·临床研究·

颈内动脉缺如超声诊断要点及其他影像学特点分析

程盼 刘保龙 赵碧波 于德林

【摘要】 **目的** 总结颈内动脉缺如的超声诊断要点及其他影像学特征。**方法与结果** 选择天津市环湖医院2014年1月至2023年5月明确诊断的14例颈内动脉缺如患者。CTA和(或)MRA均表现为颈动脉管缺失,颈内动脉全程不显影伴有颅内血管发育异常;颈内动脉缺如位于左侧8例,右侧5例,双侧1例;颅内侧支循环代偿LIE分型6例为A型,2例与A型略有不同(缺如侧大脑前动脉A1段存在),2例为B型,1例为C型,1例与D型略有不同(缺如侧大脑前动脉经前交通动脉由对侧大脑前动脉供血,缺如侧大脑中动脉由对侧颈内动脉床突段发出分支供血)。颈动脉超声均可见颈总动脉颅外段纤细且未见分叉,直接延续为颈外动脉,提示单侧或双侧颈内动脉缺如;颈动脉超声二维结构及彩色血流全程多角度扫描均未探及颈动脉分叉,颈总动脉直接延续为单一颈外动脉并可见多个分支;颞浅动脉叩击试验可见血流频谱舒张期呈"锯齿"样改变,提示为颈外动脉;缺如侧颈总动脉与颈外动脉血流频谱形态具有一致性。**结论** 颈内动脉缺如经颈动脉超声初步诊断的准确性较高,适于临床推广应用。

【关键词】 颈内动脉; 先天畸形; 超声检查; 计算机体层摄影血管造影术

The utilization of carotid artery ultrasound in diagnosis of internal carotid artery absence and its imaging features

CHENG Pan[1], LIU Bao-long[1], ZHAO Bi-bo[2], YU De-lin[1]

[1]Department of Ultrasound Diagnosis, [2]Department of Medical Imaging, Tianjin Huanhu Hospital, Tianjin 300350, China

Corresponding author: YU De-lin (Email: 13752227609@163.com)

【**Abstract**】 **Objective** To explore diagnosis points of carotid artery ultrosound in patients of internal carotid artery (ICA) absence and other imaging features. **Methods and Results** Total 14 patients diagnosed with ICA absence in Tianjin Huanhu Hospital from January 2014 to May 2023 were retrospectively analyzed. Ten patients were male and 4 patients were female. The age of patients ranged from 13 to 79 years. Imaging exam: the CTA and (or) MRA of all patients showed absence of carotid canal, no development of the entire ICA, combined with intracranial vascular abnormalities. Eight of 14 patients had left ICA absence, 5 had right ICA absence, and one had bilateral ICA absence. According to collateral compensation LIE typing, 6 cases were type A, 2 cases were similar to type A with the existent of the A1 segment of ipsilateral anterior cerebral artery (ACA), 2 cases were type B, one case was type C, and one case was similar to type D as ipsilateral ACA was supplied by opposite through the anterior communicating artery, the ipsilateral middle cerebral artery (MCA) was supplied from the clinoid process of the contralateral ICA. Carotid artery ultrasound: all the 14 patients showed thin vessels in the extracranial segment of the common carotid artery (CCA) without bifurcation, which directly continued into external carotid artery (ECA), indicating the absence of one or both ICA absence; carotid artery bifurcation was not detected in multi-angle scanning of both 2D scan and color Doppler flow imaging, and the CCA directly continued into a single artery ECA with multiple branches; a "sawtooth" spectrum of the ipsilateral ECA was observed when tap the superficial temporal artery, which indicated that the artery was ECA; blood flow spectrum of the ipsilateral CCA was consistent with ipsilateral ECA. **Conclusions** Carotid artery ultrasound has high accuracy in the initial diagnosis of ICA absence. It is suitable for clinical application.

【**Key words**】 Carotid artery, internal; Congenital abnormalities; Ultrasonography; Computed tomography angiography

Conflicts of interest: none declared

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作者单位:300350 天津市环湖医院超声科(程盼、刘保龙、于德林),影像科(赵碧波)

