

# 枕动脉-小脑后下动脉搭桥术治疗累及小脑后下动脉的椎动脉瘤

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**【摘要】** 目的 探讨枕动脉-小脑后下动脉(OA-PICA)搭桥术治疗累及小脑后下动脉的椎动脉瘤的效果。方法 纳入2016年1月至2020年12月在华中科技大学同济医学院附属同济医院诊断与治疗的6例累及小脑后下动脉的椎动脉瘤患者,均行OA-PICA搭桥术,联合同期动脉瘤孤立术、择期血管内介入治疗孤立动脉瘤或择期支架植入术。术中吲哚菁绿荧光血管造影术(ICGA)显示桥血管吻合口通畅,记录住院期间手术相关并发症,术后1~3年复查CTA或DSA评估桥血管吻合口通畅情况,术后1年改良Rankin量表(mRS)评价预后。结果 6例患者均顺利完成OA-PICA搭桥术,术中ICGA均显示桥血管吻合口通畅。1例(例4)同期行动脉瘤孤立术;3例(例1、例3、例5)择期行血管内介入治疗孤立动脉瘤;1例(例2)择期行支架植入术;1例(例6)术前动脉瘤已破裂患者术后10h发生动脉瘤再出血而死亡。5例生存患者住院期间均未发生手术相关并发症,术后平均随访37个月,复查CTA或DSA均显示桥血管吻合口通畅,术后1年预后良好(mRS评分均为1)。结论 OA-PICA搭桥术是治疗累及小脑后下动脉的椎动脉瘤的有效方法。

**【关键词】** 颈外动脉; 小脑; 动脉; 脑血管重建术; 动脉瘤; 椎动脉; 脑血管造影术

## Occipital artery - posterior inferior cerebellar artery bypass for the treatment of vertebral aneurysms involving posterior inferior cerebellar artery

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**【Abstract】 Objective** To assess the efficacy of occipital artery (OA)-posterior inferior cerebellar artery (PICA) bypass for the treatment of vertebral aneurysms involving PICA. **Methods and Results** A total of 6 patients with vertebral aneurysms involving PICA treated by OA-PICA bypass in Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology from January 2016 to December 2020 were retrospectively reviewed. Complications were recorded and outcomes were assessed by modified Rankin Scale (mRS). OA-PICA bypass was successfully performed in 6 patients and bypass patency was confirmed by intraoperative indocyanine green angiography (ICGA). OA-PICA bypass and surgical trapping were performed in the same session in one patient (Case 4). Elective endovascular trapping was applied after bypass in 3 cases (Case 1, Case 3, Case 5). Elective stent implantation was conducted in one patient (Case 2) after the bypass surgery. One patient (Case 6) died of aneurysm rehemorrhage 10 h after OA-PICA bypass. No complications were observed during the hospitalization in the remaining 5 patients. Bypass patency was achieved in a mean follow-up time of 37 months and outcome was favorable (mRS was 1, for all) one year after the final surgery. **Conclusions** OA - PICA bypass is an effective method for the treatment of PICA-involved vertebral aneurysms.

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**【Key words】** Carotid artery, external; Cerebellum; Arteries; Cerebral revascularization; Aneurysm; Vertebral artery; Cerebral angiography

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小脑后下动脉(PICA)是椎动脉入颅后的最大分支,其延髓前段、延髓外侧段和扁桃体延髓段发出重要分支供血脑干<sup>[1-3]</sup>。累及小脑后下动脉的椎动脉瘤占全部颅内动脉瘤的0.5%~3.0%<sup>[4]</sup>,由于该部位动脉瘤多呈非囊状,位置深在,毗邻脑干和后组脑神经,其治疗难点为闭塞动脉瘤的同时确保小脑后下动脉通畅。单纯开颅动脉瘤夹闭术常导致严重并发症,单纯血管内介入栓塞治疗难以致密栓塞,复发率较高,因此,血管搭桥术成为治疗该部位动脉瘤的重要选择<sup>[5-8]</sup>。华中科技大学同济医学院附属同济医院近年来采用枕动脉-小脑后下动脉(OA-PICA)搭桥术治疗6例累及小脑后下动脉的椎动脉瘤患者,回顾分析其临床资料,总结该术式的治疗经验。

