·论　　著·

多模态影像融合技术在显微血管减压术治疗原发性舌咽神经痛中的应用

赵田恒　朱徐楠　杨思源　王嘉禾　陈　罡　孙　青

【摘要】**目的** 探讨多模态影像融合技术在显微血管减压术(MVD)治疗原发性舌咽神经痛中的作用。**方法** 回顾性分析2019年1月至2020年1月MVD治疗的3例原发性舌咽神经痛的临床资料。术前均行3D-TOF-MRA和3D-FIESTA检查,利用BrainLab软件进行多模态影像融合,根据影像融合结果行MVD。**结果** 多模态融合影像清晰显示责任动脉与神经的关系,3例均顺利完成手术,术中责任血管位置与术前多模态融合影像结果一致,术后即刻疼痛明显缓解,术后无出血、颅内感染、脑脊液漏。**结论** 原发性舌咽神经痛进行MVD时,多模态影像融合技术可清晰显示责任血管,有利于提高手术的准确性、安全性、有效性,减少手术创伤。

【关键词】原发性舌咽神经痛;显微血管减压术;多模态影像融合技术

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Application of multimodal image fusion technology in microvascular decompression for primary glossopharyngeal neuralgia

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【**Abstract**】**Objective** To investigate the role of multimodal image fusion technology in microvascular decompression (MVD) for patients with primary glossopharyngeal neuralgia. **Methods** The clinical data of 3 patients with primary glossopharyngeal neuralgia underwent MVD from January 2019 to January 2020 were retrospectively analyzed. All patients underwent 3D-TOF-MRA and 3D-FIESTA examinations before operation, and multimodal image fusion was performed by the BrainLab software. MVD was performed according to the results of the fusion images. **Results** Multimodal fusion images clearly showed the relationship between responsible vessels and nerves in all 3 patients, who were successfully completed the operation. The position of responsible vessels comfirmed under the microscope was consistent with the results of multimodal fusion images. Pain was significantly relieved immediately after operation in all 3 patients, and there was no postoperative bleeding, intracranial infection, or cerebrospinal fluid leakage. **Conclusions** When patients with primary glossopharyngeal neuralgia undergoing MVD, multimodal image fusion technology can clearly show the responsible vessels, which is helpful to improving the surgical accuracy, safety, and effectiveness, and reducing the surgical trauma.

【**Key words**】Primary glossopharyngeal neuralgia; Microvascular decompression; Multimodal image fusion technology

舌咽神经痛以一侧咽喉部短暂而剧烈的疼痛并放射至口咽部或者耳部为特征,吞咽往往会诱发疼痛发作,疼痛十分剧烈,给病人带来巨大的痛苦[1]。舌咽神经痛的发病率不高,临床对其认识、了解程度不深,误诊概率高[2],术后复发是影响疗效的重要因素[3]。术后复发的重要原因是遗漏重要的责任血管[3]。本文探讨多模态影像融合技术在显微血管减压术治疗原发性舌咽神经痛中的作用。

1 资料与方法

1.1 一般资料　回顾性分析2019年1月至2020年1月在多模态影像融合技术辅助下显微血管减压术治疗的3例原发性舌咽神经痛的临床资料。3例病人基本资料见表1。

1.2 手术方法　术前均行头颅3D-TOF-MRA和3D-FIESTA检查,利用BrainLab软件进行多模态影像融合,根据融合影像行显微血管减压术。3例均采用枕下乙状窦后入路。全麻成功后,取侧卧位,在乳突后发际线内做一长约5 cm的切口,再用铣刀在乙状窦和横窦交界处做2 cm的骨窗。如果遇到乳突气房,则使用骨蜡封闭,术后再加用肌肉片及胶水进一步封堵。剪开脑膜后,缓慢释放脑脊液,然后锐性分离后组颅神经及血管上的蛛网膜,以充分显露后组颅

