ONLINE SUPPLEMENT TO:

Safety and Occlusion Rates of Surgical Treatment of Unruptured Intracranial Aneurysms - A Systematic Review and Meta-Analysis of the Literature from 1990 to 2011

Reference list of included publications and search strategy

- 1. Aghakhani N, Vaz G, David P, et al. Surgical management of unruptured intracranial aneurysms that are inappropriate for endovascular treatment: Experience based on two academic centers. *Neurosurgery*. 2008;62:1227-1234; discussion 1234-1225.
- 2. Al-khayat H, Beshay J, Manner D, et al. Vertebral artery-posteroinferior cerebellar artery aneurysms: Clinical and lower cranial nerve outcomes in 52 patients. *Neurosurgery*. 2005;56:2-10; discussion 11.
- 3. Alexander BL, Riina HA. The combined approach to intracranial aneurysm treatment. *Surg Neurol*. 2009;72:596-606; discussion 606.
- 4. Chehrazi BB. A temporal transsylvian approach to anterior circulation aneurysms. *Neurosurgery*. 1992;30:957-961.
- 5. Chung RY, Carter BS, Norbash A, et al. Management outcomes for ruptured and unruptured aneurysms in the elderly. *Neurosurgery*. 2000;47:827-832; discussion 832-823.
- 6. Chyatte D, Porterfield R. Functional outcome after repair of unruptured intracranial aneurysms. *J Neurosurg*. 2001;94:417-421.
- 7. de Oliveira JG, Borba LA, Rassi-Neto A, et al. Intracranial aneurysms presenting with mass effect over the anterior optic pathways: Neurosurgical management and outcomes. *Neurosurg Focus*. 2009;26:E3.
- 8. Deruty R, Pelissou Guyotat I, Mottolese C, et al. Management of unruptured cerebral aneurysms. *Neurological Research*. 1996;18:39-44.
- 9. Dickey P, Nunes J, Bautista C, et al. Intracranial aneurysms: Size, risk of rupture, and prophylactic surgical treatment. *Conn Med*. 1994;58:583-586.
- 10. Dix GA, Gordon W, Kaufmann AM, et al. Ruptured and unruptured intracranial aneurysms--surgical outcome. *Can J Neurol Sci.* 1995;22:187-191.
- 11. Fischer G, Stadie A, Reisch R, et al. The keyhole concept in aneurysm surgery: Results of the past 20 years. *Neurosurgery*. 2011;68:45-51; discussion 51.
- 12. Gonzalez LF, Alexander MJ, McDougall CG, et al. Anteroinferior cerebellar artery aneurysms: Surgical approaches and outcomes--a review of 34 cases. *Neurosurgery*. 2004;55:1025-1035.
- 13. Grigorian AA, Marcovici A, Flamm ES. Intraoperative factors associated with surgical outcome in patients with unruptured cerebral aneurysms: The experience of a single surgeon. *J Neurosurg*. 2003;99:452-457.

