

· 复杂颅内动脉瘤颅内-颅内血管搭桥术 ·

颅内-颅内血管搭桥术在基底动脉复杂动脉瘤中的应用

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【摘要】 目的 探讨颅内-颅内血管搭桥术治疗基底动脉复杂动脉瘤的术式和适应证。**方法与结果** 回顾 2017 年 4 月至 2023 年 4 月在天津市环湖医院行颅内-颅内血管搭桥术的 6 例基底动脉复杂动脉瘤患者的临床资料, 3 例为椎基底动脉延长扩张型动脉瘤, 1 例为基底动脉上段动脉瘤合并近端基底动脉重度狭窄, 2 例为基底动脉巨大型夹层动脉瘤; 5 例为破裂动脉瘤, Hunt-Hess 分级 V 级 1 例、IV 级 1 例、III 级 2 例、II 级 1 例; 1 例为未破裂动脉瘤。6 例患者均采用颅内-颅内血管搭桥术, 主要包括颈内动脉岩骨段-桡动脉-大脑后动脉搭桥术联合动脉瘤夹闭术(1 例)、椎动脉 V3 段-桡动脉-大脑后动脉搭桥术联合动脉瘤孤立术(4 例)、大脑中动脉 M2 段-桡动脉-大脑后动脉 P2 段搭桥术联合动脉瘤孤立术(1 例), 均顺利完成手术。术后即刻复查影像学提示桥血管通畅, 动脉瘤不显影, 基底动脉上段显影良好。4 例预后较好, 改良 Rankin 量表(mRS)评分为 0~3 分; 1 例术前即为重症蛛网膜下腔出血(Hunt-Hess 分级 IV 级), 虽手术顺利, 动脉瘤得以控制, 但预后欠佳(mRS 评分 4 分); 1 例基底动脉干巨大型动脉瘤患者, 术前存在蛛网膜下腔出血(Hunt-Hess 分级 V 级), 虽手术顺利重建后循环并处理动脉瘤, 仍于术后 1 周死亡。**结论** 对于无法使用常规手段治疗的基底动脉复杂动脉瘤, 颅内-颅内血管搭桥术能够为其提供较好的选择, 临床根据实际情况选择合适术式。

【关键词】 颅内动脉瘤; 基底动脉; 脑血管重建术

The application of intracranial-intracranial bypass for the treatment of complex basilar artery aneurysms

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【Abstract】 Objective To explore the surgical procedures and indications of intracranial-intracranial bypass for the treatment of complex aneurysms in the basilar artery (BA). **Methods and Results** A retrospective analysis was conducted on the clinical data and treatment process of 6 patients with complex BA aneurysms who underwent intracranial-intracranial bypass from April 2017 to April 2023 in Tianjin Huanhu Hospital. Among the 6 aneurysms, 3 were vertebro basilar dolichoectasia aneurysms, one was an aneurysm in the upper segment of BA combined with severe stenosis at the proximal of the aneurysm, and 2 were giant dissecting aneurysms of the BA. Among them, 5 were ruptured aneurysms, with

doi:10.3969/j.issn.1672-6731.2024.08.005

基金项目:天津市科技计划项目(项目编号:18ZXDBSY00180);天津市医学重点学科(专科)建设项目(项目编号:TJYXZDXK-022A);天津市医学重点学科(专科)建设项目(项目编号:TJYXZDXK-052B);天津市津南区科技计划项目(项目编号:20210104)

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one case of Hunt-Hess grade V, one case of grade IV, 2 cases of grade III, and one case of grade II, while the remaining one case was an unruptured aneurysm. One patient underwent petrous segment of internal carotid artery (ICA)-radial artery (RA)-posterior cerebral artery (PCA) bypass combined with aneurysm clipping, 4 patients underwent V3 segment of vertebral artery (VA)-RA-PCA bypass combined with aneurysm trapping, and one patient underwent middle cerebral artery (MCA)-RA-PCA bypass combined with aneurysm trapping. Four patients had good prognosis, with modified Rankin Scale (mRS) 0 to 3, one case scored 4 and one case died one week after surgery. **Conclusions** For complex aneurysms of the BA that cannot be treated with conventional methods, intracranial-intracranial bypass provides a good option. It is necessary to select the appropriate surgical procedure based on the actual situation in clinical practice.

