·脑静脉系统疾病·

“橄榄头”技术在脑静脉窦狭窄支架植入术中的应用

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【摘要】 **目的**　探讨“橄榄头”技术用于脑静脉窦狭窄支架植入术的临床价值。**方法**　回顾分析2017年1月至2021年5月在解放军总医院第一医学中心因脑静脉窦狭窄接受支架植入术治疗的79例患者(伴颅内高压57例、搏动性耳鸣22例)的临床资料,分析“橄榄头“技术组患者Labbe静脉特点、颅内高压患者手术前后狭窄段两端压力差变化,观察术后狭窄改善程度、静脉回流情况、颅内高压和搏动性耳鸣改善情况、支架植入术成功率和“橄榄头”技术使用率。**结果**　79例患者手术成功率为100%,术后即刻DSA显示残留狭窄率<30%、无Labbe静脉滞留。23例(29.11%)因导引导管及支架到位困难采用“橄榄头”技术协助支架顺利到位,其Labbe静脉与静脉窦汇合点直径均大于常规技术患者(t=7.041,P=0.000)。57例颅内高压患者手术前后脑静脉窦狭窄段两端的压力差分别为15.00(11.00,21.50)和1(0,2) mm Hg,二者差异有统计学意义(Z=-6.573,P=0.000);22例搏动性耳鸣患者术后症状消失或明显好转。**结论**　Labbe静脉与静脉窦汇合点直径可以作为脑静脉窦支架植入术前评估支架是否到位困难的指标。扩张的Labbe静脉汇入口易导致导引导管及支架卡顿,支架到位困难,采用”橄榄头“技术可明显提高手术成功率。

【关键词】 “橄榄头”技术(非*MeSH*词);　缩窄,病理性;　脑静脉;　颅窦;　支架

Application of "Olive - Tipped" technique during cerebral venous sinus stenosis stenting

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【**Abstract**】 **Objective**　To explore the clinical significance of "Olive - Tipped" technique during cerebral venous sinus stenosis stenting. **Methods**　A total of 79 patients (including 57 patients with intracranial hypertension and 22 patients with pulsatile tinnitus) who were diagnosed with cerebral venous sinus stenosis (VSS) and underwent stenting in Department of the First Medical Center of Chinese PLA General Hospital from January 2017 to May 2021 were retrospectively collected. The characteristics of Labbe vein in patients with "Olive-Tipped" technique, the changes of pressure difference at both ends of stenosis before and after surgery in patients with intracranial hypertension were analyzed. The improvement of postoperative stenosis and venous reflux, the improvement of postoperative intracranial hypertension and pulsatile tinnitus, the success rate of stenting and the utilization rate of "Olive-Tipped" technique were observed. **Results**　All the stents were successfully placed (79/79). Immediate DSA after procedure showed no venous stasis in all patients, and residual stenosis was < 30%. "Olive-Tipped" technique was used in 23 patients (29.11%) to assist the stent in place due to the guiding catheter and stent could not reach the predetermined position smoothly. The diameter of the confluence of Labbe vein and venous sinus in the "Olive-Tipped" technique group was significantly larger than that in the conventional technique group

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(t = 7.041, P = 0.000). The pressure difference between the two ends of venous sinus stenosis in patients with intracranial hypertension was 15.00 (11.00, 21.50) mm Hg before surgery and 1 (0, 2) mm Hg immediately after surgery, the difference was statistically significant (Z = - 6.573, P = 0.000). The tinnitus sympoms of 22 patients with pulsatile tinnitus caused by cerebral venous sinus stenosis disappeared immediately or visibly lightened. **Conclusions** The diameter of the confluence of Labbe vein and venous sinus can be used as an index to evaluate whether the stent is easy to implant before the surgery. The dilated Labbe vein confluence is easy to cause the guiding catheter and stent to get stuck, and the stent is difficult to be in place. The use of "Olive-Tipped" technique can significantly improve the success rate of the surgery.

