Advances in Clinical Medicine 临床医学进展, 2020, 10(12), 2918-2925
Published Online December 2020 in Hans. http://www.hanspub.org/journal/acm
https://doi.org/10.12677/acm.2020.1012441

Castor单分支支架与单烟囱支架在胸主动脉疾病中重建左侧锁骨下动脉的疗效分析及评价

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收稿日期：2020年11月15日；录用日期：2020年12月8日；发布日期：2020年12月15日

摘　要

目的：总结分析Castor单分支支架与单烟囱支架在治疗胸主动脉疾病中重建左锁骨下动脉的经验与体会。方法：回顾性分析2015年12月至2019年6月期间我院因胸主动脉疾病就诊的42例患者临床资料。42例患者中，应用Castor单分支支架19例，其中Stanford B型主动脉夹层13例，主动脉瘤5例，主动脉溃疡1例；应用单烟囱支架的23例，其中Stanford B型主动脉夹层14例，主动脉瘤7例，主动脉溃疡2例，比较两组在围手术期和随访期间的结果，尤其是在主动脉重塑以及内漏等并发症方面。结果：Castor单分支支架及单烟囱支架手术技术成功率均为100%且住院期间无死亡、脑卒中及截瘫患者。19例Castor支架组患者术后I型内漏1人，23例烟囱支架组患者，I型内漏7例，随访期间无死亡。Castor支架组随访时间为(18.9 ± 5.9)个月，分支支架通畅率为100%，烟囱支架随访时间为(15.5 ± 8.7)个月，烟囱支架通畅率为91.3%。结论：Castor单分支支架与单烟囱支架均可用于治疗累积左锁骨下动脉的胸主动脉疾病，近中期通畅率满意。Castor支架对左侧锁骨下动脉成角要求较低，术后假腔完全血栓化概率高，对于左锁骨下动脉成角大的患者优先考虑Castor支架，远期效果有待继续随访观察。

关键词

Castor单分支支架，单烟囱支架，主动脉弓部分支重建，主动脉疾病，左锁骨下动脉，假腔血栓化

Analysis and Evaluation of the Efficacy of Castor Single-Branch Stent and Single-Chimney Stent in the Reconstruction of the Left Subclavian Artery in Thoracic Aortic Disease

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文章引用: 邱德强, 李君, 辛海, 刘伟丽, 官笑梅, 王豪夫. Castor 单分支支架与单烟囱支架在胸主动脉疾病中重建左侧锁骨下动脉的疗效分析及评价[J]. 临床医学进展, 2020, 10(12): 2918-2925. DOI: 10.12677/acm.2020.1012441

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Received: Nov. 15th, 2020; accepted: Dec. 8th, 2020; published: Dec. 15th, 2020

Abstract

Objective: To summarize and analyze the experience of Castor single branch stent and single chimney stent in the reconstruction of the left subclavian artery in the treatment of thoracic aortic disease. Methods: Clinical data of 42 patients admitted to our hospital for aortic disease from December 2015 to June 2019 were retrospectively analyzed. Among the 42 patients, 19 patients were treated with Castor single-branch stent, including 13 patients with Stanford B aortic dissection, 5 patients with aortic aneurysm and 1 patient with aortic ulcer. Among the 23 patients treated with single-chimney stent, 14 were treated with Stanford B aortic dissection, 7 with aortic aneurysm, and 2 with aortic ulcer. Results: The success rate of Castor stent and chimney stent was 100% and there were no death, stroke or paraplegia patients. There was 1 type I endoleak of Castor stent group, and 7 type I endoleak of chimney stent group, both groups had no deaths during the follow-up period. The follow-up time of the Castor stent group was (18.9 ± 5.9) months, the patency rate of the branch stent was 100%, and the follow-up time of the chimney stent was (15.5 ± 8.7) months, and the patency rate of the chimney stent was 91.3%. Conclusion: Both the Castor single-branch stent and single-stack stent can be used for the treatment of thoracic aortic disease with cumulative left subclavian artery, with satisfactory near- and medium-term patency rates. Castor stent has a low requirement for left subclavian artery angulation, and a high probability of complete false lumen thrombosis after surgery. Castor stent is preferred for patients with large left subclavian artery angulation, and the long-term effect remains to be observed in follow-up.