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神经。在后组颅神经周围探查，并与术前多模态融合影像比对。若未能暴露术前多模态融合影像显示的责任血管，则调整体位及角度，继续寻找责任血管，直到确认有或者没有。找到责任血管后，用棉片将责任血管与舌咽、迷走神经垫开，然后用人工硬膜或者自体脑膜水密性缝合脑膜，复位骨瓣。

1.3 疗效评价 术后1 d、出院时及每3个月电话或者门诊随访，记录随访结果，疗效分为治愈、好转、无效、加重。

2 结 果

2.1 影像融合结果和手术结果 病例1术前MRI示左侧后组颅神经与一根血管关系密切（图1A），多模态融合影像可见责任血管为小脑后下动脉，起源于左侧椎动脉（图1B），并在左侧后组颅神经的腹侧形成一个小袢，压迫左侧后组颅神经（图1C）；术前模拟

表1 本文3例原发性舌咽神经痛的临床资料

Table 1 The clinical data of 3 patients with primary glossopharyngeal neuralgia reported in this paper.

病例	性别	年龄（岁）	责任血管		治疗结果	随访情况
			融合影像	术中发现		
病例1	男	56	成袢的小脑后下动脉	成袢的小脑后下动脉	治愈	未再发作
病例2	男	62	小脑后下动脉	小脑后下动脉	治愈	未再发作
病例3	女	54	小脑前下动脉	小脑前下动脉	治愈	未再发作