【**Key words**】 "Olive-Tipped" technique (not in *MeSH*); Constriction, pathologic; Cerebral veins; Cranial sinuses; Stents

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脑静脉窦狭窄(VSS)是一种较为少见的脑血管病,临床主要表现为顽固性头痛、视乳头水肿和进行性视力下降等颅内高压表现[1-2],以及搏动性耳鸣等症状与体征[3-5];最常见的狭窄部位为横窦与乙状窦交界区[6]。随着神经介入技术的发展,支架植入术已经成为脑静脉窦狭窄的主要治疗方法[7-9]。然而,由于脑静脉窦结构复杂,加之部分病例常合并有Labbe静脉汇入[10]、蛛网膜颗粒增生[11]或纤维条索等异常改变,术中极易发生支架卡顿,部分病例因此而致手术失败。故而如何提高术中支架到位率已成为脑静脉窦支架植入术的难点。为解决这一难题,解放军总医院第一医学中心神经内科医学部神经介入科对导引导管进行改进,于其头端置入球囊,一部分位于导管内,另一部分位于导管外,然后加压(2~3 atm)使球囊形成一个头部呈锥形的"橄榄头",以此来辅助导引导管顺利通过卡顿部位并协助支架到达狭窄区域。自2017年以来,解放军总医院第一医学中心共收治79例脑静脉窦狭窄病例,其中23例(29.11%)支架植入困难者于术中采用"橄榄头"技术("Olive-Tipped" technique)辅助支架到位,术中支架到位率达100%,均获成功,现将结果报告如下。

对象与方法

一、研究对象

1.纳入标准 (1)DSA检查证实存在脑静脉窦狭窄,且狭窄段两端压力差≥10 mm Hg(1 mm Hg = 0.133 kPa)。(2)具有以下症状与体征,包括头痛和进行性视力下降等颅内高压症状,脑脊液压力≥250 mm H_2O(1 mm H_2O = 9.81 × 10^{-3} kPa);明显的视乳头水肿,经药物治疗后症状持续不缓解或短期内病情进行性加重[12];经内科治疗后仍存在无法耐受的脑静脉窦狭窄所致搏动性耳鸣[13]。(3)头部影像学检查未见占位性病变。(4)患者及其家属对手术程序知情并签署知情同意书。

2.排除标准 (1)年龄<18岁。(2)妊娠期女性。(3)存在明确的抗血小板药、肝素、对比剂或麻醉剂禁忌证,或不能耐受上述药物治疗者。(4)合并有恶性肿瘤、严重凝血功能障碍、严重肝肾功能障碍,既往有颅内出血,或者未经治疗的颅内动静脉畸形或颅内动脉瘤,以及患有精神病或存在认知功能障碍不能配合检查及手术者。(5)预期生存期<1年者。(6)手术所需动脉或静脉路径不宜施行介入操作者。(7)患者或其法定委托人拒绝行DSA检查及脑静脉窦支架植入术[14]。

3.一般资料 选择2017年1月至2021年5月经我院确诊为脑静脉窦狭窄并行支架植入术的患者共79例,其中57例具有颅内高压表现,经脑脊液、眼底、DSA和脑静脉窦测压术等检查诊断为脑静脉窦狭窄伴颅内高压;其余22例临床表现为源于脑静脉窦狭窄的搏动性耳鸣。男性7例,女性72例;年龄16~62岁,平均(36.74±10.77)岁;本组病例均为横窦与乙状窦交界区狭窄,右侧59例(74.68%)、左侧20例(25.32%)。