通讯作者:于德林,Email:13752227609@163.com

颈内动脉(ICA)缺如是一种罕见的先天性血管发育异常性疾病,其发病率<0.01%,双侧发病者罕见[1]。目前,国内外关于颈内动脉缺如以个案报道居多[2],且单纯颈内动脉缺如病例更少[3],大部分病例为颈内动脉发育不良[4-5]。脑血管病的诊断"金标准"为DSA,但DSA对颈内动脉缺如的诊断存在局限性,成像过程中无法显示颈动脉管的解剖结构,仅提示颈内动脉未显影,但无法区分其与颈内动脉闭塞造成的不显影。CT可清晰显示骨质结构,故可明确颈动脉管是否存在,联合CTA和(或)MRA可以明确颈内动脉是否显影和颅内血管代偿情况。因此,颈内动脉缺如的诊断需各项影像学检查的联合诊断。近年随着国家对脑卒中重视程度的不断增加,颈动脉超声因其更便捷、低价、无创、无辐射、可重复性高的优势,越来越多地应用于高危人群的筛查,从而凸显出颈动脉超声对颈内动脉缺如的初步诊断价值。本研究以天津市环湖医院近10年明确诊断的14例颈内动脉缺如患者为观察对象,总结其超声检查和影像学检查要点,以期提高颈动脉超声的诊断应用。

临床资料

一、病例选择

1.纳入与排除标准 (1)颈内动脉缺如的诊断标准为CTA和(或)MRA主要表现为颈动脉管缺失,颈内动脉全程不显影,同时伴颅内血管发育异常[6]。(2)均行颈动脉超声检查并诊断为颈内动脉缺如。(3)至少行头颈部CTA或MRA检查中的一项并且经2位高年资影像科医师同时诊断为颈内动脉缺如。(4)临床资料完整。(5)排除颈内动脉闭塞或颈内动脉发育不良患者。

2.一般资料 根据上述纳入与排除标准,选择2014年1月至2023年5月于我院经超声和影像学检查明确诊断的颈内动脉缺如患者14例,男性10例,女性4例;年龄为13~79岁,其中1~20岁1例、21~40岁1例、41~60岁8例、61~80岁4例。4例以颈内动脉缺如侧脑卒中入院,其中2例表现为单侧肢体活动不利、2例表现为头晕、恶心伴肢体活动不利;1例以蛛网膜下腔出血入院,表现为头痛、恶心伴喷射样呕吐;余9例未发生颈内动脉缺如侧相关脑卒中,其中2例因短暂性晕厥就诊、3例头晕伴视物旋转、1例阵发性头痛数月余、1例视物不清、1例突发头痛伴意识丧失、1例癫痫发作。

二、影像学检查

本组14例患者中7例行CTA检查、5例行MRA检查、2例行CTA联合MRA检查,均显示颈动脉管缺失(图1a~1d),位于左侧者8例、右侧者5例、双侧者1例,颈内动脉全程不显影(图1e,1f)伴不同类型颅内侧支循环代偿通路;其中3例存在动脉瘤。

1.不同类型颅内侧支循环代偿通路 (1)判断标准:1968年Lie和Hage[7]提出的LIE分型,是目前颈内动脉缺如患者颅内侧支循环代偿的分型标准,共分为6种类型,即A型,缺如侧大脑前动脉(ACA)经前交通动脉由对侧大脑前动脉供血,伴缺如侧大脑前动脉A1段缺如,而缺如侧大脑中动脉(MCA)经后交通动脉供血;B型,缺如侧大脑前动脉和大脑中动脉均经前交通动脉由对侧颈内动脉供血;C型,双侧颈内动脉缺如,大脑前动脉和大脑中动脉经后交通动脉由椎-基底动脉供血;D型,单侧颈内动脉颈段缺如,缺如侧颈内动脉虹吸段经海绵窦间异常吻合支由对侧颈内动脉供血;E型,细小的双侧大脑前动脉经双侧发育不良的颈内动脉供血,而双侧大脑中动脉经扩张的后交通动脉供血;F型,缺如侧大脑前动脉和大脑中动脉经颅底吻合支由颈外动脉(ECA)供血。(2)LIE分型:本组有9例存在不同LIE分型,6例为A型(图2a)、2例为B型(图2b)、1例为C型(图2c)。(3)其他颅内侧支循环代偿类型:本组有5例为不同于LIE分型的颅内侧支循环代偿类型,2例颅内侧支代偿与A型略有不同,其缺如侧大脑前动脉A1段尚存(图2d);1例与D型略不同,表现为缺如侧大脑前动脉经前交通动脉由对侧大脑前动脉供血,缺如侧大脑中动脉由对侧颈内动脉床突段发出分支供血(图2e);1例表现为缺如侧颈内动脉海绵窦段与基底动脉异常吻合,考虑为原始三叉动脉即缺如侧大脑前动脉和大脑中动脉由后循环供血;1例表现为缺如侧大脑前动脉经前交通动脉由对侧大脑前动脉供血,缺如侧大脑前动脉A1段缺如,大脑后动脉和后交通动脉显影浅淡未供血大脑中动脉,大脑中动脉M1段不显影且远端分支显影浅淡,考虑由皮质动脉吻合支供血(图2f)。

