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·专题研究·

Talos远端打孔型胸主动脉覆膜支架治疗Stanford B型主动脉夹层首例报告（附视频）

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摘 要

背景与目的：主动脉腔内修复术（TEVAR）已成为B型主动脉夹层的一线治疗方式，如何能够最大程度覆盖主动脉夹层破口，促进主动脉重塑，而又不增加截瘫风险成为临床关注的难点。本文主要介绍新型Talos远端打孔型胸主动脉覆膜支架（以下简称“Talos支架”）在中南大学湘雅医院成功完成上市后国内首例支架置入术情况并进行相关分析。

方法：报道Talos支架上市后国内首例置入病例的临床资料，并分析Talos支架的优缺点及进行相关文献回顾。

结果：72岁男性Stanford B型主动脉夹层患者，因主动脉夹层累及范围广泛，需使用支架长度较长，经本人及家属同意后采用新上市的Talos支架行TEVAR。术中支架轻松到达病变部位，同时定位精准。患者完成支架置入后主动脉破口隔绝完全，假腔完全血栓化，而远端打孔段肋间动脉完整保留，同时无主动脉相关不良事件的发生。

结论：Talos支架性能优良，长段的支架主体能够最大程度完成主动脉夹层的破口修复，促进主动脉重塑；同时远端的打孔设计能够在修复夹层破口的同时，保留肋间动脉，预防脊髓缺血所致截瘫。

关键词 动脉瘤，夹层；主动脉；血管内操作；脊髓缺血；Talos支架

中图分类号：R654.3

Talos distal perforating stent-graft in the treatment of Stanford type B aortic dissection: a first case report (with video)

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Abstract

Background and Aims: Thoracic endovascular aortic repair (TEVAR) has become the first-line treatment for type B aortic dissection. Maximizing the aortic dissection coverage and promoting aortic remodeling without increasing the risk of paraplegia has become challenging in clinical practice. Here,

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the authors report the first case of clinical implantation of the new Talos distal perforating stent (Talos stent) in our country successfully performed in Xiangya Hospital of Central South University after its market release and analyze the related problems.

Methods: The clinical data of the first case of implantation of Talos Stent in China after its introduction to the market were reported. The advantages and disadvantages of this type of stent were analyzed and reviewed with a literature review.

Results: A 72-year-old male patient with Stanford type B aortic dissection requiring a long-length stent due to the extensive involvement of the aortic dissection underwent TEVAR with the newly-marketed novel Talos stent with the approval of himself and his family. The stent was easily guided towards the lesion during operation with precise positioning. After stenting, the aortic tears of the patient were thoroughly repaired, the false lumens were thrombosed entirely, and the distal intercostal perforating branches were preserved intact, with no development of aortic-related adverse events.

Conclusion: The Talos stent has excellent procedural performance, its long body ensures to the maximum extent possible the repair of aortic dissection and promotes aortic remodeling, and the distal perforation design can repair the aortic tears and preserve intercostal branches at the same time, and thereby prevent paraplegia caused by spinal cord ischemia.

Key words Aneurysm, Dissecting; Aorta; Endovascular Procedures; Spinal Cord Ischemia; Talos stent

CLC number: R654.3

胸主动脉腔内修复术（thoracic endovascular aortic repair，TEVAR）已成为治疗 B 型主动脉夹层的主要治疗方式，其主要通过修复主动脉夹层近端破口改善真腔供血，降低假腔压力，从而实现真腔扩张、假腔缩小等形态学改变即为主动脉重塑[1-4]。TEVAR 能够修复主动脉近端的破口，但难以实现全主动脉的修复，TEVAR 术后远端残余破口引发的远端夹层动脉瘤改变及远端新发破口（distal stent graft-induced new entry，d-SINE）成为临床面临的挑战[5-6]。多个研究[7-9]表明，通过增加支架的长度，覆盖更多的破口，便可以实现更好的管腔重塑。但长段的支架会覆盖多对肋间动脉易引起脊髓缺血，使患者出现截瘫的风险增大[10-11]。Talos 远端打孔型胸主动脉覆膜支架（以下简称“Talos 支架”）系统独特的设计能够实现最大程度的主动脉重塑，同时又可以避免截瘫及主动脉远端的不良事件的发生。本文将对 Talos 支架在中南大学湘雅医院成功完成上市后国内首例临床置入病例进行报道并分析。