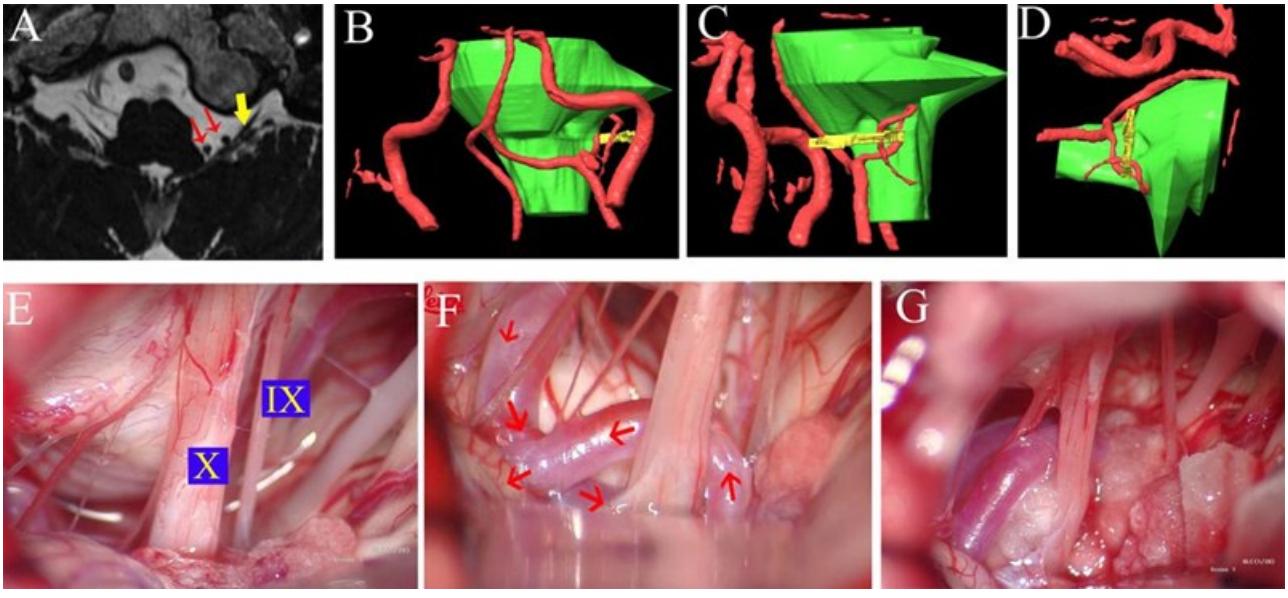

图1 多模态影像融合技术辅助显微血管减压术治疗原发性舌咽神经痛

A. 术前MRI像轴位示左侧后组颅神经（黄色↑示）与血管（红色↑示）关系密切；B、C. 术前多模态融合影像可见责任血管为小脑后下动脉，起源于左侧椎动脉，责任血管在后组颅神经的腹侧形成一个小袢，压迫后组颅神经；D. 模拟手术视角可以分辨血管的走行，明确近心端以及远心端；E. 术中牵拉小脑后，可见后组颅神经，然而预想中的责任血管并未见到；F. 术中进一步松解蛛网膜、调整体位、牵拉小脑后，可见责任血管隐藏在舌咽、迷走神经腹侧面出入脑干区（红色↑示）；G. 术中用Teflon棉片垫开责任血管与舌咽神经

Figure 1 Preoperative images and intraoperative microscopic observation of a patient with primary glossopharyngeal neuralgia undergoing microvascular decompression assisted by multimodal image fusion technology

A: The preoperative axial MR images showed a close relationship between the left posterior cranial nerve (yellow arrow) and the responsible vessel (red arrow). B–C: The preoperative multimodal fusion images showed that the responsibile vessel was the posterior inferior cerebellar artery, originating from the left vertebral artery, forming a small loop on the ventral side of the posterior cranial nerve and compressing the glossopharyngeal nerve. D: The preoperative multimodal fusion images could distinguish the course of the responsilbe vessel, and clarify its proximal and distal ends. E: The posterior cranial nerve was visible after traction of the cerebellum, but the expected responsibile vessel was not seen. F: After further release of arachnoid, adjustment of position and traction of the cerebellum, the responsibile vessel was found in the ventral surface of the glossopharyngeal and vagus nerves and the brainstem area (red arrow). G: The responsible vessel and the glossopharyngeal nerve were separated by a Teflon pad under the scope.