【Key words】 Intracranial aneurysm; Basilar artery; Cerebral revascularization

This study was supported by Science and Technology Project of Tianjin (No. 18ZXDBSY00180), Tianjin Key Medical Discipline (Specialty) Construction Project (No. TJYXZDXK-022A, TJYXZDXK-052B), and Science and Technology Project of Jinnan District in Tianjin (No. 20210104).

Conflicts of interest: none declared

近年来,颅内-颅内血管搭桥术逐渐成为处理特定部位颅内动脉瘤的可靠手段,甚至在某些情况下可替代经典颅外-颅内血管搭桥术^[1]。Lawton教授将其视作第一代颞浅动脉-大脑中动脉(STA-MCA)搭桥术和第二代高流量颅外-颅内血管搭桥术之后的第三代脑血管搭桥术^[2]。颅内-颅内血管搭桥术在前循环动脉瘤治疗中的应用较多,很少应用于位于基底动脉(BA)的复杂动脉瘤^[3]。基底动脉动脉瘤的处理非常危险且极具挑战性,当应用搭桥结合载瘤动脉闭塞的方法时,因为搭桥后血流动力学改变,基底动脉极易因血栓形成或穿支闭塞而带来严重后果。因此,替代整个基底动脉上部供血且产生足够强的逆向血流需要高流量血管搭桥术。颈外动脉(ECA)作为供体动脉已经在临床得以广泛应用^[4],而以颈内动脉(ICA)岩骨段和床突段、大脑中动脉(MCA)、椎动脉(VA)V3段及颌内动脉(IMA)为代表的颅内或邻近区域来源供体动脉也日益受到临床重视^[2,5-9]。本研究介绍天津市环湖医院采用颅内-颅内高流量血管搭桥术治疗基底动脉复杂动脉瘤的经验,并与现有的多种搭桥术式进行比较,以为临床处理基底动脉复杂动脉瘤提供搭桥术式的参考。

对象与方法

一、研究对象

1. 纳入标准 (1)经DSA证实为基底动脉动脉瘤。(2)传统开颅夹闭或介入栓塞无法处理的动脉瘤。(3)均行颅内-颅内血管搭桥术。(4)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)术前经CT或MRI显示动脉瘤腔完全闭塞的血栓性动脉瘤。(2)感染性动脉瘤或外伤性假性动脉瘤。

3. 一般资料 纳入2017年4月至2023年4月在天津市环湖医院神经外科住院治疗的基底动脉动脉瘤患者共6例,其中男性4例,女性2例;年龄45~65岁,平均55.67岁;3例为椎基底延长扩张型动脉瘤,1例为基底动脉上段动脉瘤合并近端基底动脉重度狭窄,2例为基底动脉巨大型夹层动脉瘤;5例为破裂动脉瘤,Hunt-Hess分级V级1例、IV级1例、III级2例、II级1例,余1例为未破裂动脉瘤,既往存在蛛网膜下腔出血(SAH)史。

二、研究方法

1. 手术方法 (1)术前准备:术前所有患者均采用多普勒超声、脑血管造影和头部MRI评价动脉瘤形态及相应侧支循环情况;CT灌注成像(CTP)或灌注成像(PWI)评估载瘤动脉远端组织血供及充盈情况。术前手外科医师负责评估前臂血供和桡动脉(RA)情况,并在术中负责桡动脉获取及处理。(2)手术操作步骤:根据术前脑血流评估及可获得的桡动脉长度,综合考虑后选择手术适应证和手术方式。①ICA岩骨段-RA-大脑后动脉(PCA)搭桥术(图1)。经由扩大的中颅底入路开颅,骨窗下缘平中颅底,离断脑膜中动脉,剥离中颅底硬脑膜以充分显露Glasscock三角骨质,高速磨钻磨除骨质,显露颈内动脉岩骨段,硬膜内分开侧裂,向后上牵拉和抬起颞叶,形成颞极通道,通过此通道在小脑幕缘找到同侧大脑后动脉P2段,分离备用,分别行ICA岩骨段-RA吻合和RA-PCA吻合。吻合成功后以术中听