1　病例资料

患者　男，72 岁，因胸背部疼痛 3 个月，加重 1 d 于 2022 年 7 月 14 日入院。患者 3 个月前无明显诱因出现胸背部撕裂样疼痛，于当地医院诊断为主动脉夹层（Stanford B 型），并住院进行保守治疗，疼痛缓解后出院。1 d 前无明显诱因再次突发剧烈的背痛，复查主动脉全长 CTA，主动脉夹层较前进展，为求进一步治疗遂转来中南大学湘雅医院。既往有高血压病史 6 年，糖尿病病史 6 年，都经过规范治疗，血压血糖控制尚可。入院后进一步完善相关检查，血常规，肝肾功能，凝血功能，心肺功能等术前检查结果无明显异常。术前 CTA 可见胸主动脉左锁骨下动脉以远至腹腔干动脉段多发局限性夹层病变（图 1）。患者入院诊断为 B 型主动脉夹层，属于不稳定性主动脉夹层，有夹层破裂致死风险。有手术指征，无明显手术禁忌证，拟限期于 2022 年 7 月 19 日行 TEVAR，但因患者主动脉夹层累及范围广泛，需使用支架长度较长，经患者及家属同意后，计划置入新上市的国内首例心脉医疗™Talos 支架。

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图1 术前影像学资料 A：患者术前主动脉全长CTA；B–D：主动脉全长CTA可见胸主动脉多发夹层破口（红色箭头所示）

Figure 1 Preoperative imaging data A: Preoperative CTA of whole-length of the aorta; B–D: CTA of whole-length of the aorta showing multiple intimal tears of the aorta (indicated by the red arrow)

2 手术方法

2.1 材料

本次手术须在DSA透视下完成，需要用到的材料有常用的外周血管介入耗材，包括常规的血管鞘（泰尔茂公司），泥鳅导丝（泰尔茂公司），金标猪尾巴导管（COOK公司），多功能导管（COOK公司），Back-Meier加强导丝（美敦力公司），ProGlide血管缝合器系统（雅培公司）等辅助器材，支架为心脉医疗™Talos支架，根据术前测量的主动脉直径相关数据，支架规格定为T3224–200060。具体的规格为支架总长度为260 mm，其中近端200 mm为全覆膜结构，后面的60 mm长度为AI激光打孔段，搭配50%孔洞率（图2）。

2.2 手术方法

术前常规禁食禁饮8 h，全麻成功后，经右股动脉处采用改良Seldinger穿刺术，18 G穿刺针刺入后撤去穿刺针，造影证实穿刺点位于股总动脉后（视频1A），以8 F血管鞘内芯扩张穿刺点，依次导入2把ProGlide血管缝合器系统进行预缝合，预埋缝合器成功后，置入8 F血管鞘，并给予50 mg肝素。泥鳅导丝配合金标猪尾巴导管至腹主动脉上段造影，证实内脏血管真假腔供血情况，同时寻找主动脉夹层真腔（视频1B）。确保导管导丝位于主动脉真腔后，将猪尾巴导管送至升主动脉，分别行正位、左前斜45°血管造影，明确夹层破口位置数量，真假腔，病变累及长度及左锁骨下动脉至腹腔干动脉段主动脉长度等信息，根据造影与测量的破口近端相对正常主动脉内径、破口直径等信息（视频1C–D）。更换Back-Meier加强导丝，沿着加强导丝置入Talos覆膜支架至预定部位，确保心率在90次/min左右，收缩压在90 mmHg（1 mmHg=0.133 kPa）左右，透视下释放主动脉支架主体部分（视频1E），并打开支架头端后释放系统（视频1F），回收支架输送系统（视频1G）。再次行造影检查，观察主动脉弓上三分支情况，支架位置形态，破口覆盖情况（视频1H），支架打孔段肋间动脉及内脏血管显影情况（视频1I），确保分支血管及支架内顺畅，排除内漏现象后，ProGlide血管缝合器关闭切口并加压包扎，生命体征平稳后安返至麻醉恢复室。手术顺利，手术时间约1 h，DSA透视时间约20 min，出血量约50 mL。术后严密监测患者生命体征，控制心率、血压、血糖等，重点观察患者术后意识状态，胸背部疼痛情况及四肢活动情况，若有异常及时通知医师并采取干预措施；了解患者是否合并紧张、焦虑等负性心理，并根据个体情况给予针对性的护理干预措施。术中情况如图3所示。