2.颅内动脉瘤 本组有3例存在颅内动脉瘤,其中1例为前交通动脉瘤(图2c),1例为前交通动脉瘤合并主动脉瘤(图2g),1例为基底动脉瘤(图2d)。

三、超声检查

1.颈动脉超声检查 采用日本Hitachi株式会社Asendus、荷兰Phillips公司IU 22和(或)深圳迈瑞

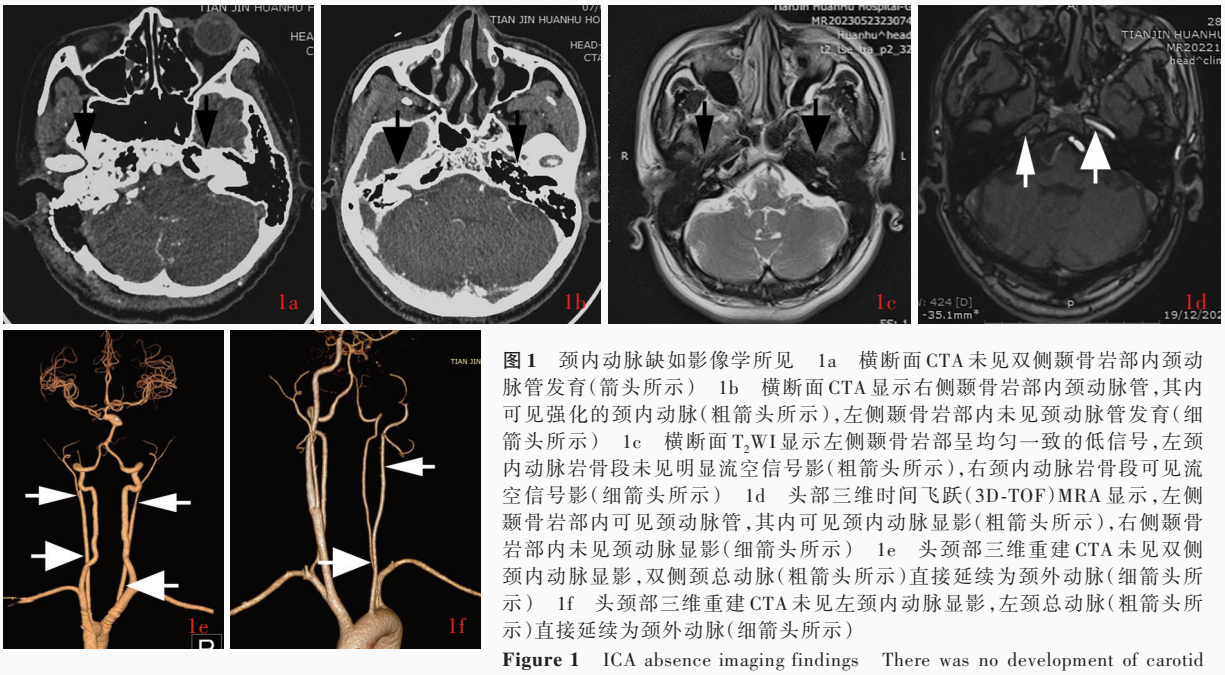

图1　颈内动脉缺如影像学所见　1a　横断面CTA未见双侧颞骨岩部内颈动脉管发育(箭头所示)　1b　横断面CTA显示右侧颞骨岩部内颈动脉管,其内可见强化的颈内动脉(粗箭头所示),左侧颞骨岩部内未见颈动脉管发育(细箭头所示)　1c　横断面T_2WI显示左侧颞骨岩部呈均匀一致的低信号,左颈内动脉岩骨段未见明显流空信号影(粗箭头所示),右颈内动脉岩骨段可见流空信号影(细箭头所示)　1d　头部三维时间飞跃(3D-TOF)MRA显示,左侧颞骨岩部内可见颈动脉管,其内可见颈内动脉显影(粗箭头所示),右侧颞骨岩部内未见颈动脉显影(细箭头所示)　1e　头颈部三维重建CTA未见双侧颈内动脉显影,双侧颈总动脉(粗箭头所示)直接延续为颈外动脉(细箭头所示)　1f　头颈部三维重建CTA未见左颈内动脉显影,左颈总动脉(粗箭头所示)直接延续为颈外动脉(细箭头所示)

Figure 1　ICA absence imaging findings　There was no development of carotid canal in the petrous part of bilateral temporal bones (arrows indicate, Panel 1a). The carotid canal was visible in the petrous part of right temporal bone, with enhanced ICA (thick arrow indicates). There was no development of carotid canal in the petrous part of left temporal bone (thin arrow indicates, Panel 1b). Axial T_2WI of the petrous part of left temporal bone showed uniform hypointensity. There was no obvious flow signal in left ICA petrous segment (thick arrow indicates), while the flow signal was visible in the right ICA petrous segment (thin arrow indicates, Panel 1c). Head 3D-TOF MRA showed the carotid canal was visible in the petrous part of left temporal bone, with ICA development (thick arrow indicates). There was no development of carotid canal in the petrous part of right temporal bone (thin arrow indicates, Panel 1d). 3D VR reconstruction image of the head and neck CTA showed no enhancement of bilateral ICA, and bilateral CCA (thick arrows indicate) continued directly to ECA (thin arrows indicate, Panel 1e). 3D VR reconstruction image of the head and neck CTA showed no enhancement of the left ICA, and the left CCA (thick arrow indicates) continued directly to the ECA (thin arrow indicates, Panel 1f).