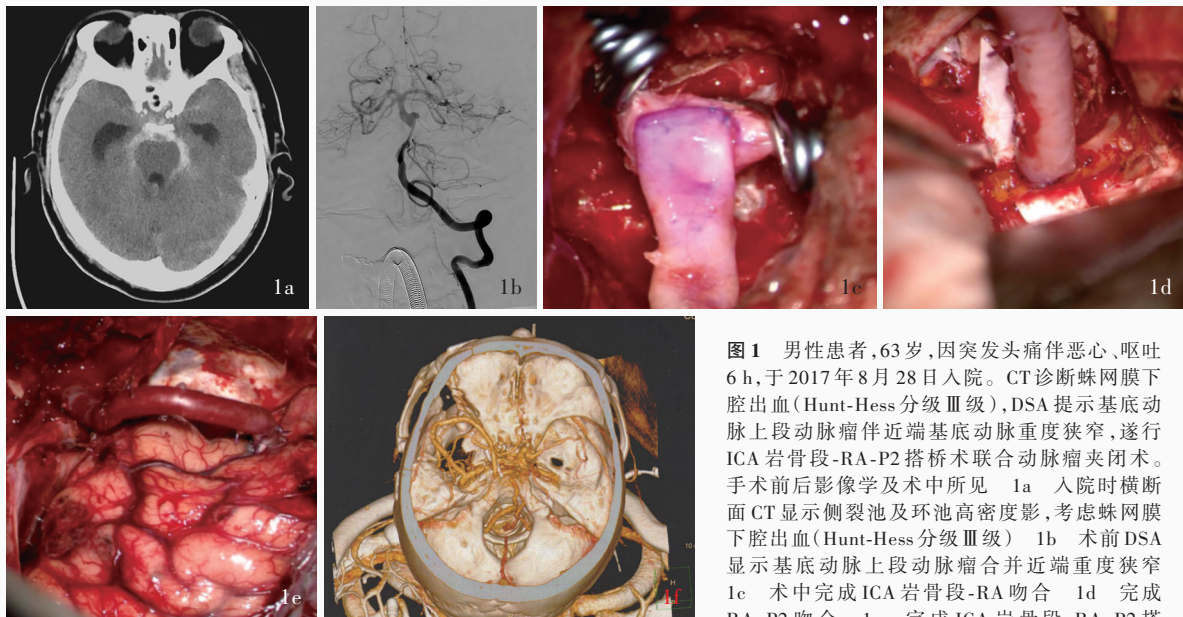


图1 男性患者,63岁,因突发头痛伴恶心、呕吐6 h,于2017年8月28日入院。CT诊断蛛网膜下腔出血(Hunt-Hess分级Ⅲ级),DSA提示基底动脉上段动脉瘤伴近端基底动脉重度狭窄,遂行ICA岩骨段-RA-P2搭桥术联合动脉瘤夹闭术。手术前后影像学及术中所见 1a 入院时横断面CT显示侧裂池及环池高密度影,考虑蛛网膜下腔出血(Hunt-Hess分级Ⅲ级) 1b 术前DSA显示基底动脉上段动脉瘤合并近端重度狭窄 1c 术中完成ICA岩骨段-RA吻合 1d 完成RA-P2吻合 1e 完成ICA岩骨段-RA-P2搭