## 资料与方法

### 一、临床资料

1. 纳入标准 (1)经CTA或DSA证实的椎动脉瘤并累及小脑后下动脉。(2)单发动脉瘤。(3)均行OA-PICA搭桥术。(4)年龄18~80岁。(5)所有患者及其家属均对手术方案知情并签署知情同意书。

2. 排除标准 (1)椎动脉瘤未累及小脑后下动脉。(2)多发动脉瘤。(3)预计无法耐受手术。(4)既往曾行动脉瘤夹闭术或栓塞术。

3. 一般资料 选择2016年1月至2020年12月在华中科技大学同济医学院附属同济医院神经外科住院治疗的累及小脑后下动脉的椎动脉瘤患者共6例,均为男性,年龄36~59岁,平均49.67岁;主要表现为动脉瘤性蛛网膜下腔出血(SAH)4例,慢性头痛2例;入院时改良Rankin量表(mRS)评分为2~4,平均为2.83;均采用OA-PICA搭桥术。6例累及小脑后下动脉的椎动脉瘤患者的临床资料参见表1。

### 二、研究方法

1. 术前评估 所有患者术前均行DSA检查,评估动脉瘤大小、形态,双侧椎动脉发育情况,患侧小脑前下动脉(AICA)、小脑上动脉(SCA)和对侧小脑

后下动脉向患侧小脑后下动脉供血区代偿情况;评估枕动脉直径、走行,并于头皮描记。如果患侧椎动脉为非优势侧、直径接近或小于对侧椎动脉,则同期行动脉瘤孤立术。

2. 手术方法 患者侧俯卧位或坐位,气管插管全身麻醉。采取经远外侧入路,手术切口自C<sub>4</sub>水平沿中线向上达枕外粗隆,平行上项线向外至乳突后缘,手术显微镜下解剖并游离枕动脉后以肝素化生理盐水冲洗备用;枕下骨瓣开颅,动脉瘤破裂者切除部分枕髁和寰椎(C<sub>1</sub>)后弓以增加显露范围和减压效果,手术显微镜下轻牵小脑显露小脑后下动脉尾襟,于尾襟附近行枕动脉与小脑后下动脉端侧吻合,术中行吲哚菁绿荧光血管造影术(ICGA)观察桥血管吻合口通畅情况。对于动脉瘤体易于显露者,同期行动脉瘤孤立术(图1),分别在动脉瘤近心端、远心端和小脑后下动脉近心端各放置1枚动脉瘤夹;对于未破裂动脉瘤、病变节段较长、瘤体较大或脑肿胀严重等难以显露动脉瘤者,择期血管内介入治疗孤立动脉瘤(图2)。

3. 预后评价 (1)记录住院期间手术相关并发症。(2)术后1~3年复查CTA或DSA评估动脉瘤闭塞和桥血管吻合口通畅情况。(3)术后1年采用mRS量表评价预后,mRS评分≤2为预后良好、>2为预后不良。

## 结 果

本组6例患者计6个动脉瘤,动脉瘤直径4.20~8.30 mm,平均4.65 mm。DSA显示,1例(例2)为患侧椎动脉优势,余5例为对侧椎动脉优势;2例(例1、例2)同侧小脑前下动脉部分代偿,1例(例4)同侧小脑前下动脉和对侧小脑后下动脉部分代偿,3例(例3、例5、例6)无明显代偿;6例枕动脉走行均正常,枕动脉在上项线处直径为1.30~1.50 mm,平均1.32 mm。