生物医疗电子股份有限公司Resona 7彩色多普勒超声诊断仪。探头选用3~9 MHz超宽频线阵探头和4~8 MHz微凸阵探头。颈动脉颅外段超声检查方法参照《中国脑卒中血管超声检测指导规范》(http://www. nhc. gov. cn/yzygj/s3593/202108/50c4071a86df4bfd9666e9ac2aaac605. shtml)。颈动脉超声均可见颈总动脉(CCA)颅外段纤细且未见分支,直接延续为颈外动脉,提示单侧或双侧颈内动脉缺如。颈动脉超声二维结构及彩色血流全程多角度扫描均未探及颈动脉分叉,颈总动脉直接延续为单一颈外动脉,并可见多个分支(图3a);缺如侧颈总动脉与颈外动脉血流频谱形态具有一致性(图3b,3c),对侧颈总动脉血流频谱形态介于颈内动脉与颈外动脉之间(图3d~3f)。于颈总动脉甲状腺水平测量缺如侧管径为3.10~5.80 mm、平均为(3.99±0.73) mm,对侧管径为5.70~10.10 mm,平均为(7.12±1.26) mm,缺如侧管径较对侧纤细且差异具有统计学意义(配对t检验:t=7.732,P=0.000;图4a,4b)。

2. 颞浅动脉叩击试验　本组14例患者缺如侧颈总动脉远端在频谱多普勒模式下行颞浅动脉(STA)叩击试验,可见血流频谱舒张期呈"锯齿"样改变,提示为颈外动脉,即颈总动脉直接延续为颈外动脉(图4c)。

讨　论

颈内动脉是颈总动脉的分支,通常双侧存在,配对的颈内动脉作用主要是向大脑前2/3供血,亦为双眼和其他颅骨结构供血。颈内动脉为大脑重要供血动脉之一,很少发生解剖变异。1787年,Tode教授首次在尸检时发现颈动脉发育不全[8]。一般认为,颈内动脉起源于第三主动脉弓[9],但颈总动脉和颈外动脉起源仍存争议。有研究认为,近心端颈内动脉和颈外动脉均起源于第三主动脉弓,故颈内动脉缺如应伴随同侧颈外动脉缺如[10];另有研究认为,由于颈内动脉独立于主动脉囊,即使颈内动脉发育不全,颈外动脉和颈总动脉仍可以正常发育[11]。本研究14例患者颈内动脉缺如侧颈总动脉