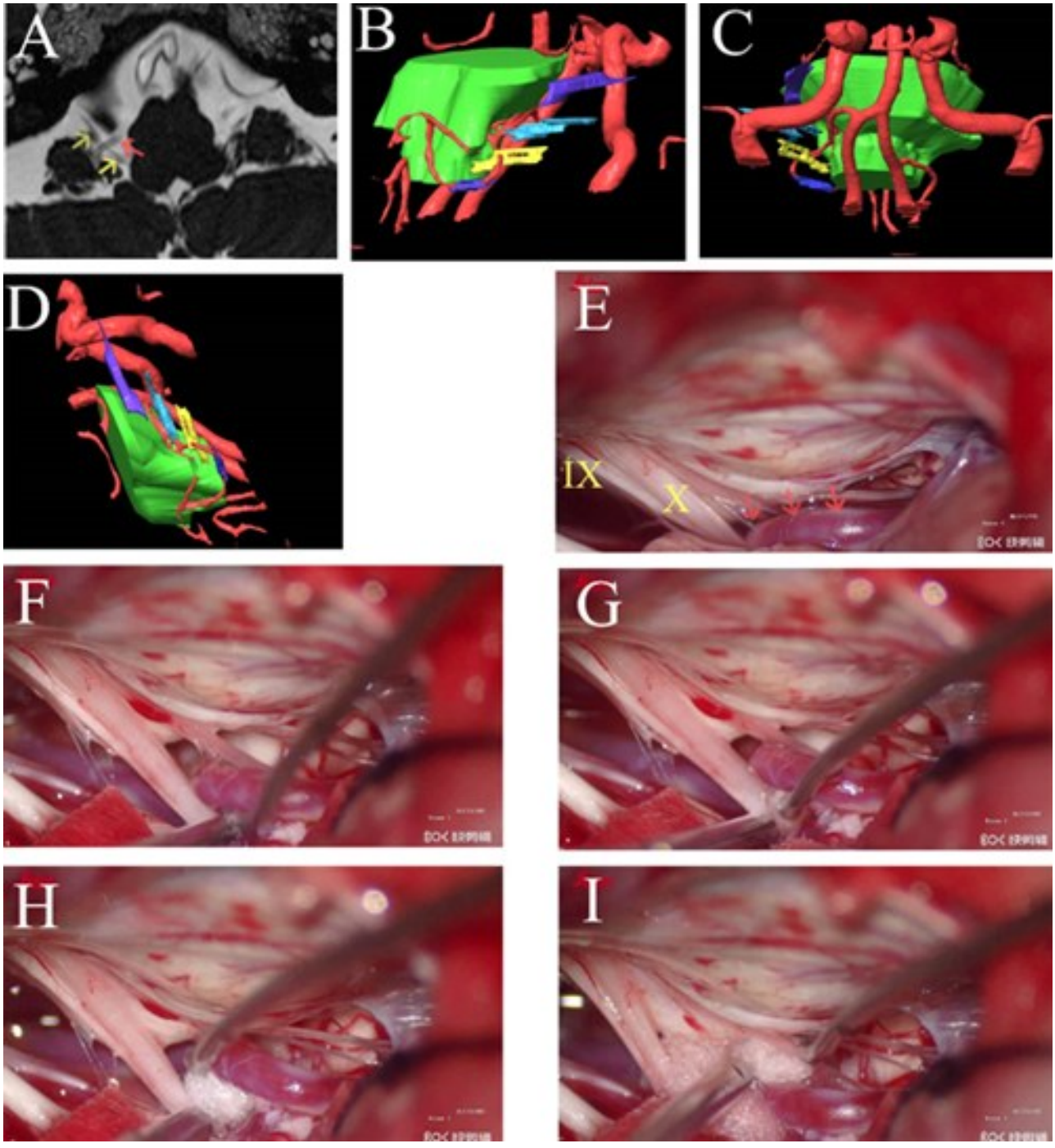

图2 多模态影像融合技术辅助显微血管减压术治疗原发性舌咽神经痛

A. 术前MRI轴位隐约可见舌咽迷走神经(黄色↑示)与一根动脉血管(红色↑示)关系密切;B~D. 多模态融合影像可见责任血管为小脑后下动脉,起源于左侧椎动脉,并在后组颅神经中穿行(黄色↑示);E. 术中打开脑膜后,牵拉小脑可见舌咽神经迷走神经靠得较近,与副神经之间可见责任动脉(红色↑示);G~I. 术中先将责任动脉与舌咽迷走分离开,然后采用Teflon棉片逐步垫开

Figure 2 Preoperative images and intraoperative microscopic observation of a patient with primary glossopharyngeal neuralgia undergoing microvascular decompression assisted by multimodal image fusion technology

A: The preoperative axial MR images found that the glossopharyngeal vagus nerve (yellow arrow) was closely related to an artery (red arrow). B-D: The multimodal fusion images showed that the responsible vessel was the posterior inferior cerebellar artery, originating from the left vertebral artery and running through the posterior cranial nerves (yellow arrow). E: After the dural was opened during operation, the posterior cranial nerves could be seen by pushing aside the cerebellum, and the responsible vessel could be seen between the glossopharyngeal vagus nerve and the accessory nerve (red arrow). G-I: The responsible vessel and the glossopharyngeal vagus nerve were separated by a Teflon pad.