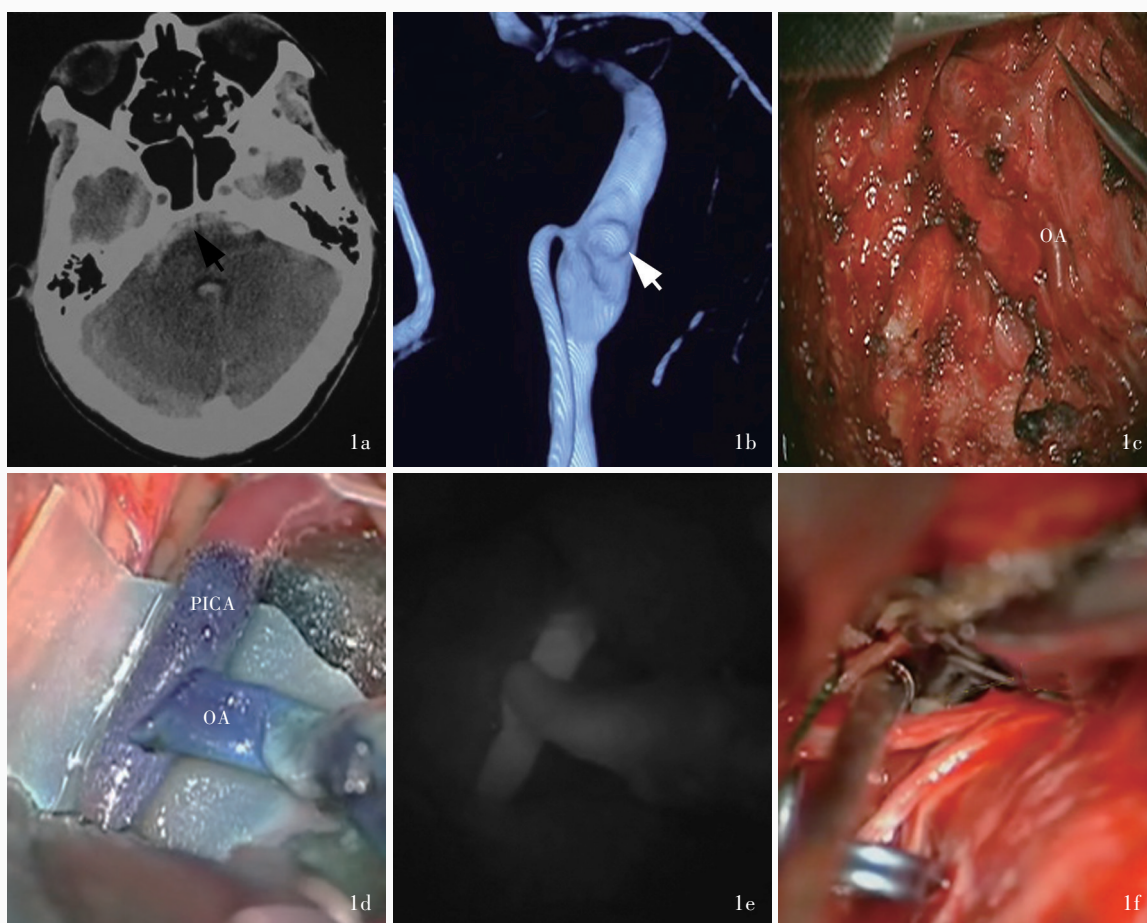
6例患者均顺利完成OA-PICA搭桥术,术中ICGA显示桥血管吻合口通畅。1例(例4)同期行动脉瘤孤立术;3例(例1、例3、例5)择期血管内介入

表1 6例累及小脑后下动脉的椎动脉瘤患者的临床资料

Table 1. Clinical data of 6 patients with PICA-involved vertebral aneurysms

序号	性别	年龄(岁)	临床表现	术前评估	治疗方法	两次手术时间间隔(d)	mRS评分	
							入院时	术后1年
1	男性	51	蛛网膜下腔出血	同侧AICA部分代偿	OA-PICA搭桥术+择期血管内介入治疗孤立动脉瘤	7	3	1
2	男性	53	慢性头痛	同侧AICA部分代偿	OA-PICA搭桥术+择期支架植入术	9	2	1
3	男性	36	慢性头痛	无明显代偿	OA-PICA搭桥术+择期血管内介入治疗孤立动脉瘤	7	2	1
4	男性	59	蛛网膜下腔出血	同侧AICA部分代偿, 对侧PICA部分代偿	OA-PICA搭桥术+同期动脉瘤孤立术	无	3	1
5	男性	51	蛛网膜下腔出血	无明显代偿	OA-PICA搭桥术+择期血管内介入治疗孤立动脉瘤	7	3	1
6	男性	48	蛛网膜下腔出血	无明显代偿	OA-PICA搭桥术(未同期行动脉瘤孤立术)	—	4	—