二、治疗方法

1.围手术期处理 所有患者术前均予阿司匹林

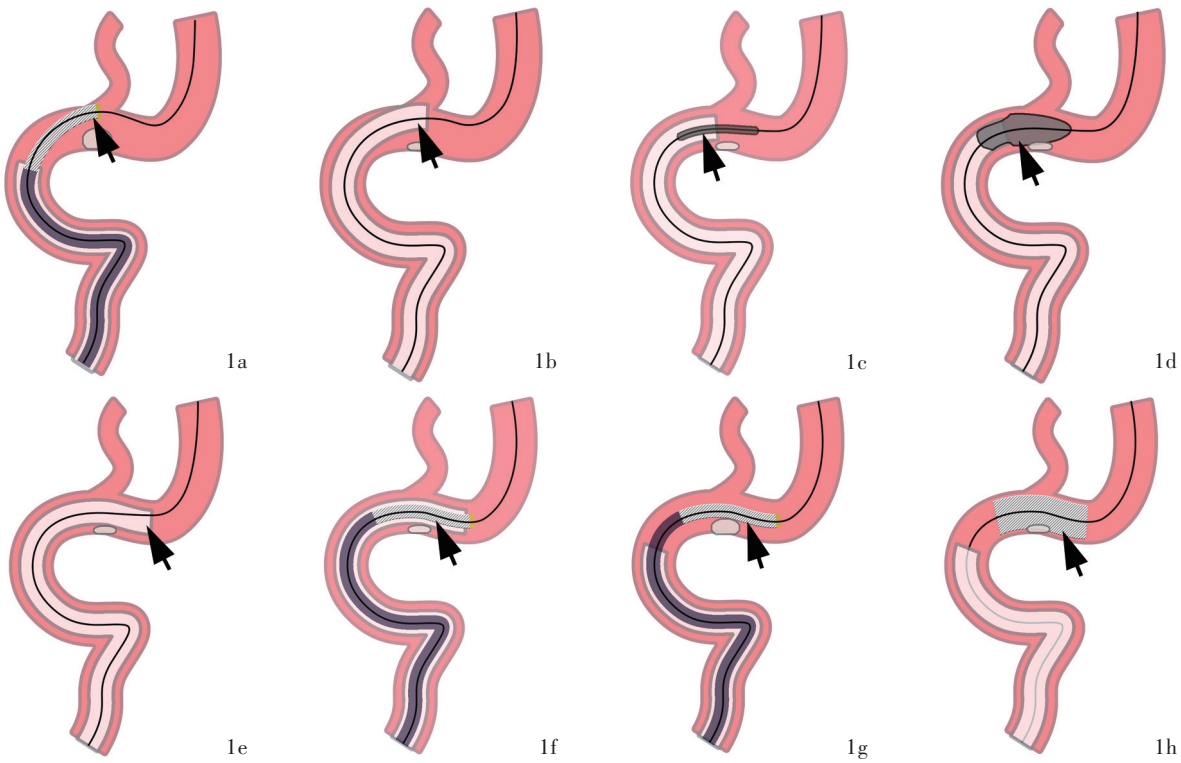

图1　“橄榄头”技术操作示意图　1a　支架头端卡顿在Labbe静脉汇入点(箭头所示)　1b　欲向远端输送导引导管,但头端卡顿在Labbe静脉汇入点(箭头所示)　1c　置入球囊,一半置于导引导管头端内,另一半露出导引导管头端(箭头所示)　1d　呈锥形的“橄榄头”球囊充盈(箭头所示)　1e　导引导管通过狭窄段血管(箭头所示)　1f　支架在导引导管的引导下到达狭窄段血管(箭头所示)　1g　回撤导引导管,准确定位并准备释放支架(箭头所示)　1h　支架释放完毕,定位准确,覆盖病变区域(箭头所示)

Figure 1　Detailed operation chart of "Olive-Tipped" technique　The head of stent was stuck at the confluence point of Labbe vein (arrow indicates, Panel 1a). The guiding catheter attempted to pass through the stenosis site and reach the distal end to assist the stent in place, but the head end of the guiding catheter was stuck at the confluence point of Labbe vein (arrow indicates, Panel 1b). The balloon was delivered to target position, half of the balloon was placed in the head end of the guiding catheter, and the other half was exposed from the head end of the guiding catheter (arrow indicates, Panel 1c). The balloon inflated and formed aconical "Olive-Tipped" structure (arrow indicates, Panel 1d). The guiding catheter passed through the stenosis site (arrow indicates, Panel 1e). The stent reached stenosis site through the guiding catheter (arrow indicates, Panel 1f). After the stent reached predetermined position, we pulled the guiding catheter back and prepared to release the stent (arrow indicates, Panel 1g). The stent was released, positioned accurately and covered the lesion completely (arrow indicates, Panel 1h).

