is necessary to include the expenses derived from this follow-up, which involves re-admissions and invasive tests, in addition to those costs generated by the retreatments.

In the literature there are several studies that try to elucidate which of the two treatments is the most economical for broken aneurysms. Most studies do not take into account follow-up or retreatment's when calculating costs. Some works are indirect studies based on previously published series where estimations of expenditures were calculated [8,10,11,15] while others are based on patient series [7,12,13,16,18]. From reviewing the literature, it can be deduced that the costs of EV treatment are generally higher than SC treatment and in those publications which differ, costs of follow-up and retreatment are not included, and this is important to highlight as they are a significant part of the overall expenditure per patient.

The current series was selected from a previously studied global series. It had been paired according to the prognostic factors which influence the results and the ALOS such as age, Hunt-Hess scale at admission and Fischer grade.

The clinical results are better in the SC group, maybe due to the fact that most of the aneurysms were located in the anterior circulation, where results of surgical treatment are usually better.

The ALOS was 3,6 days higher in the SC group but the high cost of the embolization materials increased the expense per patient for the EV group, so that the final cost of the first admission was similar in both groups. Subsequently, follow-up costs (arteriographies and MRI angiography) and the retreatment rate increased the expenditure per patient, so that overall the EV treatment was 24.0% more expensive than the SC one. On the other hand, the clinical and angiographic results were superior in the SC group. Retreatment rate was about 18% and the size of the aneurysms that needed retreatment was bigger than those that didn't need (8,8 mms versus 6 mms). The current series has advantages over other previously published studies due to the use of paired cases, which implies that a priori, the prognostic expectations of the patients were similar and that they could have opted for either treatment indistinctly. Therefore, the differences obtained (especially those in the costs section) can be attributed exclusively to the therapeutic technique used.

The series presented also has limitations. Firstly, the series is relatively short and, data relating to clinical outcomes may not be extrapolated. In fact in the initial series of 229 patients the clinical results were similar between both the EV and SC series, with a very slight advantage for the SC group and furthermore data related to average costs are correlated with the initial series. The second limitation is that it is a retrospective study and expenditure estimated has been made using various sources and sometimes indirect methods. Finally, this study does not evaluate the differences in terms of the labor reincorporation rate which could exist between the treatments, and the so-called loss of profit, which could influence the savings generated by one technique over the other.

CONCLUSIONS

In this series, the clinical and angiographic results of the SC treatment were superior to the EV treatment, with a considerably lower cost per patient. The expenses generated by retreatment and follow-up constituted a significant percentage of the money

invested in the EV management of SAH. An adequate selection of cases for SC or EV treatment could translate into significant economic savings in the management of this pathology without changes in clinical outcomes. The number of patients is a major limitation of this study that makes difficult to extrapolate the results.

ACKNOWLEDGEMENTS

Special thanks to Manuela Expósito for her help with the statistical analysis.