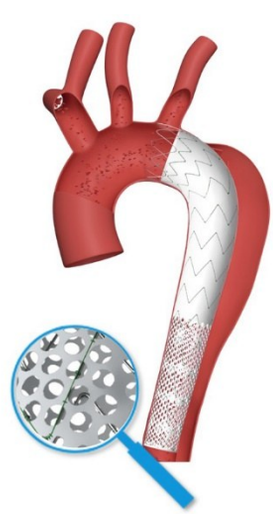

图2 Talos支架近端为主动脉覆膜支架全覆膜段，远端为打孔设计段（Talos支架示意图由心脉医疗提供）

Figure 2 The covered proximal portion and the distal perforation design of the Talos stent (Schematic illustration of the Talos stent provided by Shanghai Endovastec. Co., Ltd.)

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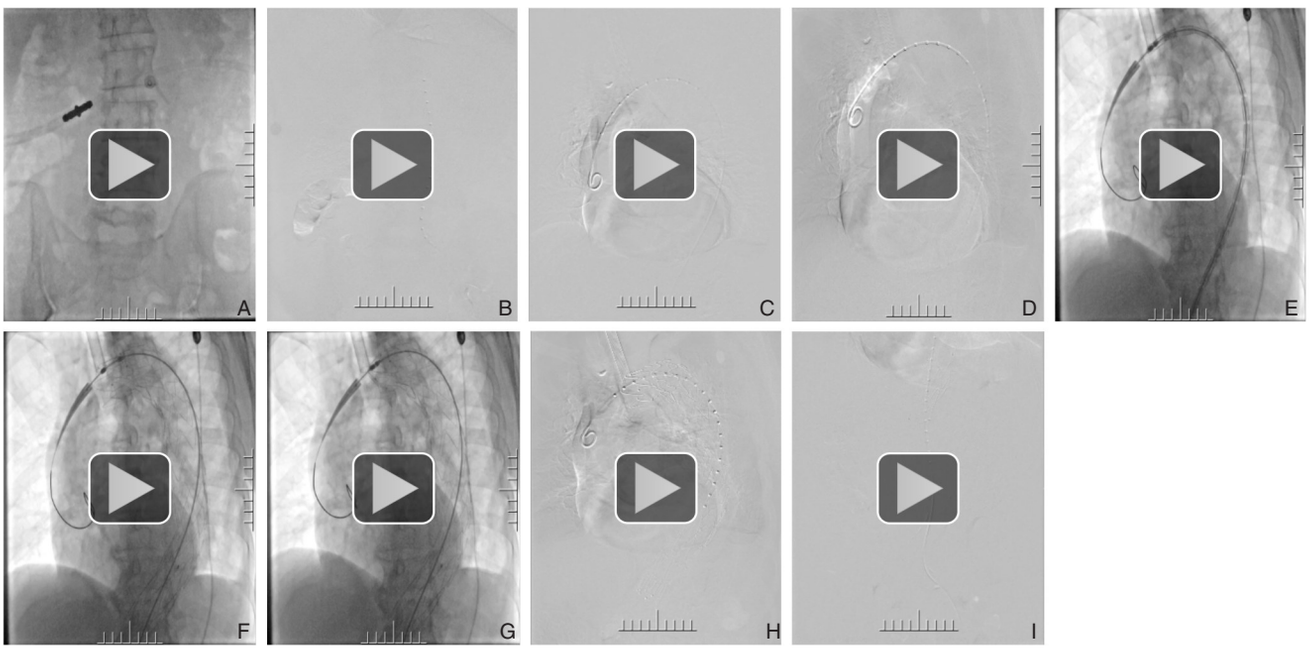