桥 1f 术后CTA三维容积重建显示,动脉瘤未显影,ICA岩骨段-RA-P2搭桥血流通畅,血管结构良好

Figure 1 A 63-year-old male patient was admitted to the hospital (August 28, 2017) due to sudden onset of headache accompanied by nausea and vomiting for 6 h. CT confirmed the diagnosis of SAH (Hunt-Hess grade Ⅲ). DSA indicated the presence of an aneurysm at the upper segment of the BA, accompanied by severe stenosis proximal to the aneurysm. Consequently, a petrous segment of ICA-RA-P2 bypass combined with aneurysm clipping was performed. The preoperative and postoperative imaging findings and intraoperative findings Axial CT at admission showed high density in the sylvian fissure cistern and ambient cistern, suggesting SAH (Hunt-Hess grade Ⅲ, Panel 1a). Preoperative DSA showed the presence of an aneurysm at the upper segment of BA with severe stenosis proximal to the aneurysm (Panel 1b). A petrous segment of ICA-RA anastomosis was finished (Panel 1c). RA-P2 anastomosis was finished (Panel 1d). Whole view of the petrous segment of ICA-RA-P2 bypass (Panel 1e). Postoperative CTA 3D volume reconstruction showed that the aneurysm was not visualized, and the patency of the bypass (Panel 1f).

咪菁绿荧光血管造影术(ICGA)和多普勒超声确认桥血管通畅性。②V3-RA-PCA搭桥术(图2)。经由功能性岩骨入路开颅,分层翻开枕后肌群,在枕下三角显露椎动脉V3段备用,枕下开颅,磨钻磨除部分乳突以充分显露横窦及乙状窦缘,经由小脑上通道显露同侧大脑后动脉P2段,分别行V3-RA吻合和RA-P2吻合,术中采用ICGA确认桥血管通畅后,在V3-RA吻合口远端闭塞椎动脉。③M2-RA-P2搭桥术。经由扩大中颅底入路开颅,骨窗下缘平中颅底,硬膜内分开侧裂,显露大脑中动脉M2段备用,向后上牵拉和抬起颞叶,形成颞极通道,通过此通道在小脑幕缘找到同侧大脑后动脉P2段,分离备用,分别行M2-RA吻合和RA-P2吻合。吻合成功后以术中ICGA和多普勒超声确认桥血管通畅性。

2. 术后治疗及预后评价 术后即刻复查DSA以确认桥血管通畅性以及动脉瘤情况。术后1周予以阿司匹林100 mg/d口服,持续1年。术后随访每6个月以CTA或DSA评估桥血管通畅性和动脉瘤变化。分别于出院时、术后3个月和1年采用改良

Rankin量表(mRS)评估神经功能预后,其中0~3分为预后良好,即神经功能正常或轻残,生活可自理;4~5分为预后不良,即神经功能重残,生活完全不能自理;6分为死亡。

结 果

本组6例患者均采用颅内-颅内血管搭桥术,主要包括ICA岩骨段-RA-PCA搭桥术联合动脉瘤夹闭术(1例,图1)、V3-RA-PCA搭桥术联合动脉瘤孤立术(4例,图2)、M2-RA-P2搭桥术联合动脉瘤孤立术(1例)。所有患者手术均顺利完成。术后即刻复查影像学提示桥血管通畅,动脉瘤不显影,基底动脉上段显影良好。4例患者预后良好,出院时mRS评分0~3分,随访1年仍预后良好;1例术前即为重症蛛网膜下腔出血(Hunt-Hess分级Ⅳ级),虽手术顺利,动脉瘤得以控制,但预后欠佳(出院时mRS评分4分),术后3个月和1年随访时mRS评分均未见明显降低;1例基底动脉干巨大型动脉瘤患者,术前存在蛛网膜下腔出血(Hunt-Hess分级Ⅴ级),手术顺利