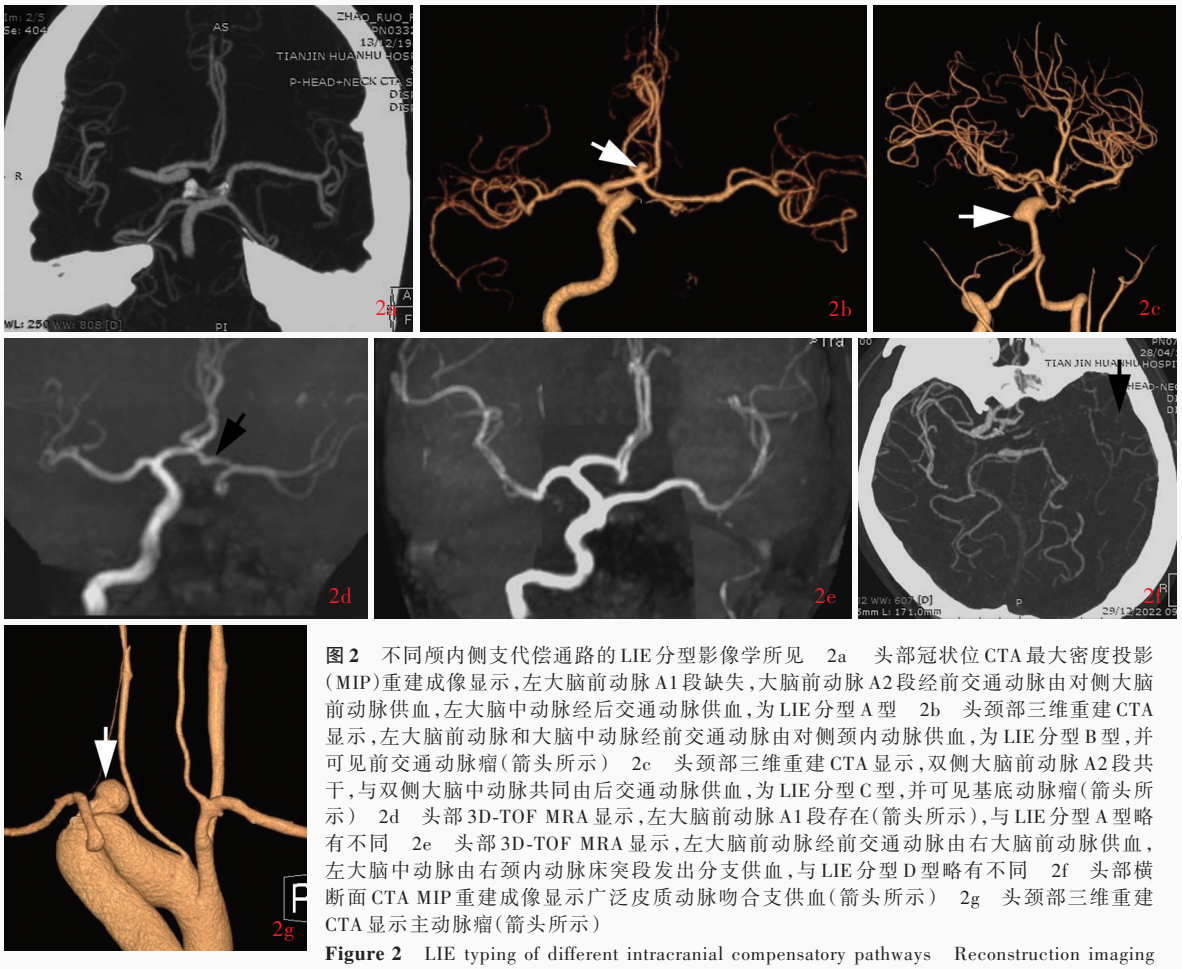

图2 不同颅内侧支代偿通路的LIE分型影像学所见 2a 头部冠状位CTA最大密度投影(MIP)重建成像显示,左大脑前动脉A1段缺失,大脑前动脉A2段经前交通动脉由对侧大脑前动脉供血,左大脑中动脉经后交通动脉供血,为LIE分型A型 2b 头颈部三维重建CTA显示,左大脑前动脉和大脑中动脉经前交通动脉由对侧颈内动脉供血,为LIE分型B型,并可见前交通动脉瘤(箭头所示) 2c 头颈部三维重建CTA显示,双侧大脑前动脉A2段共干,与双侧大脑中动脉共同由后交通动脉供血,为LIE分型C型,并可见基底动脉瘤(箭头所示) 2d 头部3D-TOF MRA显示,左大脑前动脉A1段存在(箭头所示),与LIE分型A型略有不同 2e 头部3D-TOF MRA显示,左大脑前动脉经前交通动脉由右大脑前动脉供血,左大脑中动脉由右颈内动脉床突段发出分支供血,与LIE分型D型略有不同 2f 头部横断面CTA MIP重建成像显示广泛皮质动脉吻合支供血(箭头所示) 2g 头颈部三维重建CTA显示主动脉瘤(箭头所示)

Figure 2 LIE typing of different intracranial compensatory pathways Reconstruction imaging of maximum intensity projection (MIP) of head CTA showed the A1 segment of left ACA was absent, the A2 segment of left ACA supplied through anterior communicating artery, and the left MCA supplied blood through the posterior communicating artery, as type A of LIE (Panel 2a). 3D VR reconstruction image of head and neck CTA showed the left ACA and MCA were supplied by the contralateral ICA through the anterior communicating artery, as type B of LIE, while anterior communicating aneurysm was seen (arrow indicates, Panel 2b). 3D VR reconstruction image of head and neck CTA showed the A2 segment of bilateral ACA was co-stem, the bilateral MCA were supplied by posterior communicating artery, as type C of LIE, while basal aneurysm was seen (arrow indicates, Panel 2c). 3D-TOF of head MRA showed the A1 segment of left ACA was existent (arrow indicates), which was slightly different from the type A of LIE (Panel 2d). 3D-TOF of head MRA showed the left ACA was supplied by the opposite through the anterior communicating artery, the left MCA was supplied from the clinoid process of the contralateral ICA, which was slightly different from the type D of LIE (Panel 2e). Reconstruction image of MIP of head CTA showed extensive cortical anastomosis branch blood supply (arrow indicates, Panel 2f). 3D VR reconstruction image of head and neck CTA showed the aortic aneurysm (arrow indicates, Panel 2g).