100 mg/d联合氯吡格雷75 mg/d双联抗血小板治疗至少5天,术前血栓弹力图(TEG)检查,花生四烯酸(AA)抑制率>50%且ADP抑制率>30%,提示抗血小板治疗达标。术前脑脊液检测压力<250 mm H_2O的颅内高压患者,不予手术治疗。

2.脑静脉窦支架植入术　患者仰卧位、全身麻醉,经股动脉入路将4F造影导管(美国Cordis公司)置入患侧颈动脉和椎动脉,DSA确认脑静脉窦狭窄位置[15]。经对侧股静脉入路,将8F导引导管(美国Boston Scientific公司)经患侧颈内静脉置入乙状窦;Renegade微导管(美国Boston Scientific公司)通过狭窄段血管置于上矢状窦内,并对狭窄段两端血管测压[16]。采用导丝交换技术,将300 cm Transend导丝(美国Boston Scientific公司)置于上矢状窦内,沿微导丝导入球囊,扩张狭窄段血管,于球囊充盈时行动脉造影明确引流静脉是否存在回流障碍,然后撤出球囊,沿微导丝送入Precise支架(美国Cordis公司)并释放[14]。对于常规操作技术导引导管及支架到位困难的患者,采用“橄榄头”技术,即选择1个直径4~5 mm、长度20 mm的球囊,将球囊一半置于导引导管头端内,另一半露出导引导管头端,然后将球囊压力升至2~3 atm,使球囊在导引导管头端形成一个锥形、类似“橄榄头”的结构,协助导引导管通过狭窄段血管,然后再导入支架至导引导管,支架到位后回撤导引导管,准确定位后释放支架(图1)。对于术前伴有颅内高压的患者,术后3~7 d行脑脊液检查。

3.评价指标　(1)计算支架植入术成功率和“橄

橄头”技术使用率。(2)选择患者术前DSA静脉窦期,测量Labbe静脉汇入静脉窦之前的最大直径和Labbe静脉与静脉窦汇合点的最大直径,以分析应用“橄榄头”技术的Labbe静脉特点。(3)术前采用微导管测量静脉窦狭窄段两端压力差,支架释放后再次采用微导管测量静脉窦狭窄段两端压力差,以观察手术前后狭窄段两端压力差变化。(4)支架释放后即刻行患侧颈动脉或椎动脉DSA造影,观察脑静脉窦狭窄改善程度和静脉回流情况。(5)术后颅内高压和搏动性耳鸣症状改善情况。

4.统计分析方法 应用SPSS 22.0统计软件进行数据处理与分析。计数资料以相对数构成比(%)或率(%)表示。采用Kolmogorov-Smirnov检验数据是否符合正态分布,呈正态分布的计量资料采用均数±标准差($\bar{x} \pm s$)表示,两组间比较采用两独立样本的t检验;呈非正态分布的计量资料采用中位数和四分位数间距[$M(P_{25}, P_{75})$]表示,两组间比较采用Wilcoxon秩和检验。以$P \leq 0.05$为差异具有统计学意义。

结 果

本组79例患者脑静脉窦狭窄支架植入术均获成功,手术成功率为100%,所有患者术后即刻DSA显示残留狭窄率<30%,无一例Labbe静脉滞留。其中,23例(29.11%)术中导引导管及支架到位困难,改用“橄榄头”技术协助支架到位(图2),并顺利完成手术。采用“橄榄头”技术的患者中,导引导管及支架难以通过狭窄段的主要原因为Labbe静脉汇入静脉窦处扩张,亦有少部分患者为静脉窦内蛛网膜颗粒增生或纤维条索形成,导引导管及支架通过弯曲的横窦与乙状窦交界区时,头端形成向上的张力,易卡顿在以上突起结构处,导致支架到位困难(图2)。

根据是否采用“橄榄头”技术将患者分为常规技术组(56例)与“橄榄头”技术组(23例),对两组患者Labbe静脉直径及其与静脉窦汇合点直径进行对比分析,Labbe静脉直径组间差异无统计学意义($P=0.751$),但Labbe静脉与静脉窦汇合点直径“橄榄头”技术组大于常规技术组($P=0.000$,表1),提示Labbe静脉与静脉窦汇合点直径较大者,更易造成导引导管卡顿,为术中需采用“橄榄头”技术的适宜人群。