手术视角，可以分辨血管的走行，明确其近心端、远心端（图1D）。术中锐性分离后组颅神经及血管上的蛛网膜，充分显露后组颅神经，未发现责任血管（图1E）；进一步松解蛛网膜、调整体位、牵拉小脑后，可见责任血管隐藏在神经腹侧面出入脑干区内（图1F）；先将责任血管松解剥离后，再用棉片将责任血管与舌咽迷走神经之间垫开（图1G）。术后咽喉部疼痛即刻缓解，随访期间未再发作。

病例2术前MRI隐约可见舌咽迷走神经（图2A）与一根动脉血管（图2A）关系密切，多模态融合影像可见责任血管为小脑后下动脉，起源于左侧椎动脉（图2B），在后组颅神经中穿行（图2B~D）。术中打开脑膜后，牵拉小脑可见后组颅神经，而且舌咽神经、迷走神经靠得较近（图2E），与副神经之间可见责任动脉（图2E）。根据术前多模态融合影像（图2D），很容易判断血管的近心端以及远心端。术中先将责任动脉与舌咽迷走神经分离开，然后用棉片逐步垫开（图2G~I）。术后疼痛明显缓解。随访期间未再发作。

病例3术前MRI隐约可见舌咽迷走神经与一根动脉血管相接触（图3A），多模态融合影像可见同侧小脑前下动脉与后组颅神经相接触（图3B）；加入淡绿色半透明脑干组织后，可见责任血管压迫的是后组颅神经的脑池段（图3C）；模拟手术入路视角，可见责任血管从后组颅神经的上方压迫后组颅神经（图3D）。术中剪开后组颅神经上的蛛网膜后，可见责任血管与后组颅神经的关系与术前融合影像一致（图3E）。用棉片垫开责任血管和后组颅神经（图3F）。术后疼痛明显缓解，随访期间未再发作。