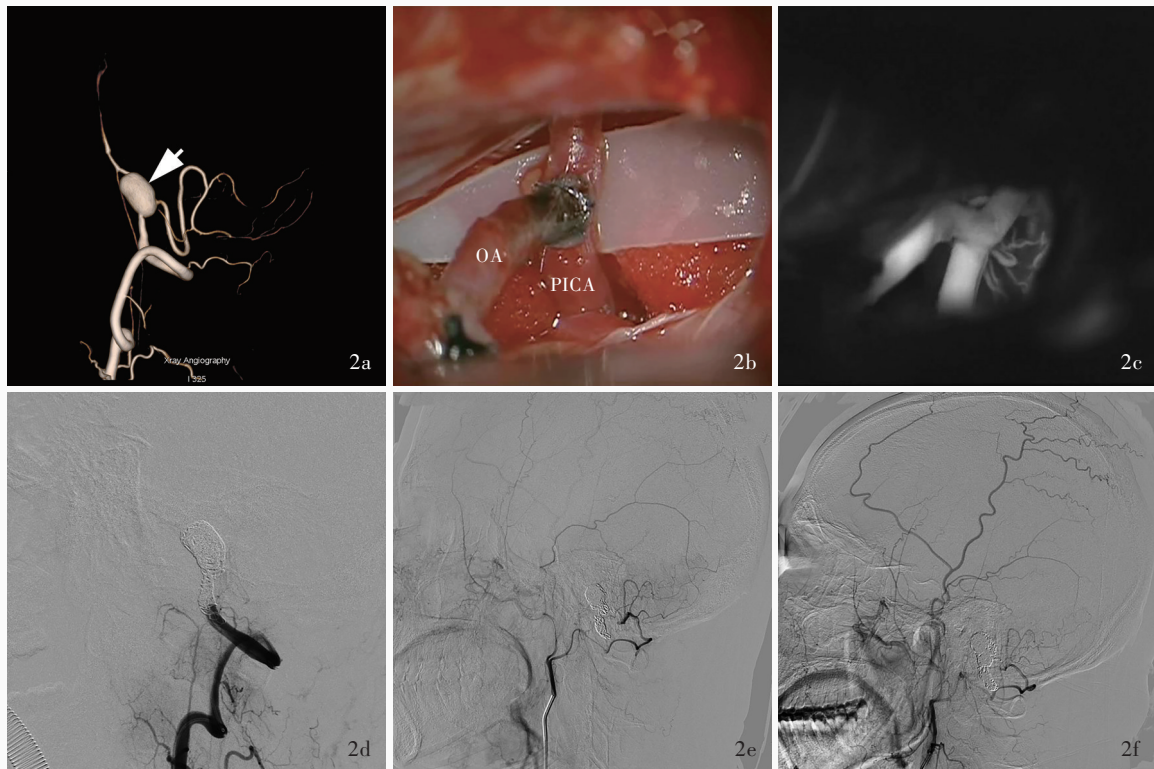
—, the aneurysm rebleeding 10 h after surgery resulted in death, 术后10 h 动脉瘤再出血致死亡。mRS, modified Rankin Scale, 改良Rankin量表; AICA, anterior inferior cerebellar artery, 小脑前下动脉; PICA, posterior inferior cerebellar artery, 小脑后下动脉; OA, occipital artery, 枕动脉



OA, 枕动脉; PICA, 小脑后下动脉。The same for Figure 2

图1 例4患者, 男性, 59岁, 因蛛网膜下腔出血1 d入院, 临床诊断为累及小脑后下动脉的椎动脉瘤(已破裂), 行OA-PICA搭桥术+同期动脉瘤孤立术 1a 术前CT显示, 颅后窝蛛网膜下腔出血, 第四脑室积血(箭头所示) 1b 术前3D-DSA显示, 右椎动脉夹层动脉瘤累及小脑后下动脉(箭头所示) 1c 术中游离枕动脉 1d 术中将枕动脉与小脑后下动脉端侧吻合 1e 术中ICGA显示, 桥血管吻合口通畅 1f 同期行动脉瘤孤立术