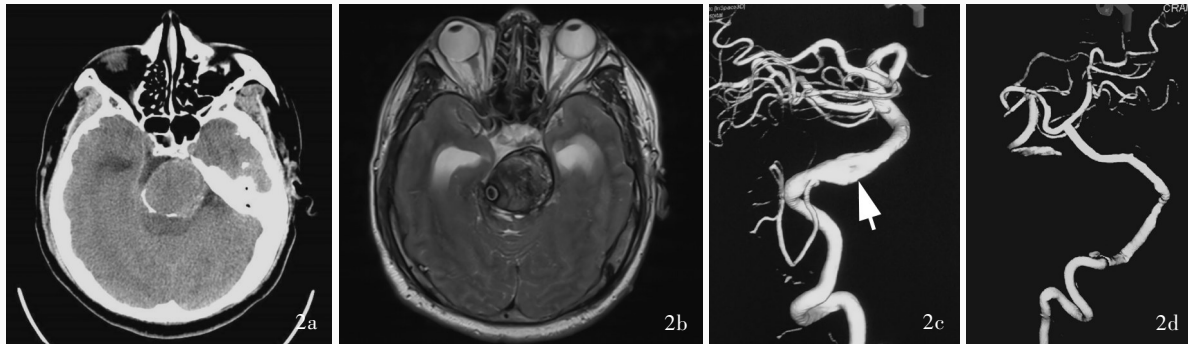


图2 男性患者,52岁,因吞咽障碍伴间断肢体无力2个月,于2017年4月25日入院,既往有蛛网膜下腔出血史(13年前)。DSA提示基底动脉巨型夹层动脉瘤,遂行V3-RA-P2搭桥术联合动脉瘤孤立术。手术前后影像学所见 2a 术前横断面CT显示后颅窝巨大等密度影,考虑巨型基底动脉动脉瘤 2b 术前横断面T₂WI显示,基底动脉巨型夹层动脉瘤伴血栓形成,脑干受压后移 2c 术前DSA三维容积重建可见基底动脉巨型夹层动脉瘤(箭头所示) 2d 术后1周复查DSA三维容积重建可见桥血管通畅,载瘤动脉闭塞,动脉瘤几乎不显影

Figure 2 A 52-year-old male was admitted to the hospital (April 25, 2017) due to dysphagia accompanied by intermittent limb weakness for 2 months. He had a history of SAH 13 years ago. DSA showed a giant dissecting aneurysm of the BA. Consequently, a bypass surgery involving the V3 segment of the VA to the P2 segment of the PCA via the RA, combined with occlusion of the parent artery origin, was performed. The preoperative and postoperative imaging findings Preoperative axial CT shows a huge isodensity in the posterior cranial fossa, suggesting a huge BA aneurysm (Panel 2a). Preoperative axial T₂WI showed a giant dissecting aneurysm of the BA with thrombosis, causing compression on the brainstem (Panel 2b). Preoperative DSA 3D volume reconstruction showed the presence of a giant dissecting aneurysm of the BA (arrow indicates, Panel 2c). One week postoperatively, DSA 3D volume reconstruction showed the bypass vessel was patent, the parent artery was occluded, and the aneurysm was barely visible (Panel 2d).

重建后循环并处理动脉瘤,但因术前病情较严重,经全力抢救,仍于术后1周死亡。

讨 论

基底动脉复杂动脉瘤通常表现为夹层动脉瘤或基底动脉延长扩张型动脉瘤,因此无法通过传统开颅夹闭和介入栓塞将其治愈,血管搭桥术结合动脉瘤孤立术即为此类患者的最后选择,而当动脉瘤累及基底动脉穿支时,低流量血管搭桥术无法足够供血基底动脉上段,因此需要高流量血管搭桥术以逆转整个基底动脉上段的血流并保证基底动脉穿支的供血^[10-11]。

作为传统后循环搭桥的供体动脉,颞浅动脉和枕动脉的缺点是血流量不足,仅可以满足单支大脑后动脉或小脑上动脉的供血,而无法提供足够的对冲血流和整个基底动脉顶端供血,因此低流量血管搭桥术不适宜处理此类动脉瘤^[12],颈外动脉-桡动脉-大脑后动脉高流量血管搭桥术可使此类患者获益,得益于颈外动脉足够强劲的供血,这一术式在处理基底动脉上段动脉瘤中是不可或缺的。其缺点亦不容忽视,走行距离较长导致需要较长的合适直径的桡动脉;桥血管全程穿行在皮下,长期缺乏保护极易受到外界影响如外力损伤,因此,针对后循环的颅内-颅内血管搭桥术日益受到重视。与传