3 讨 论

原发性舌咽神经痛也叫原发性迷走舌咽神经

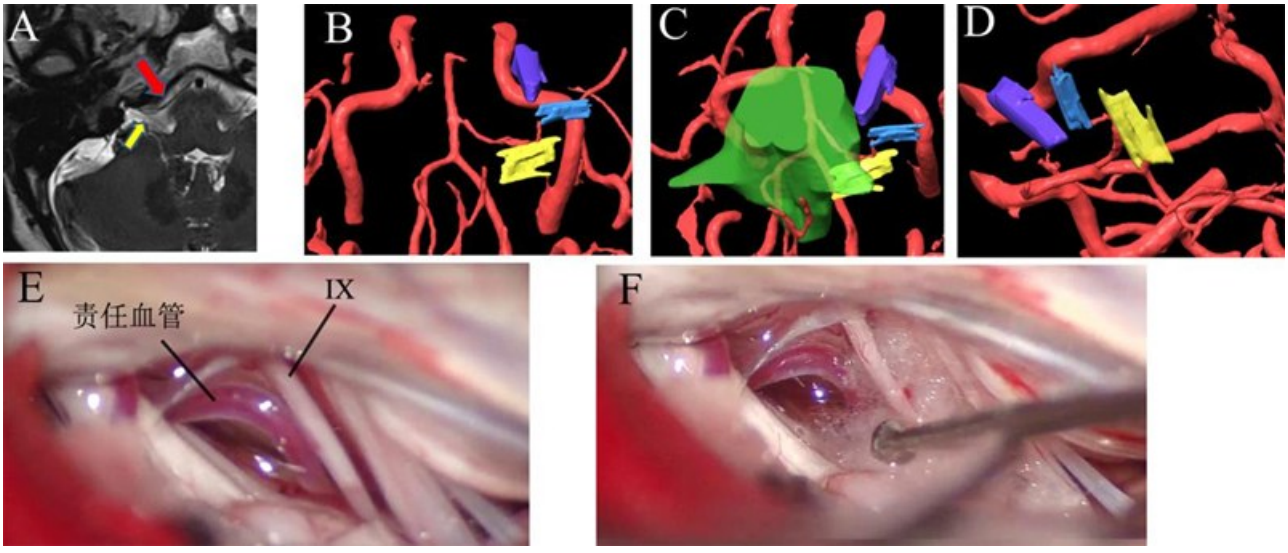

图3 多模态融合技术辅助显微血管减压术治疗原发性舌咽神经痛

A. 术前MRI轴位隐约可见舌咽迷走神经（黄色↑示）与一根动脉血管（红色示）相接触；B. 多模态融合影像可同侧小脑前下动脉与后组颅神经（黄色）相接触，蓝绿色为面听神经，蓝色为三叉神经；C. 加入淡绿色半透明的脑干组织后，多模态融合影像可见责任血管压迫的是后组颅神经的脑池段；D. 模拟手术入路视角可见责任血管从后组颅神经的上方压迫后组颅神经；E. 术中可见责任血管和后组颅神经的关系与术前融合影像结果一致；F. 术中在显微镜下用Teflon棉片垫开责任血管和后组颅神经

Figure 3 Preoperative images and intraoperative microscopic observation of a patient with primary glossopharyngeal neuralgia undergoing microvascular decompression assisted by multimodal image fusion technology

A. The axial preoperative MR images suspected that the glossopharyngeal vagus nerve (yellow) was in contact with an arterial vessel (red). B. The multimodal fusion images showed that the ipsilateral anterior inferior cerebellar artery was in contact with the posterior cranial nerve (yellow), the facial and auditory nerves showed in blue-green, and the trigeminal nerve showed in blue. C: After adding the brainstem tissues showed in light green translucent form, the multimodal fusion images showed that the cistern segment of the posterior cranial nerve was compressed by the responsible vessel. D: The simulated surgery showed that the respnosible vessel was above the posterior cranial nerve. E: The relationship between the responsible vessel and the posterior cranial nerves found in the preoperative fusion image was consistent with that found under the microscope. F: The responsible vessel and the posterior cranial nerves were separated by some Teflon pads.

痛，责任神经为舌咽神经以及迷走神经，因为舌咽神经和迷走神经有共同感觉区。原发性舌咽神经痛的发病机制的主流学说是血管卡压颅内神经移行区，认为责任血管在舌咽神经和迷走神经进出脑干区造成压迫，导致舌咽神经痛[4]。该区域是中枢神经系统和周围神经髓鞘之间的移行区，神经纤维上缺乏施旺氏细胞的包裹保护，因此对搏动性刺激较为敏感，血管压迫该区域即可引起疼痛[5]。

FIESTA-TOF影像学检查可以帮助判断是否有责任血管压迫舌咽、迷走神经根部[6]，为选择合理的治疗方案提供帮助。如果有明确的血管压迫，则原发性舌咽神经痛的治疗以显微血管减压术为主[7]。据报道，责任血管的遗漏是手术效果不佳的重要原因[3]。因此术前了解责任血管的位置、走行至关重要。传统的FIESTA或者TOF序列影像均为二维图像，难以从三维角度了解责任血管的走行，难以明确责任血管压迫的位置，不利于术中判断责任血管的远心端及近心端[8]。随着技术的发展，利用软件技术，将磁共振FIESTA序列及TOF序列的数据进行融合，利用FIESTA序列勾勒神经走行，利用TOF序列识别动脉走行，这样就可以从三维融合重建的模型上看到血管和神经，帮助判断血管是否压迫神经。三维模型观察、判断是否存在血管压迫神经的准确性明显高于二维图像，而且压迫点的位置和数目也一目了然。本文病例1（图1），如果没有术前多模态融合影像，术前知晓责任血管形成了一个袢，血管压迫点有两个；那么术中就可能将其中一个压迫点解除后就结束手术，忽略了隐藏在更深部的另一个压迫点，这样就会造成手术效果不佳。

有报道通过切断舌咽神经治疗舌咽神经痛[9]，但切断舌咽神经容易导致饮水呛咳、声音嘶哑等并发症。术前多模态融合影像提供全方位视角，明确责任血管，术中做到有的放矢，减少术中对脑组织的无效牵拉，可以避免出现责任血管遗漏的情况，有助于改善治疗结果，并减少手术的创伤。

总之，多模态影像融合技术可清晰显示责任血管，有利于提高手术的准确性、安全性、有效性。

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