视频 1　Talos 支架置入术　A：入路造影；B：腹主动脉段造影；C–D：升主动脉造影；E：Talos 支架释放过程；F：打开后释放系统；G：回收支架输送系统；H：TEVAR 后升主动脉造影；I：TEVAR 后腹主动脉造影

Video 1　Implantation of the Talos stent　A: Approach angiography; B: Abdominal aortography; C–D: Ascending aortography; E: Release of the Talos stent; F: Deployment of the post-release system; G: Retriveval of the delivery system; H: Ascending aortography after TEVAR; I: Abdominal aortography after TEVAR

扫描至移动设备观看手术视频：

http://www.zpwz.net/zgptwkzz/article/abstract/PW220493

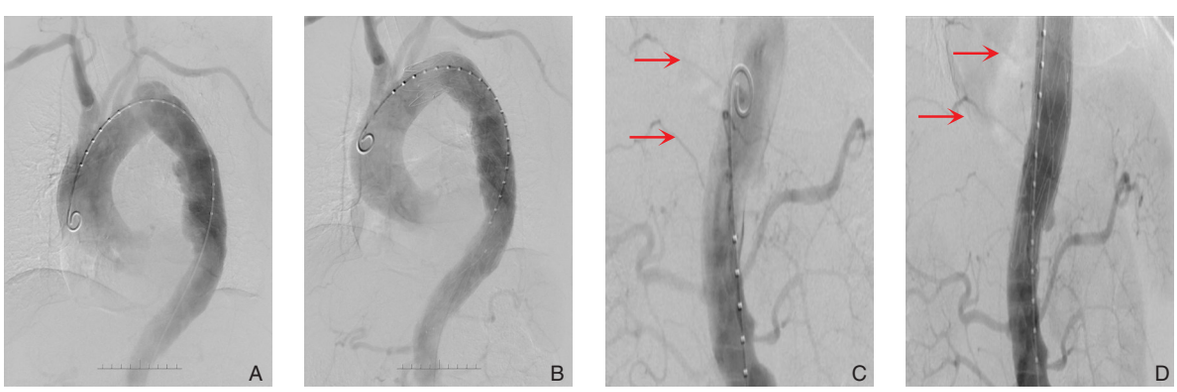

图 3　术中情况　A–B：支架置入前后 DSA 可见胸主动脉多发夹层破口修复；C–D：支架置入后 DSA 主动脉夹层破口隔绝完全，打孔段肋间动脉显影（红色箭头所示）

Figure 3　Intraoperative data　A–B: DSA showing multiple intimal tears of the aorta before stenting and complete repair after stenting; C–D: DSA showing the completely occluded tears of the aorta and display of the intercostal branches in the perforation section (indicated by the red arrow)

2.3　手术结果

患者麻醉苏醒后，回普通病房继续治疗。术后意识清醒，四肢肌力活动正常，无异常胸背部疼痛等不适，恢复顺利。术后第 3 天，复查主动脉全长 CTA，CTA 提示支架位置形态好，主动脉破口封堵满意，未见明显支架移位及内漏等发生，远端打孔段肋间动脉显影（图 4）。患者术后第 4 天顺利出院。目前随访患者恢复良好，无特殊不适。