和颈外动脉均存在,仅表现为缺如侧颈总动脉较对侧纤细,更支持后一种观点。

在颈内动脉缺如的情况下,颈内动脉远端和脑血流模式取决于胚胎发育受损阶段。Cali等[12]认为,如果胚胎发育受损发生于Willis环形成之前,侧支循环的原始通路(即颈内动脉海绵窦段间吻合)在供血中占主导地位;如果胚胎发育受损发生于胚胎发育至24毫米后,Willis环侧支代偿则占主导地位。本研究14例患者中有6例为LIE分型A型,还有2例与A型略有不同,即缺如侧大脑前动脉A1段存在,亦见于金鑫等[13]的个案报道;2例为LIE分型B型,但此2例均同时存在其他颅内血管变异,其中1例对侧小脑上动脉远端发出分支与缺如侧脉络膜后动脉吻合,1例对侧颈内动脉床突段发出分支与缺如侧后交通动脉吻合,且对侧为胚胎型大脑后动脉,同时该例患者还存在前交通动脉瘤和主动脉瘤;仅1例为LIE分型C型,即双侧大脑前动脉和大脑中动脉由后交通动脉供血,双侧大脑前动脉A2段共干,后循环粗壮伴基底动脉瘤,可能与该部位血流量大、血流速度快、血管壁承受压力大易受损有关,与Gao等[14]的研究相类似;1例与LIE分型D型略有不同,缺如侧大脑中动脉由对侧颈内动脉床突

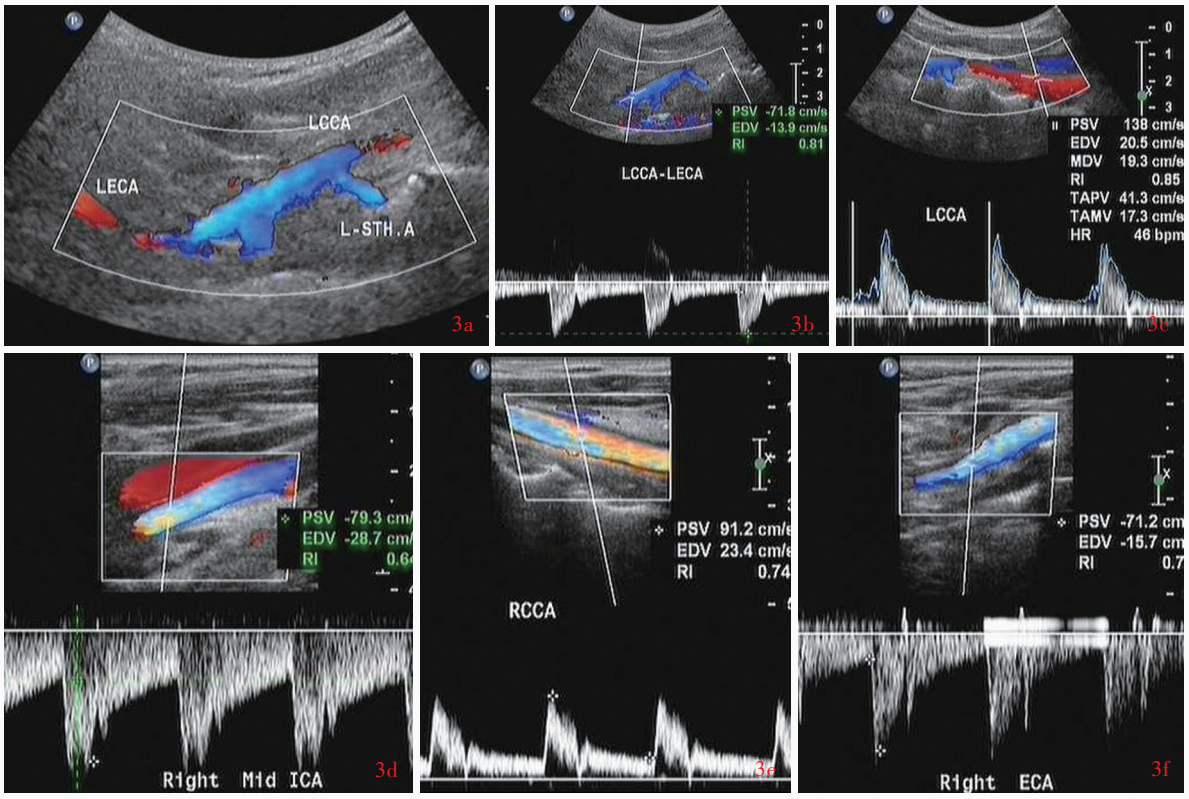

图3 颈内动脉缺如患者颈动脉超声彩色血流及频谱多普勒所见 3a 左颈外动脉多个分支 3b 左颈外动脉血流频谱 3c 左颈总动脉血流频谱与左颈外动脉频谱形态具有一致性 3d 右颈内动脉血流频谱 3e 右颈总动脉血流频谱，频谱形态介于右颈内动脉与右颈外动脉血流频谱形态之间 3f 右颈外动脉血流频谱