- 14. Hauck EF, Wohlfeld B, Welch BG, et al. Clipping of very large or giant unruptured intracranial aneurysms in the anterior circulation: An outcome study. *J Neurosurg*. 2008;109:1012-1018.
- 15. Hempelmann RG, Barth H, Buhl R, et al. Clinical outcome after surgery of intracranial unruptured aneurysms: Results of a series between 1991 and 2001. *Acta Neurochir Suppl*. 2002;82:51-54.
- 16. Hindman BJ, Todd MM, Gelb AW, et al. Mild hypothermia as a protective therapy during intracranial aneurysm surgery: A randomized prospective pilot trial. *Neurosurgery*. 1999;44:23-32; discussion 32-23.
- 17. Inagawa T, Hada H, Katoh Y. Unruptured intracranial aneurysms in elderly patients. *Surg Neurol*. 1992;38:364-370.
- 18. Inoue T. Treatment of incidental unruptured aneurysms. *Acta Neurochir Suppl.* 2002;82:11-15.
- 19. Ishihara H, Yoshimura S, Konu L, et al. Surgical prognosis of unruptured cerebral aneurysms. Report of 40 cases in university hospital zurich. *Acta Neurochir Suppl.* 2002;82:35-39.
- 20. Kashiwagi S, Yamashita K, Kato S, et al. Elective neck clipping for unruptured aneurysms in elderly patients. *Surg Neurol*. 2000;53:14-20.
- 21. Kato Y, Sano H, Imizu S, et al. Surgical strategies for treatment of giant or large intracranial aneurysms: Our experience with 139 cases. *Minim Invasive Neurosurg*. 2003;46:339-343.
- 22. Khanna RK, Malik GM, Qureshi N. Predicting outcome following surgical treatment of unruptured intracranial aneurysms: A proposed grading system. *J Neurosurg*. 1996;84:49-54.
- 23. Kim JE, Lim DJ, Hong CK, et al. Treatment of unruptured intracranial aneurysms in South Korea in 2006 : A nationwide multicenter survey from the Korean Society of Cerebrovascular Surgery. *J Korean Neurosurg Soc*. 2010;47:112-118.
- 24. Kivisaari RP, Porras M, Ohman J, et al. Routine cerebral angiography after surgery for saccular aneurysms: Is it worth it? *Neurosurgery*. 2004;55:1015-1022.
- 25. Krisht AF, Gomez J, Partington S. Outcome of surgical clipping of unruptured aneurysms as it compares with a 10-year nonclipping survival period. *Neurosurgery*. 2006;58:207-216; discussion 207-216.
- 26. Lawton MT, Spetzler RF. Surgical management of giant intracranial aneurysms: Experience with 171 patients. *Clin Neurosurg*. 1995;42:245-266.
- 27. Leber KA, Klein GE, Trummer M, et al. Intracranial aneurysms: A review of endovascular and surgical treatment in 248 patients. *Minim Invasive Neurosurg*. 1998;41:81-85.
- 28. Lindekleiv HM, Jacobsen EA, Kloster R, et al. Introduction of endovascular embolization for intracranial aneurysms in a low-volume institution. *Acta Radiol*. 2009;50:555-561.
- 29. Lot G, Houdart E, Cophignon J, et al. Combined management of intracranial aneurysms by surgical and endovascular treatment. Modalities and results from a series of 395 cases. *Acta Neurochir (Wien)*. 1999;141:557-562.
- 30. Lozier AP, Kim GH, Sciacca RR, et al. Microsurgical treatment of basilar apex aneurysms: Perioperative and long-term clinical outcome. *Neurosurgery*. 2004;54:286-296; discussion 296-289.
- 31. Mizoi K, Yoshimoto T, Nagamine Y, et al. How to treat incidental cerebral aneurysms: A review of 139 consecutive cases. *Surg Neurol*. 1995;44:114-120; discussion 120-111.
- 32. Moroi J, Hadeishi H, Suzuki A, et al. Morbidity and mortality from surgical treatment of unruptured cerebral aneurysms at Research Institute for Brain and Blood Vessels-Akita. *Neurosurgery*. 2005;56:224-231; discussion 224-231.