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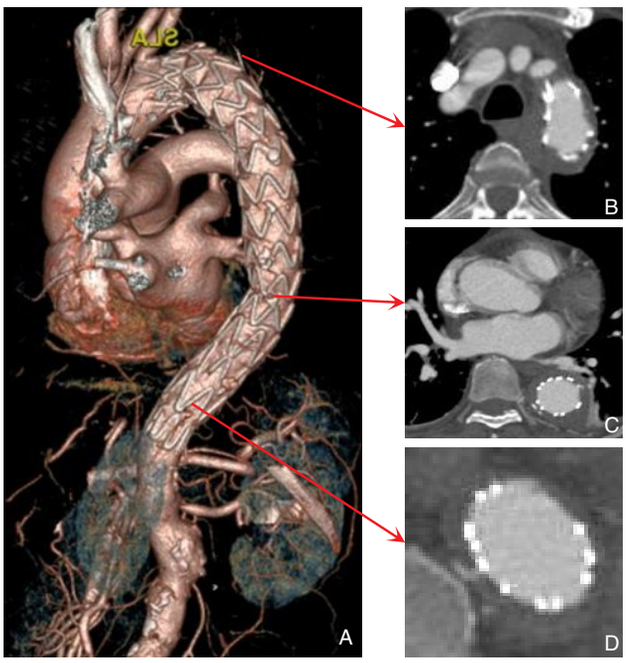

图4 术后影像学资料 A-C：主动脉支架将之前的夹层破口完全修复（红色箭头所示）；D：远端打孔段可见肋间动脉显影良好（红色箭头所示）

Figure 4 Postoperative imaging data A-C: Completely repaired tears by the aortic stent graft (shown by the red arrow); D: Better display of the intercostal branches in the distal perforation segment (indicated by the red arrow)

3 讨 论

近年来，TEVAR被广泛用于治疗Stanford B型主动脉夹层，数项随机对照试验及Meta分析研究[12-13]均显示出其具有明显的优势，逐渐成为B型主动脉夹层一线治疗方案。对全球17个中心567例TEVAR患者随访31个月，发现7.8%的患者术后发生了主动脉瘤或持续假腔灌注导致的瘤样扩张；d-SINE发生的概率为1.1%，而由它导致的病死率可高达28.6%[14-15]。因此TEVAR术后降主动脉远端残余破口及d-SINE的处理，促进主动脉重塑成为临床急需解决的问题。

B型主动脉夹层远端破口数量多且复杂，94.9%患者远端存在3个破口以上的破口，而部分破口存在一定的隐蔽性，TEVAR术后真腔血供恢复后才显示出破口[16-17]。远端破口的持续存在，会导致假腔内持续的血流灌注，从而引起主动脉重塑不良，10%的患者会因为远端假腔扩张呈夹层动脉瘤破裂死亡[7]。有鉴于此，一系列技术被发明出来，以促进TEVAR术后主动脉重塑，提高远期预后，诸如“petticoat”“假腔栓塞技术”等。“petticoat”技术本质为在主体覆膜支架远端释放一个较小的裸支架，用以稳定远端活动的内膜瓣，同时可以提供一定的径向力压闭假腔，从而达到主动脉重塑的效果[18]。Lombardi等[19]印证了这一点，应用“petticoat”技术后，主动脉真腔扩大，假腔减小，支架区假腔血栓化比率达到100%。这表明了“petticoat”技术在促进主动脉重塑方面的优秀表现。但是“petticoat”技术也有不足之处，覆膜支架加远端限制性金属裸支架的分段式设计，增加了术中操作的复杂程度，并且远端的裸支架有一定的移位风险，并且支架覆盖的总长度有一定程度的不可控空间[20]。假腔栓塞技术有多种，如“candy-plug”技术、“after”技术和“cork in the bottleneck”技术等，其原理是在主体支架释放后，在假腔内利用小型覆膜支架、弹簧圈、胶水、封堵器、滤器等栓塞假腔，以达到隔绝假腔血流、促进假腔血栓化的目的，进而促进主动脉重塑[21-23]。而假腔栓塞技术不适合于假腔太大或者夹层破口太多的患者，并且在栓塞过程中有栓塞材料移位，引起异位栓塞的风险。同时过多的栓塞材料所需治疗成本会大幅度增加，其远期效果有待进一步证实。近期发表的一项多中心研究以降主动脉支架占比（percentage of stented descending aorta，PSAD）统一表示支架移植物的覆盖范围，结果显示当PSAD>31.3%时发生胸主动脉扩张的风险更低，即较长的支架移植物覆盖范围可促进TEVAR后胸主动脉的良性重塑[24]，但同时过长的支架移植物覆盖会大大增加术后脊髓缺血所致截瘫的风险[25]。而本次笔者团队术中使用的国内首例Talos支架，很好地平衡了支架长度和脊髓缺血的风险。该支架最长的长度可达260 mm，足够的支架长度可以使夹层远端的真腔尽可能扩大，假腔缩小，其原理类似于“petticoat”技术，而其优点是一体化的设计可以减少术中操作步骤，避免远端支架移位的风险，并且支架覆盖的范围变得可控，远端定位更为精准。同时支架远端60 mm打孔的特殊设计，可以让血流通过小的孔洞到达脊髓，从而保证脊髓的血液灌注，防止肋间动脉一次性被过多覆盖而导致脊髓的急性缺血所致截瘫的发生，因此该支架也被称为“会呼吸”的支架。通过分析患者术中及术后的影像学资料，可

