Simple Lateral Suboccipital Approach and Modification for Vertebral Artery Aneurysms: A Study of 52 Cases Over 10 Years

Mardjono Tjahjadi, Behnam Rezai Jahromi, Joseph Serrone, Ville Nurminen, Joham Choque-Velasquez, Riku Kivisaari, Hanna Lehto, Mika Niemelä, Juha Hernesniemi

■ INTRODUCTION: **Complex skull base approaches are frequently used to treat intracranial vertebral artery (VA) and proximal posterior inferior cerebellar artery (PICA) aneurysms. These complex procedures are associated with higher risk of neurovascular injury. Hence, a less-invasive surgical approach is needed to improve the efficacy and safety of treatment.**

■ METHODS: **A retrospective analysis was conducted on clinical and radiologic data from surgeries in which simple lateral suboccipital and "lateral-enough" approaches were used to clip VA aneurysms in the Department of Neurosurgery at Helsinki University Central Hospital from 2000 to 2009.**

■ RESULTS: **Fifty-two VA or PICA aneurysms were treated using the simple lateral suboccipital approach. Sixteen patients (31%) presented with an unruptured aneurysm, 21 patients (40%) with World Federation of Neurosurgical Societies (WFNS) grade 1–3, and 15 patients (29%) with World Federation of Neurosurgical Societies grade 4–5. The aneurysms were saccular in 48 cases (92%), dissecting in 3 cases (6%), and fusiform in 1 case (2%). The most common aneurysm location was the VA-PICA junction (81%). The mean final modified Rankin Scale score was 2, and in unruptured cases, all patients had favorable clinical outcomes. The main causes of unfavorable outcome were poor preoperative clinical grade ($P = 0.002$), preoperative intraventricular hemorrhage ($P = 0.008$), postoperative hydrocephalus ($P = 0.003$), brain infarction ($P = 0.005$), and postoperative pneumonia ($P < 0.001$).**

■ CONCLUSIONS: **We describe a 10-year experience using a simple lateral suboccipital approach and its modification by the senior author (J.H.) to treat VA and proximal PICA aneurysms. Unfavorable outcome was related to the poor preoperative clinical grade, preoperative intraventricular hemorrhage, and postoperative pneumonia.**

INTRODUCTION

Vertebral artery (VA) aneurysms account for approximately 3% of all intracranial aneurysms and 10%–15% of aneurysms in the vertebrobasilar system.[1-5] Treatment of VA aneurysms can be difficult because of the relationship of the VA with the brainstem, tortuosity, and proximity to lower cranial nerves. The lateral suboccipital approach was classically used to treat these aneurysms.[6-9]

Because of the long working distance and narrow working corridor, more extensive skull base procedures have been used (e.g., far-lateral, transcondylar, paracondylar, juxtacondylar, supracondylar, transjugular, or extreme lateral approach).[10-26] The goal of these skull base approaches is to remove the bony anatomy lateral to the foramen magnum (i.e., occipital condyle and jugular tubercle), allowing for a larger working corridor.[16,27,28] However, more extensive skull base approaches are associated with

Key words
- Aneurysm clipping
- Lateral suboccipital approach
- Vertebral artery aneurysm

Abbreviations and Acronyms
CSF: Cerebrospinal fluid
CT: Computed tomography
IAR: Intraoperative aneurysm rupture
IVH: Intraventricular hemorrhage
LCNP: Lower cranial nerve palsy
LOS: Length of stay
mRS: Modified Rankin Scale
PICA: Posterior inferior cerebellar artery
VA: Vertebral artery
WFNS: World Federation of Neurosurgical Societies

Department of Neurosurgery, University of Helsinki and Helsinki University Hospital, Helsinki, Finland

To whom correspondence should be addressed: Mardjono Tjahjadi, M.D. [E-mail: mardjonotjahjadi@gmail.com; joy_mardjono@yahoo.com]
Citation: World Neurosurg. (2017) 108:336-346.
https://doi.org/10.1016/j.wneu.2017.09.014

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

increased surgical time and carry potential complications of neurovascular injury and craniocervical instability.[27]

The improvement of neuroanesthetic techniques along with the advancement in microsurgical equipment may reduce the need of these extensive surgical approaches. In this study, we assess the efficacy of a simple lateral suboccipital approach and its modification used by the senior author (J.H.) to treat VA aneurysms.