本研究中57例脑静脉窦狭窄伴颅内高压患者术后症状明显好转,术前脑脊液压力>330 mm H_2O者35例(61.40%),250~330 mm H_2O者22例(38.60%);术后脑脊液压力>330 mm H_2O者1例(1.75%),250~330 mm H_2O者9例(15.79%),180~250 mm H_2O者33例(57.89%)以及<180 mm H_2O者14例(24.56%)。术前静脉窦狭窄段两端压力差为10~59 mm Hg,中位值15.00(11.00,21.50) mm Hg,术后即刻狭窄段两端压力差为0~8 mm Hg,中位值1(0,2) mm Hg,手术前后差异具有统计学意义($Z=-6.573$,$P=0.000$)。22例脑静脉窦狭窄致搏动性耳鸣患者中20例(90.91%)术后耳鸣即刻消失,2例(9.09%)明显改善。

讨 论

自1994年Marks等[17]首次报告采用支架植入术治疗脑静脉窦狭窄以来,随着神经介入技术的不断发展,脑静脉窦支架植入术已成为治疗症状性(伴颅内压升高和搏动性耳鸣)脑静脉窦狭窄最为有效的方法[13,18-19]。但是由于脑静脉窦结构复杂,支架植入较为困难,手术成功率仅约80%,主要原因是支架无法顺利到位[12],且手术并发症发生率较高[20-21]。大样本尸检研究显示,约30.4%的正常人静脉窦内存在蛛网膜颗粒、29.4%可见纤维条索[22],当蛛网膜颗粒或纤维条索发生增生即可导致窦腔变小、狭窄;此外,静脉窦狭窄合并Labbe静脉汇入静脉窦处扩张者亦十分常见。在支架植入过程中,导引导管和支架通过乙状窦与横窦交界区时,其头端极易卡顿在Labbe静脉汇入口、蛛网膜颗粒、纤维条索等结构内,导致支架到位困难。其主要原因是交换导丝与导引导管之间存在的直径差所致,使导引导管的边缘被静脉窦内的结构所阻挡。为此,本研究团队对导引导管头端进行改进,将球囊头端置于导管开口的位置,然后部分扩张球囊使其前端呈锥形,扩张后的球囊恰可消除交换导丝与导引导管之间的直径差,同时球囊导管也可增加导引导管的支撑力,使导引导管可以顺畅地通过静脉窦内部不平滑的结构。由于导引导管头端的球囊类似于“橄榄”样结构,因此命名为“橄榄头”技术。经检索,目前尚无应用“橄榄头”技术治疗脑静脉系统疾病的报道,但曾有学者应用类似技术处理椎动脉起始部支架植入术中保护伞回收困难病例,即将保护伞回收鞘在小球囊的引导下通过迂曲的椎动脉开口[23],但后续研究较少。