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以看到假腔的血栓化重塑和肋间动脉完整的显影，患者术后也无明显的截瘫表现，这也充分证实了 Talos 支架的优势。

Li 等[26]报道的 579 例 B 型夹层，TEVAR 术后共 39 例患者出现 d-SINE，其发生率为 6.7%，平均发生时间为 22 个月。d-SINE 的发生与主动脉本身和手术支架的选择同时相关。d-SINE 相关风险因素包括支架末端着陆区状况、支架移植物弹性应力、主动脉扭曲等[27-28]。TEVAR 中支架末端的着陆区经常位于夹层累及区域，支架的远端着陆区内膜片悬浮于管腔内，无法耐受支架远端的支撑作用而容易形成 d-SINE。目前较为公认的评价支架弹性应力的指标有径向支撑力、弹性回直力、抗平行以及局部点挤压力，其中径向支撑力被认为对 d-SINE 形成影响最大。多个研究[29-31]认为在 d-SINE 形成过程中，支架径向支撑力可能起主导作用，而支架的弹性回直力为辅助作用，而支架远端的直径过大的放大率则是 d-SINE 的根本原因。按照人体主动脉的渐细特点，设计成带有不同锥度的渐细支架，以减少远端过大的放大率，从而减少支架远端的径向支撑力，可以减少 d-SINE 的发生。另有研究[32]报道将支架主体长度尽量延长，从而有效减小支架与血管纵径的夹角，达到了减小 d-SINE 发生的效果。Talos 支架是按照主动脉生理形态进行设计，它的多锥度设计，可以顺应主动脉的直径变化，同时它的长度最长可达 260 mm，从而减少支架置入术后 d-SINE 的发生。

Talos 支架为当前条件下较为合适的用于主动脉夹层的主动脉支架，但因上市时间短，目前缺乏大规模的术后随访资料，近期效果确切，但远期效果有待于日后更多临床病例的积累。主动脉夹层病变复杂，累及广泛，对支架要求相对更高，设计出专门适用于主动脉夹层治疗的支架，能够最大顺应人体主动脉的力学特点，尽可能多地修复主动脉破口，同时与人体主动脉有较好的组织相容性，实现主动脉管腔的正性重塑，最好依据每一个不同的夹层的特点生产出个性化的生物可吸收支架。相信随着材料科学的发展，移植物的改进和腔内技术的成熟，TEVAR 术后支架相关并发症一定会越来越少。

利益冲突：所有作者均声明不存在利益冲突。

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