Figure 1 OA-PICA bypass and aneurysm trapping were performed in a 59 years old male (Case 4) with a ruptured aneurysm manifested as SAH for 1 d Preoperative CT showed SAH in the posterior cranial fossa, and there was hematocoele in the fourth ventricle (arrow indicates, Panel 1a). 3D-DSA showed a PICA-involved of right VA dissection aneurysm (arrow indicates, Panel 1b). The OA was harvested and OA-PICA end-to-side anastomosis was conducted (Panel 1c, 1d). Intraoperative ICGA showed bypass patency was confirmed (Panel 1e). The aneurysm was trapped by clips in the same session (Panel 1f).



**图 2** 例 3 患者, 男性, 36 岁, 因慢性头痛 3 年入院, 临床诊断为累及小脑后下动脉的椎动脉瘤(未破裂), 行 OA-PICA 搭桥术 + 择期血管内介入治疗孤立动脉瘤。2a 术前 3D-DSA 显示, 左椎动脉夹层动脉瘤累及小脑后下动脉(箭头所示)。2b 术中 将 枕 动 脉 与 小 脑 后 下 动 脉 端 侧 吻 合。2c 术 中 ICGA 显 示, 桥 血 管 吻 合 口 通 畅。2d 术 后 7 d 再 次 行 动 脉 瘤 孤 立 术。2e 术 后 1 年 复 查 DSA 显 示 桥 血 管 吻 合 口 通 畅, 动 脉 瘤 未 显 影。2f 术 后 3 年 复 查 DSA 均 显 示 桥 血 管 吻 合 口 通 畅, 动 脉 瘤 未 显 影。

**Figure 2** OA-PICA bypass and secondary endovascular obliteration were performed in a 36 years old male (Case 3) with an unruptured aneurysm presented with chronic headache for 3 years. Preoperative 3D-D SA showed a left VA dissection aneurysm involving PICA (arrow indicates, Panel 2a). OA-PICA end-to-side anastomosis was performed (Panel 2b). Intraoperative ICGA showed bypass patency was confirmed (Panel 2c). Endovascular obliteration was performed 7 d after bypass (Panel 2d). One and 3 years follow-up after endovascular therapy, DSA showed the bypass was patent and the aneurysm was obliterated (Panel 2e, 2f).

治疗孤立动脉瘤, 两次手术时间间隔均为 7 d; 1 例(例 2)择期支架植入术; 1 例动脉瘤破裂患者(例 6)为出血急性期, 脑组织肿胀严重, 无法显露动脉瘤, 术后 10 h 发生动脉瘤再出血而死亡。5 例生存患者住院期间均未发生手术相关并发症。

本组患者术后随访 23 ~ 54 个月, 平均为 37 个月。5 例生存患者随访期间复查 CTA 或 DSA 均显示桥血管吻合口通畅, 术后 1 年均预后良好(mRS 评分均为 1)。

## 讨 论

血管内治疗技术和材料的进步, 特别是血流导向装置的出现<sup>[9]</sup>, 扩大了颅内动脉瘤血管内治疗的适应证, 使血管搭桥术在颅内动脉瘤治疗中的应用逐渐减少, 但仍在复杂颅内动脉瘤的治疗中具有不

可替代的作用<sup>[10-11]</sup>。对于巨大、宽颈或无颈动脉瘤, 瘤体累及重要分支, 瘤颈严重钙化或瘤内血栓, 术中需长时间阻断载瘤动脉, 以及血管内治疗后复发的复杂动脉瘤, 应将血管搭桥术作为重要选择<sup>[10]</sup>。累及小脑后下动脉的椎动脉瘤属于复杂动脉瘤, 本研究采用 OA-PICA 搭桥术治疗该部位动脉瘤, 预后良好(mRS 评分为 1)率达 5/6, 与既往文献报道相一致<sup>[12-13]</sup>, 表明 OA-PICA 搭桥术是治疗累及小脑后下动脉的椎动脉瘤的有效方法。