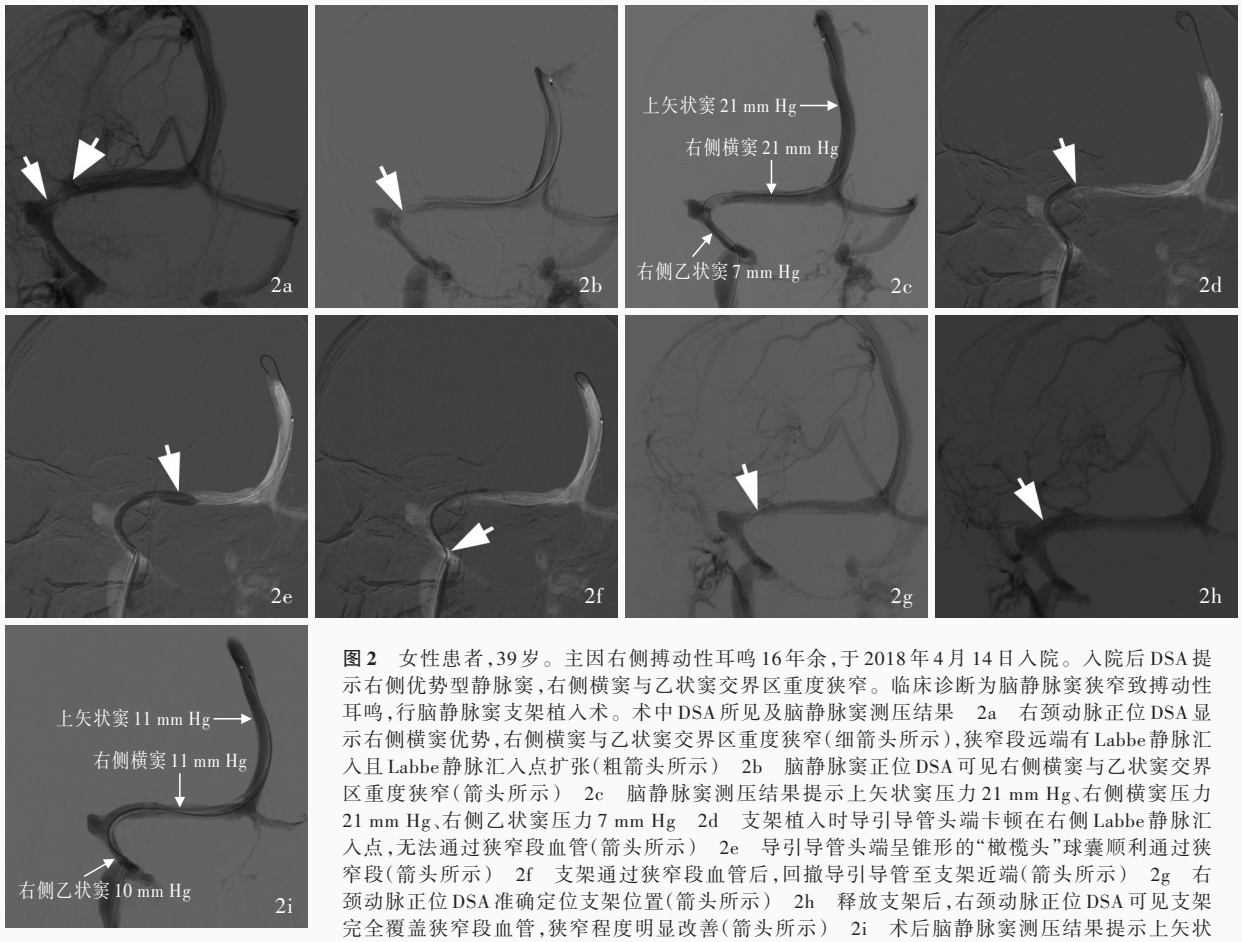

图2　女性患者，39岁。主因右侧搏动性耳鸣16年余，于2018年4月14日入院。入院后DSA提示右侧优势型静脉窦，右侧横窦与乙状窦交界区重度狭窄。临床诊断为脑静脉窦狭窄致搏动性耳鸣，行脑静脉窦支架植入术。术中DSA所见及脑静脉窦测压结果　2a　右颈动脉正位DSA显示右侧横窦优势，右侧横窦与乙状窦交界区重度狭窄（细箭头所示），狭窄段远端有Labbe静脉汇入且Labbe静脉汇入点扩张（粗箭头所示）　2b　脑静脉窦正位DSA可见右侧横窦与乙状窦交界区重度狭窄（箭头所示）　2c　脑静脉窦测压结果提示上矢状窦压力21 mm Hg、右侧横窦压力21 mm Hg、右侧乙状窦压力7 mm Hg　2d　支架植入时导引导管头端卡顿在右侧Labbe静脉汇入点，无法通过狭窄段血管（箭头所示）　2e　导引导管头端呈锥形的“橄榄头”球囊顺利通过狭窄段（箭头所示）　2f　支架通过狭窄段血管后，回撤导引导管至支架近端（箭头所示）　2g　右颈动脉正位DSA准确定位支架位置（箭头所示）　2h　释放支架后，右颈动脉正位DSA可见支架完全覆盖狭窄段血管，狭窄程度明显改善（箭头所示）　2i　术后脑静脉窦测压结果提示上矢状窦压力11 mm Hg、右侧横窦压力11 mm Hg、右侧乙状窦压力10 mm Hg