统颅外-颅内血管搭桥术相比,对于涉及后循环的颅内-颅内血管搭桥术,选择颌内动脉、颈内动脉岩骨段、颈内动脉、大脑中动脉和椎动脉V3段作为供体动脉的代表;桥血管则多选择较短长度的桡动脉,因此,选择合适的供体动脉和搭桥方式仍值得进一步探讨。

目前的颅内-颅内血管搭桥术主要的供体动脉包括颈内动脉岩骨段、颈内动脉床突上段、大脑中动脉M2段等,而当这些位于颅内的供体动脉不可用时,邻近区域的供体动脉也被视作颅内供体动脉的补充,如椎动脉V3段、颌内动脉等;常用的桥血管则是桡动脉或大隐静脉(GSV)。大脑中动脉M2段和大脑后动脉P2段则是常用的受体动脉。(1)ICA岩骨段-RA-P2搭桥术:作为Fukushima搭桥的一部分,因其充足的血流和足够短的桥血管长度而广受关注^[13]。这一搭桥术式强调颅底概念,通过磨除颅底骨质充分显露颈内动脉岩骨段以获得较大直径和较高流量的供血,缩短的桥血管长度也避免因动脉痉挛收缩带来的低通畅性和低压力。但准确定位颈内动脉岩骨段并磨除骨质以显露合适长度的血管仍然需要熟练的颅底手术技巧^[14-15]。在本研究中,有1例患者采用这一经典搭桥术式(图1),并获得满意疗效,该术式血流量充足,桥血管短且位于颅底,是值得进一步研究的颅内-颅内血管搭桥术。

(2) V3-RA/GSV-P2搭桥术:椎动脉V3段位置表浅,易于显露,是公认的颅内-颅内血管搭桥术的供体动脉^[16-18]。其备受瞩目的优点是可一期处理基底动脉下段或椎动脉动脉瘤,以及同期完成枕动脉-小脑后下动脉(OA-PICA)搭桥术以保证小脑后下动脉供血^[19],而随着神经介入技术的发展,这一优点已不再突出,而此类搭桥术式较长的桥血管长度、较复杂的显露以及公园长椅卧位给桡动脉获取带来诸多不便^[20]。(3)ICA床突上段/M2-RA-P2搭桥术:以颈内动脉床突上段或大脑中动脉M2段作为供体动脉,此类搭桥的本意是在缺乏后交通动脉的患者中建立1条人工后交通动脉,以维持基底动脉顶端甚至后循环的血供^[2,5]。作为经典的颅内-颅内血管搭桥术式的一种,具有血流量中等偏高、桥血管长度短且血管全程位于颅内、保护性强等优点;而其缺点也显而易见,首先,其供血来源于颈内动脉床突上段或大脑中动脉M2段,其血流量不如颈外动脉或颈内动脉岩骨段;其次,一旦桥血管血栓形成,很可能导致前后循环同时缺血^[20-21]。本研究有1例采用类似搭桥术式,虽然桥血管通畅,但因其病情严重而导致预后不良,因此,该搭桥术式仅可在特定情况下使患者获益。(4)IMA-RA-P2搭桥术:颌内动脉虽不起自颅内,但其起源接近中颅底,桥血管长度短于常规的颅外-颅内高流量血管搭桥术,因而也被视为颅内-颅内血管搭桥术的可靠来源^[22]。但颌内动脉位置深在且显露困难,故不将其作为首选。

综上所述,颅内-颅内血管搭桥术是后循环搭桥技术的一种创新和发展,能够为后循环提供强劲的血流,值得临床根据实际情况选择合适的术式,并深入研究。受限于病例数和回顾性研究,以及缺乏足够长时间的随访和脑血管造影结果,本研究结论尚待进一步证实。

利益冲突 无

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(收稿日期:2024-06-13)

(本文编辑:袁云)

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《中国现代神经疾病杂志》编辑部关于稿件参考文献的要求

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