REFERENCES

1. Mitchell P, Kerr R, Mendelow AD, Molyneux A. Could late rebleeding overturn the superiority of cranial aneurysm coil embolization over clip ligation seen in the International Subarachnoid Aneurysm Trial? J Neurosurg. 2008; 108: 437-442.
2. Andaluz N, Zuccarello M. Recent trends in the treatment of cerebral aneurysms: analysis of a nationwide inpatient database. J Neurosurg. 2008; 108: 1163-1169.
3. Molyneux AJ, Kerr RS, Yu LM, Clarke M, Sneade M, Yarnold JA, et al. International Subarachnoid Aneurysm Trial (ISAT) ofneurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial. Lancet. 2002; 360: 1267-1274.
4. Bakker NA, Metzemaekers JD, Groen RJ, Mooij JJ, Van Dijk JM. International subarachnoid aneurysm trial 2009: endovascular coiling of ruptured intracranial aneurysms has no significant advantage over neurosurgical clipping. Neurosurgery. 2010; 66: 961-962.
5. Molyneux AJ, Kerr RS, Birks J, Ramzi N, Yarnold J, Sneade M, et al. Risk of recurrent subarachnoid haemorrhage, death, or dependence and standardised mortality ratios after clipping or coiling of an intracranial aneurysm in the International Subarachnoid Aneurysm Trial (ISAT): long-term follow-up. Lancet Neurol. 2009; 8: 427-433.
6. Spetzler RF, McDougall CG, Zabramski JM, Albuquerque FC, Hills NK, Russin JJ, et al. The Barrow Ruptured Aneurysm Trial: 6-year results. J Neurosurg. 2015; 123: 609-617.
7. Bairstow P, Dodgson A, Linto J, Khangure M. Comparison of cost and outcome of endovascular and neurosurgical procedures in the treatment of ruptured intracranial aneurysms. Australas Radiol. 2002; 46: 249-251.
8. Brinjikji W, Kallmes DF, Lanzino G, Cloft HJ. Hospitalization costs for endovascular and surgical treatment of ruptured aneurysms in the United States are substantially higher than Medicare payments. AJNR Am J Neuroradiol. 2012; 33: 49-51.
9. Halkes PH, Wermer MJ, Rinkel GJ, Buskens E. Direct costs of surgical clipping and endovascular coiling of unruptured intracranial aneurysms. Cerebrovasc Dis. 2006; 22: 40-45.
10. Chang HW, Shin SH, Suh SH, Kim BS, Rho MH. Cost-Effectiveness Analysis of Endovascular Coiling versus Neurosurgical Clipping for Intracranial Aneurysms in Republic of Korea. Neurointervention. 2016; 11: 86-91.
11. Hoh BL, Chi YY, Dermott MA, Lipori PJ, Lewis SB. The effect of coiling versus clipping of ruptured and unruptured cerebral aneurysms on length of stay, hospital cost, hospital reimbursement, and surgeon reimbursement at the university of Florida. Neurosurgery. 2009; 64: 614-619.
12. Hoh BL, Chi YY, Lawson MF, Mocco J, Barker FG. Length of stay and total hospital charges of clipping versus coiling for ruptured and unruptured adult cerebral aneurysms in the Nationwide Inpatient Sample database 2002 to 2006. Stroke. 2010; 41: 337-342.
13. Javadpour M, Jain H, Wallace MC, Willinsky RA, ter Brugge KG, Tymianski M. Analysis of cost related to clinical and angiographic outcomes of aneurysm patients enrolled in the international subarachnoid aneurysm trial in a North American setting. Neurosurgery. 2005; 56: 886-894.
14. Koffijberg H, Buskens E, Rinkel GJ. Aneurysm occlusion in elderly patients with aneurysmal subarachnoid haemorrhage: a cost-utility analysis. J Neurol Neurosurg Psychiatry. 2011; 82: 718-727.
15. Maud A, Lakshminarayan K, Suri MF, Vazquez G, Lanzino G, Qureshi AI. Cost-effectiveness analysis of endovascular versus neurosurgical treatment for ruptured intracranial aneurysms in the United States. J Neurosurg. 2009; 110: 880-886.
16. Zubair Tahir M, Enam SA, Pervez Ali R, Bhatti A, ul Haq T. Cost-effectiveness of clipping vs coiling of intracranial aneurysms after subarachnoid hemorrhage in a developing country--a prospective study. Surg Neurol. 2009; 72: 355-360.
17. Wolstenholme J, Rivero-Arias O, Gray A, Molyneux AJ, Kerr RS, Yarnold JA, et al. Treatment pathways, resource use, and costs of endovascular coiling versus surgical clipping after aSAH. Stroke. 2008; 39: 111-119.
18. Ridwan S, Urbach H, Greschus S, Hagen J, Esche J, Bostrom A. Healthcare costs of spontaneous aneurysmal subarachnoid hemorrhage for rehabilitation, home care and in-hospital treatment for the first year. World Neurosurg. 2016; 97: 495-500.
19. CARAT Investigators. Rates of delayed rebleeding from intracranial aneurysms are low after surgical and endovascular treatment. Stroke. 2006; 37: 1437-1442.
20. Johnston SC, Dowd CF, Higashida RT, Lawton MT, Duckwiler GR, Gress DR. Predictors of rehemorrhage after treatment of ruptured intracranial aneurysms: the Cerebral Aneurysm Rerupture After Treatment (CARAT) study. Stroke. 2008; 39: 120-125.
21. Sluzewski M, van Rooij WJ, Beute GN, Nijssen PC. Late rebleeding of ruptured intracranial aneurysms treated with detachable coils. AJNR Am J Neuroradiol. 2005; 26: 2542-2549.
22. Gallas S, Pasco A, Cottier JP, Gabrillargues J, Drouineau J, Cognard C, et al. A multicenter study of 705 ruptured intracranial aneurysms treated with Guglielmi detachable coils. AJNR Am J Neuroradiol. 2005; 26: 1723-1731.
23. Murayama Y, Nien YL, Duckwiler G, Gobin YP, Jahan R, Frazee J, et al. Guglielmi detachable coil embolization of cerebral aneurysms: 11 years' experience. J Neurosurg. 2003; 98: 959-966.
24. Thornton J, Debrun GM, Aletich VA, Bashir Q, Charbel FT, Ausman J. Follow-up angiography of intracranial aneurysms treated with endovascular placement of Guglielmi detachable coils. Neurosurgery. 2002; 50: 239-249.
25. Byrne JV, Sohn MJ, Molyneux AJ, Chir B. Five-year experience in using coil embolization for ruptured intracranial aneurysms: outcomes and incidence of late rebleeding. J Neurosurg. 1999; 90: 656-663.
26. Campi A, Ramzi N, Molyneux AJ, Summers PE, Kerr RS, Sneade M, et al. Retreatment of ruptured cerebral aneurysms in patients randomized by coiling or clipping in the International Subarachnoid Aneurysm Trial (ISAT). Stroke. 2007; 38: 1538-1544.

Cite this article

Horcajadas A, Ortiz I, Katati M, Jorques A, Olivares G (2017) Clinical and Cost Results of Endovascular Treatment in Compar-ison with Surgery for Aneurismatic Subarachnoid Hemorrhage (Asah) in a Paired Series. JSM Neurosurg Spine 5(4): 1093.