Figure 3 Colour Doppler flow and spectral Doppler of carotid artery ultrasound in patients of ICA absence Multiple branches of left ECA (Panel 3a). Blood flow spectrum of the left ECA (Panel 3b). Blood flow spectrum of the left CCA was consistent with left ECA (Panel 3c). Blood flow spectrum of right ICA (Panel 3d). Blood flow spectrum of right CCA, the wave form varied from right ECA to right ICA (Panel 3e). Blood flow spectrum of the right ECA (Panel 3f).

段供血，但缺如侧大脑前动脉由前交通动脉供血，Guerreiro等[15]也报告过类似病例；本研究未见LIE分型为E型患者，是由于该通路基于双侧颈内动脉存在，仅为颈内动脉发育不全，本研究所纳入对象均为颈内动脉缺如患者，故不可能出现该分型；本研究还有1例为原始三叉动脉，基底动脉经原始三叉动脉供血缺如侧颈内动脉海绵窦段，这一类型虽不属于LIE分型，亦多见于其他病例报道[16-17]，是否可以作为经典LIE分型的补充，尚待扩大样本量进一步验证。有1例为缺如侧大脑前动脉经前交通动脉由对侧大脑前动脉供血，缺如侧大脑前动脉A1段缺如，而缺如侧大脑后动脉和后交通动脉显影浅淡，未供血大脑中动脉，缺如侧大脑中动脉M1段不显影，远端分支稀疏浅淡，考虑由皮质动脉吻合支供血，该例患者由于自身血管条件较差，无法形成有效的一级代偿，故出现二级代偿方式。

本研究有3例计4处发生动脉瘤，发生率为3/14，与文献报道的先天性颈内动脉缺如患者颅内动脉瘤发生率为24%～34%相近，远高于健康人群的2%～4%[18]。究其原因，可能是由于颈内动脉缺如侧支循环相关病理性脑血流模式或血管结构完整性缺陷所致，故建议此类患者应密切随访。本研究男性：女性为2.5：1，与文献报道的男女比例1：4有较大差异[19]；患病侧别左侧：右侧为1.6：1，虽好发于左侧，但与Florio等[20]报告的左侧：右侧3：1存在一定差异；双侧颈内动脉缺如更罕见，本研究中仅1例为双侧颈内动脉缺如，发生率为1/14，与Elazab等[21]报告的<10%相近。通常情况下，颈内动脉缺如造成的脑血流改变可通过重新建立的侧支循环代偿良好，不出现明显症状，故本研究14例患者中仅4例有相应脑卒中病史，但该病伴发的颅内血管异常具有重要临床意义，本研究1例13岁女性患儿首发症状为蛛网膜下腔出血，系双侧颈内动脉缺如，认为可能与颅内动脉瘤破裂有关[6]。

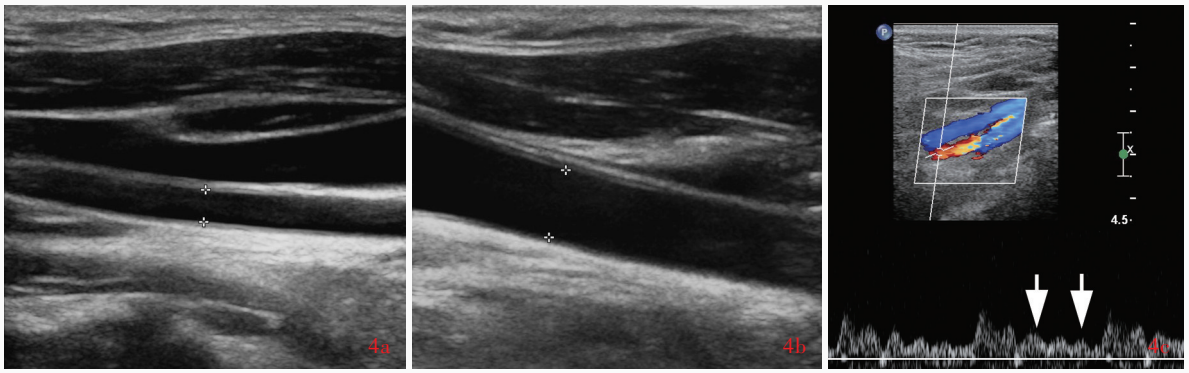

图4 颈内动脉缺如患者颈动脉超声和颞浅动脉叩击试验所见 4a,4b 缺如侧颈总动脉管径较对侧颈总动脉管径纤细 4c 颞浅动脉叩击试验时缺如侧颈外动脉血流频谱呈“锯齿”样改变(箭头所示)

Figure 4 The carotid artery ultrasound and STA tapping test findings in patients of ICA absence Diameter of ipsilateral CCA was thinner than contralateral CCA (Panel 4a, 4b). A "sawtooth" spectrum of the ipsilateral ECA was observed when tap the STA (arrows indicate, Panel 4c).