Figure 2　A 39-years-old female patient was admitted to the hospital on April 14, 2018 due to right pulsing tinnitus for more than 16 years. After the admission, DSA showed that the right transverse sinus was dominant and a severe stenosis at the right transverse-sigmoid junction. The patient was diagnosed clinically as pulsatile tinnitus related to VSS and underwent cerebral venous sinus stenting. Intraoperative DSA findings and microcatheter pressure measurement results　The anterior-posterior view of right carotid artery DSA showed a severe stenosis at the right transverse-sigmoid junction (thin arrow indicates), Labbe vein confluence was found at the distal end of the stenosis, and the confluence point of Labbe vein and venous sinus was dilated (thick arrow indicates, Panel 2a). Cerebral venous sinus frontal angiography revealed a focal stenosis at the right transverse-sigmoid junction (arrow indicates, Panel 2b). The results of microcatheter pressure measurement showed the pressure of superior sagittal sinus was 21 mm Hg, the pressure of right transverse sinus was 21 mm Hg, and the pressure of right sigmoid sinus was 7 mm Hg (Panel 2c). During the surgery, the head of the guiding catheter was stuck at the right Labbe confluence point and could not pass through the stenosis site (arrow indicates, Panel 2d). The "Olive-Tipped" technique was used and the conical olive-tipped balloon assisted the guiding catheter smoothly passing the stenosis site (arrow indicates, Panel 2e). After the stent passed through the stenosis, the guide catheter was retracted to the proximal end of the stent (arrow indicates, Panel 2f). The anterior-posterior view of right carotid artery DSA showed the stent was accurately positioned (arrow indicates, Panel 2g). After the stent was released, the anterior-posterior view of right carotid artery showed the stent completely covered the stenosis and the stenosis improved obviously (arrow indicates, Panel 2h). Postoperative microcatheter pressure measurement showed the pressure of superior sagittal sinus was 11 mm Hg, the pressure of right transverse sinus was 11 mm Hg, and the pressure of right sigmoid sinus was 10 mm Hg (Panel 2i).

本研究团队自2017年以来在脑静脉窦支架植入术中成功应用“橄榄头”技术解决导引导管及支架头端通过静脉窦内不平滑结构时卡顿的问题，极大地提高了技术成功率。本组79例患者中23例在脑静脉窦支架植入术中应用“橄榄头”技术，应用率约为29.11%，观察结果表明，Labbe静脉与静脉窦汇合点直径与术中支架到位困难密切相关，尤其是Labbe静脉与静脉窦汇合点直径较大者这种情况更为严重，故建议对此类患者采用“橄榄头”技术以提高手术成功率；此外，Labbe静脉与静脉窦汇合点的直径也可作为术前评估支架是否到位困难的指标。我们的临床经验表明，对于Labbe静脉与静脉窦汇合点扩张、术中支架到位困难的患者，“橄榄头”技术可以提高手术成功率、减少并发症。

“橄榄头”技术仅是采用现有介入器械，通过非常规组合应用以提高手术成功率的方法，未来希望

表1 常规技术组与“橄榄头”技术组患者Labbe静脉解剖特点的比较($\bar{x} \pm s$,mm)

Table 1. Comparison of anatomical characteristics of Labbe vein between conventional technology group and "Olive-Tipped" technology group ($\bar{x} \pm s$, mm)

组别	例数	静脉直径	静脉与静脉窦汇合点直径
常规技术组	56	2.26±0.65	2.52±0.95
“橄榄头”技术组	23	2.31±0.53	4.63±1.69
t值		0.319	7.041
P值		0.751	0.000

能够延续该理念,设计出适用于脑静脉窦的专用导引导管和支架,从根本上解决脑静脉窦支架植入术成功率低的问题。

利益冲突 无

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