METHODS

A retrospective analysis was conducted on clinical and radiologic data from surgeries in which simple lateral suboccipital and "lateral-enough" approaches were used to clip VA aneurysms in the Department of Neurosurgery at Helsinki University Central Hospital from 2000 to 2009. The preoperative and postoperative radiologic examination and analyses were mostly based on computed tomography (CT) and CT angiography. Digital subtraction angiography was used if there was uncertainty in initial diagnosis or in evaluation of the operative result. This study was approved by the research ethics committee of Helsinki University Central Hospital.

Patient Data

We reviewed 601 patients with posterior circulation aneurysms. In these patients, microsurgery was performed in 421 aneurysms, endovascular therapy in 66 aneurysms, and conservative management in 114 aneurysms. The lateral suboccipital approach was performed on 52 aneurysms in 51 patients.

Clinical Data

Preoperative clinical condition for ruptured aneurysms was assessed using the World Federation of Neurosurgical Societies (WFNS) score (good, 1–3; poor, 4–5). The outcome after surgery was assessed using the modified Rankin Scale (mRS) score at discharge and at final follow-up. Outcomes were classified as favorable (mRS score 0–3), unfavorable (mRS score 4–5), or death (mRS score 6).

Radiologic Measurement

Preoperative and postoperative radiologic data for the study were obtained from CT angiography and digital subtraction angiography. Radiologic images were analyzed both in 2 dimensions and in 3 dimensions using the GE Centricity RA 600 software (GE Medical Systems, Milwaukee, Wisconsin, USA) and the IMPAX software version 5.3 (Agfa, Mortsel, Belgium). The aneurysm characteristics for statistical analysis included 1) aneurysm dome size, 2) neck size, and 3) postoperative angiographic occlusion. Aneurysm dome size was categorized as very small (<3 mm), small (3–6 mm), medium (7–13 mm), large (14–24 mm), or giant (≥25 mm). The degree of occlusion was categorized as complete occlusion (100%), near-complete/neck remnant (>90%), partial occlusion (80%–90%), incomplete occlusion (<80%), and treatment failure (unable to clip aneurysm).

Statistical Analysis

The continuous data are expressed as means with ranges in parentheses and tested with the Student *t* test and analysis of variance. Categorical variables are presented as percentages and are analyzed using a χ^2 test. A *P* value less than 0.05 was considered significant. Statistical analysis was performed using SPSS software for Macintosh (version 22.0 [IBM Corp., Armonk, New York, USA]).

Operative Technique and Methods

Patient Positioning. For the lateral suboccipital approach,[29] the patient is placed in the lateral park bench position with the head elevated 20 cm above the heart level. The upper body is rotated slightly (5°–10°) anteriorly and the upper shoulder is heavily retracted caudally and posteriorly. The head is positioned 1) flexed slightly; 2) tilted contralaterally; and 3) slightly rotated toward the floor, with the mastoid tip becoming the highest point. A lumbar drain is placed to release 50 mL of cerebrospinal fluid (CSF).

Skin Incision and Craniotomy. A vertical linear skin incision is placed 2 cm behind the mastoid process centered over the transverse sigmoid junction (Figure 1). A curved self-retaining

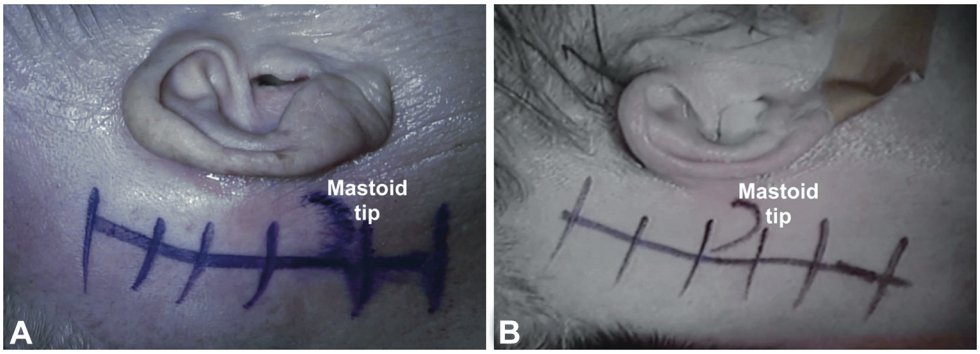

Figure 1. (**A**) Skin incision for simple lateral suboccipital approach for higher positioned vertebral/posterior inferior cerebellar artery aneurysm. (**B**) Skin incision for lateral-enough approach for lower positioned aneurysm.