累及小脑后下动脉的椎动脉瘤行单纯血管内治疗时, 不完全栓塞率高达 72.7%<sup>[14]</sup>, 复发率为 14.7%<sup>[15]</sup>, 可见采取单纯血管内治疗的方式保护小脑后下动脉易导致动脉瘤栓塞不彻底, 对已发生动脉瘤破裂出血的患者意味着较高的再出血风险, 对未破裂动脉瘤意味着较高的复发风险。采用血管

搭桥术重建小脑后下动脉血运联合动脉瘤孤立术,是处理此部位动脉瘤的理想方法<sup>[5,16-17]</sup>。球囊闭塞试验(BOT)是动脉瘤孤立术前常用的评估方法<sup>[18]</sup>,但在小脑后下动脉起始部行椎动脉 BOT 试验有一定风险,可能造成该部位动脉瘤破裂或栓子脱落,因此本研究术前未采用 BOT 试验判断侧支代偿,而是根据 DSA 检查结果评估患侧椎动脉和小脑后下动脉的侧支代偿情况。

通过血管搭桥术重建小脑后下动脉血运主要有以下方法:(1)小脑后下动脉与小脑后下动脉侧侧吻合,该方法无需移植血管,但是其缺点为双侧小脑后下动脉尾攀相距较远或尾攀缺如时难以吻合,并且术中需要同时阻断双侧小脑后下动脉,吻合耗时较长,存在缺血风险;此外,术后一旦发生吻合口血栓,双侧小脑后下动脉吻合口以远发生缺血事件<sup>[19]</sup>。(2)小脑后下动脉与椎动脉端侧吻合,该方法需移植桡动脉(RA)或大隐静脉,耗时较长,且椎动脉位置深在,吻合时易损伤后组脑神经<sup>[20]</sup>。(3)切除动脉瘤后小脑后下动脉端端吻合,该方法适用于小脑后下动脉主干动脉瘤,切除动脉瘤后小脑后下动脉缩短,为避免吻合失败常需移植血管以降低吻合口张力<sup>[21]</sup>。(4)枕动脉与小脑后下动脉端侧吻合,该方法无需移植血管,但缺点为枕动脉近端走行于肌肉深面,解剖复杂,易痉挛,全程在显微镜下锐性游离枕动脉,可防止痉挛发生;优点为采取后正中入路或远外侧入路有多个吻合点可供选择,对脑干毗邻结构的干扰较小,且枕动脉长度足够,可无张力吻合<sup>[22-24]</sup>。本研究 6 例累及小脑后下动脉的椎动脉瘤患者均选择枕动脉与小脑后下动脉端侧吻合,1 例(例 4)同期行动脉瘤孤立术,2 例(例 1、例 5)因病变节段较长、血管搭桥术难以完整显露动脉瘤,选择择期血管内介入治疗孤立动脉瘤;1 例(例 3)因瘤体较大、阻挡术野无法显露载瘤动脉远心端,且动脉瘤未破裂,亦选择择期血管内介入治疗孤立动脉瘤;1 例(例 2)因患侧椎动脉优势,且动脉瘤未破裂、病变节段较长,择期行支架植入术;1 例(例 6)为动脉瘤破裂出血急性期,脑组织肿胀严重,无法显露动脉瘤,拟次日行动脉瘤孤立术,但该例患者术后 10 小时突发病情加重,头部 CT 证实动脉瘤再出血,死亡。因此对于此类已破裂出血且需血运重建的复杂动脉瘤,建议行同期动脉瘤孤立术,或在复合手术室行同期血管内介入治疗孤立动脉瘤,防止再出血。

综上所述,OA-PICA 搭桥术联合同期动脉瘤孤立术或择期血管内介入栓塞治疗(支架植入术或动脉瘤孤立术),是累及小脑后下动脉的椎动脉瘤的有效治疗方法。对于此部位已破裂动脉瘤,建议行同期动脉瘤孤立术,或在复合手术室行同期血管内介入治疗孤立动脉瘤,防止两次手术间期动脉瘤再出血。

利益冲突 无

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