- 33. Naso WB, Rhea AH, Poole A. Management and outcomes in a low-volume cerebral aneurysm practice. *Neurosurgery*. 2001;48:91-99; discussion 99-100.
- 34. Niskanen M, Koivisto T, Rinne J, et al. Complications and postoperative care in patients undergoing treatment for unruptured intracranial aneurysms. *J Neurosurg Anesthesiol*. 2005;17:100-105.
- 35. Nussbaum ES, Madison MT, Myers ME, et al. Microsurgical treatment of unruptured intracranial aneurysms. A consecutive surgical experience consisting of 450 aneurysms treated in the endovascular era. *Surg Neurol.* 2007;67:457-464; discussion 464-456.
- 36. Ogilvy CS, Carter BS. Stratification of outcome for surgically treated unruptured intracranial aneurysms. *Neurosurgery*. 2003;52:82-87; discussion 87-88.
- 37. Orz YI, Hongo K, Tanaka Y, et al. Risks of surgery for patients with unruptured intracranial aneurysms. *Surg Neurol*. 2000;53:21-27; discussion 27-29.
- 38. Raftopoulos C, Goffette P, Vaz G, et al. Surgical clipping may lead to better results than coil embolization: Results from a series of 101 consecutive unruptured intracranial aneurysms. *Neurosurgery*. 2003;52:1280-1287.
- 39. Raftopoulos C, Mathurin P, Boscherini D, et al. Prospective analysis of aneurysm treatment in a series of 103 consecutive patients when endovascular embolization is considered the first option. *J Neurosurg*. 2000;93:175-182.
- 40. Redekop GJ, Durity FA, Woodhurst WB. Management-related morbidity in unselected aneurysms of the upper basilar artery. *J Neurosurg*. 1997;87:836-842.
- 41. Regli L, Dehdashti AR, Uske A, et al. Endovascular coiling compared with surgical clipping for the treatment of unruptured middle cerebral artery aneurysms: An update. *Acta Neurochir Suppl*. 2002;82:41-46.
- 42. Regli L, Uske A, de Tribolet N. Endovascular coil placement compared with surgical clipping for the treatment of unruptured middle cerebral artery aneurysms: A consecutive series. *J Neurosurg*. 1999;90:1025-1030.
- 43. Rice BJ, Peerless SJ, Drake CG. Surgical treatment of unruptured aneurysms of the posterior circulation. *J Neurosurg*. 1990;73:165-173.
- 44. Rinne J, Hernesniemi J, Niskanen M, et al. Analysis of 561 patients with 690 middle cerebral artery aneurysms: Anatomic and clinical features as correlated to management outcome. *Neurosurgery*. 1996;38:2-11.
- 45. Sano H. Treatment of complex intracranial aneurysms of anterior circulation using multiple clips. *Acta Neurochir Suppl*. 2010;107:27-31.
- 46. Seifert V, Gerlach R, Raabe A, et al. The interdisciplinary treatment of unruptured intracranial aneurysms. *Dtsch Arztebl Int*. 2008;105:449-456.
- 47. Solomon RA, Fink ME, Pile-Spellman J. Surgical management of unruptured intracranial aneurysms. *J Neurosurg*. 1994;80:440-446.
- 48. Steinberg GK, Drake CG, Peerless SJ. Deliberate basilar or vertebral artery occlusion in the treatment of intracranial aneurysms. Immediate results and long-term outcome in 201 patients. *J Neurosurg*. 1993;79:161-173.
- 49. Suyama K, Kaminogo M, Yonekura M, et al. Surgical treatment of unruptured cerebral aneurysms in the elderly. *Acta Neurochir Suppl.* 2005;94:97-101.
- 50. Taha MM, Nakahara I, Higashi T, et al. Endovascular embolization vs surgical clipping in treatment of cerebral aneurysms: Morbidity and mortality with short-term outcome. *Surg Neurol*. 2006;66:277-284; discussion 284.
- 51. Takayasu M, Nagatani T, Noda A, et al. Clinical safety and performance of Sugita titanium aneurysm clips. *Acta Neurochir (Wien)*. 2000;142:159-162; discussion 162-153.
- 52. Taylor B, Harries P, Bullock R. Factors affecting outcome after surgery for intracranial aneurysm in Glasgow. *Br J Neurosurg*. 1991;5:591-600.