颈动脉超声可为颈内动脉缺如的准确诊断提供重要提示,可提供影像学检查的额外信息,进而判断颈内动脉是否存在以及脑血流动力学特征。首先,缺如侧颈总动脉管径明显减小是颈内动脉缺如的典型特征,可以作为颈动脉超声预测颈内动脉缺如的指标[22];然后,继续向头侧扫查,横断面和纵切面联合反复扫查后,缺如侧颈动脉全程均未探及分叉,而是延续为单一动脉走行于颈外动脉区域,且沿途可探及多个分支。正常情况下,颈总动脉的血流频谱形态介于颈内动脉的低阻与颈外动脉的高阻之间,而颈内动脉缺如患者颈总动脉血流频谱形态倾向于颈外动脉,呈现与颈外动脉一致的高阻。本研究颈总动脉与颈外动脉的血流频谱形态十分相似,颈总动脉表现出与缺如侧颈外动脉相同的高阻,与Dinç等[23]报告的3例颈内动脉缺如患者的颈总动脉血流波形和频谱特点相一致。亦有文献报道1例颈内动脉缺如患者的缺如侧颈总动脉与颈外动脉血流波形和频谱形态均呈低阻改变[24],分析可能与缺如侧颈外动脉远端侧支循环代偿途径有关,例如,LIE分型F型的颈外动脉向颅底吻合支供血,然而遗憾的是,该项研究并未对颅内侧支循环代偿通路加以阐述。本研究14例患者中9例颅内侧支循环代偿分别属于LIE分型A~C型、2例与A型略有不同、1例与D型略有不同,均为一级代偿,可完全供应脑实质的需求,无需颅外段参与代偿,故呈现为高阻频谱。颈内动脉缺如的颈动脉超声诊断尚无一致性标准,笔者通过总结本研究患者颈动脉超声特点,认为颈动脉超声诊断要点主要包括:(1)颈动脉超声二维结构及彩色血流模式下颈动脉全程未探及分叉,颈总动脉延续为单一动脉走行于颈外动脉区域,且可探及多个分支。(2)缺如侧颈外动脉频谱多普勒模式下叩击同侧颞浅动脉,可见传导而来的震颤性血流波形,即颈外动脉血流频谱呈“锯齿”样改变。(3)缺如侧颈总动脉血流频谱不再介于颈内动脉与颈外动脉之间,而更倾向于颈外动脉。

颈内动脉缺如进行颈动脉超声检查时应注意与以下疾病相鉴别:(1)颈内动脉闭塞。颈内动脉闭塞性疾病通常由动脉粥样硬化、血栓栓塞、动脉夹层、炎症等因素所致,一般管径为正常大小,即使后期进展为负性重构管腔变细,颈动脉超声仍可见纤细的管腔结构或残端。颈内动脉缺如则是颈动脉无明确分叉,颈总动脉直接顺延为颈外动脉,无颈内动脉结构,无明确的管壁管腔形态的胚胎发育异常。CTA、MRA仅可证明动脉未显影,而无法评估管壁结构;颈动脉超声的可视化对于鉴别诊断极具优越性。(2)颈总动脉分叉异常(低位分叉、高位分叉或分叉角度过大)。如无名动脉或主动脉弓发出较短颈总动脉,随即分叉为颈内动脉和颈外动脉伴行向头侧走行;分叉高于下颌角位置;颈动脉先天分叉角度过大(无颈动脉体瘤干扰),分叉角接近平角。虽然上述情况极为罕见但易忽略颈总动脉的分叉结构,提示超声科医师应注意颈部血管的全程、连续扫描;颈动脉超声二维结构与彩色血流及频谱多普勒相结合、横断面与纵切面相结合,以及联合低频凸阵探头深度扫查。

综上所述，颈内动脉缺如发病率低，且通常情况下无临床症状，但常伴多种侧支循环、颅内血管变异和动脉瘤易发等特点，故早期发现颈内动脉缺如有助于提示临床进一步评估颅内血管变异或侧支循环代偿情况[25]。颈动脉超声操作简便、价格低廉，且对颈内动脉缺如的初步诊断准确度较高，适用于脑血管病的大规模人群筛查。

利益冲突　无

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