- 53. Tsukahara T, Murakami N, Sakurai Y, et al. Treatment of unruptured cerebral aneurysms; a multi-center study at japanese national hospitals. *Acta Neurochir Suppl*. 2005;94:77-85.
- 54. Tuffiash E, Tamargo RJ, Hillis AE. Craniotomy for treatment of unruptured aneurysms is not associated with long-term cognitive dysfunction. *Stroke*. 2003;34:2195-2199.
- 55. Wiebers DO, Whisnant JP, Huston J, 3rd, et al. Unruptured intracranial aneurysms: Natural history, clinical outcome, and risks of surgical and endovascular treatment. *Lancet*. 2003;362:103-110.
- 56. Yanaka K, Nagase S, Asakawa H, et al. Management of unruptured cerebral aneurysms in patients with polycystic kidney disease. *Surg Neurol*. 2004;62:538-545; discussion 545.
- 57. Yasui N, Nishimura H. Surgical treatment of unruptured intracranial aneurysms over the past 22 years. *Neurol Med Chir (Tokyo)*. 2004;44:155-161; discussion 162-153.
- 58. Yasunaga H, Matsuyama Y, Ohe K. Risk-adjusted analyses of the effects of hospital and surgeon volumes on postoperative complications and the modified rankin scale after clipping of unruptured intracranial aneurysms in Japan. *Neurol Med Chir (Tokyo)*. 2008;48:531-538; discussion 538.
- 59. Yoshimoto T, Mizoi K. Importance of management of unruptured cerebral aneurysms. *Surg Neurol*. 1997;47:522-525; discussion 525-526.
- 60. Zhitao J, Yibao W, Anhua W, et al. Microsurgical subtemporal approach to aneurysms on the p(2) segment of the posterior cerebral artery. *Neurol India*. 2010;58:242-247.

Search strategy: Medline: "Intracranial Aneurysm"[All Fields] AND ("surgery"[Subheading] OR "Clip*"[All Fields] OR "Microsurgery "[Mesh] OR "Ligation "[Mesh]) AND (("1990/01"[PDat] : "2011/04"[PDat]) AND (Humans[Mesh]). Embase: "Intracranial aneurysm" AND "Mortality" OR "Morbidity" AND "Humans" AND "1990-Current". For ISI Web of Knowledge: "UIA" AND "Clip" OR "Surgery" OR "Outcome" AND "1990-2011"

Additional online supplement for submission: Jnnp-2011-302068.R1

Reference lists of subgroup meta-analyses

Quality Scores of study

Score 19-26 studies (n⁺=9, 2704 patients, 3027 aneurysms)^{6, 16, 24, 38, 39, 48, 52, 54, 55}

Score 6-18 studies (n=51, 7141 patients, 8012 aneurysms)^{1-5, 7-15, 17-23, 25-37, 40-47, 49-51, 53, 56-60}

Origin of Study

North America (n=24, 4901 patients, 5343 aneurysms)^{2-6, 9, 10, 12-14, 16, 22, 25, 26, 30, 33, 35, 36, 40, 43, 47, 48, 54, 55}

Europe (n=17, 1351 patients, 1764 aneurysms)^{1, 8, 11, 15, 19, 24, 27-29, 34, 38, 39, 41, 42, 44, 46, 52}

Asia (n=18, 3583 patients, 3920 aneurysms)^{17, 18, 20, 21, 23, 31, 32, 37, 45, 49-51, 53, 56-60}

Midyear of Treatment

1990-2000 (n=22, 1711 patients, 1853 aneurysms)^{4, 5, 8-10, 16, 17, 20, 22, 26, 27, 29, 31, 37, 39, 40, 44, 47, 48, 51, 52, 59}

2001-2011 (n= 38, 8134 patients, 9186 aneurysms)^{1-3, 6, 7, 11-15, 18, 19, 21, 23-25, 28, 30, 32-36, 38, 41-43, 45, 46, 49, 50, 53-58, 60}

<u>Age</u>

Mean age >55 y (n= 9, 433 patients)^{5, 7, 17, 20, 22, 37, 49, 56, 60}

Mean age ≤55 y (n=5, 93 patients)^{7, 14, 22, 56, 60}

Location

Anterior (n= 17, 2461 patients)^{4, 7, 13-15, 20, 22, 28, 32, 35-37, 41, 42, 44, 45, 56}

Posterior (n= 13, 549 patients)^{2, 13, 20, 22, 30, 32, 35-37, 44, 48, 56, 60}

Fundus Size

<10 mm (n= 6, 240 patients)^{7, 22, 33, 37, 47, 56}

10-25mm (n=7, 195 patients)^{7, 22, 33, 37, 43, 47, 56}

>25mm (n= 7, 156 patients)^{7, 22, 26, 30, 33, 37, 47}

† n = number of studies