Keywords

Castor Single Branch Stent, Single Chimney Stent, Reconstruction of Partial Branches of the Aortic Arch, Aortic Disease, Left Subclavian Artery, False Lumen Thrombosis

1. 引言

随着腔内技术的发展，血管腔内修复术已经成为治疗胸主动脉疾病的首选方法[1]，胸主动脉弓部病变常常累及或临近左锁骨下动脉(Left Subclavian Artery, LSA)，导致近端锚定区不足，以往会放弃腔内手段，改用开放手术或杂交手术治疗[2] [3]。但开放手术需要充分暴露左锁骨下动脉，技术难度高，且会大大增加围术期脑血管意外风险，尤其是对于一般情况较差的患者，预后不佳[4]。而杂交手术时间长、创伤大、移植物及切口感染、吻合口漏、动脉闭塞等风险[5]。现在应用 Castor 单分支支架和单烟囱支架延长近端锚定区，并重建主动脉弓部左锁骨下动脉，缩短手术时间，降低手术风险，减少术后并发症。针对 Castor 单分支支架和单烟囱支架的选择，本文对 2015 年 12 月至 2019 年 6 月于我院诊治的累及左锁骨下动脉的主动脉疾病的患者进行回顾性分析，分析比较二者的近中期疗效及选择标准。

2. 资料与方法

2.1. 一般资料

2015 年 12 月至 2019 年 6 月于我院应用 Castor 单分支支架或单烟囱支架治疗累积左锁骨下动脉的主动脉疾病患者的基本资料包括性别、年龄、入院诊断、合并症、左锁骨下动脉成角、支架近端锚定区、手术方式、术后并发症(各型内漏、脑卒中、截瘫等)、随访分支支架通畅率等。

2.2. 手术及随访

术前根据 CT 血管造影(Computerized Tomography Angiography, CTA)明确左锁骨下动脉成角、近端锚定区等选择合适支架。Castor 单分支支架手术：常规消毒铺巾后切开股动脉及左桡动脉，置入导丝导管，造影定位左锁骨下动脉位置，循导丝置入 Castor 支架输送系统，分支支架进入左侧锁骨下动脉，造影确定支架位置合适，释放支架并撤出输送系统，再次造影定位支架位置查看有无内漏。单烟囱支架手术：常规消毒铺巾后穿刺股动脉及左桡动脉，置入导丝导管，造影定位左锁骨下动脉位置，支架主体从股动脉入路输送，烟囱支架从左侧桡动脉入路输送，造影确定支架位置及有无内漏。患者术后均接受随访，门诊预约复查 CTA，复查时间为术后 3、6、12 个月，及以后 1 年复查 1 次。

2.3. 纳入及排除标准

所有患者均被诊断为近端锚定区不足(破口位于 LSA 远端 < 15 mm)，并评估 LSA 的直径、主要破口位置以及 LSA 与左颈总动脉之间的距离，以确定烟囱移植物和分支支架移植物尺寸。这些患者均不适合或不愿接受开放手术，并同意接受 TEVAR 联合 LSA 重建手术。当入院时未出现持续的顽固性胸痛，破裂，难治性高血压，不稳定的血液动力学或明显的器官缺血的证据时，考虑进行腔内修复。否则，急症行 TEVAR 手术。

3. 结果

3.1. 一般资料(表 1)

本次实验患者共 42 例，其中 Castor 单分支支架组共 19 例，Stanford B 型主动脉夹层 13 例，主动脉瘤 5 例，主动脉溃疡 1 例，男性 16 例，女性 3 例，平均年龄(55.1 ± 10.9)岁，单烟囱支架组共 23 例，Stanford B 型主动脉夹层 14 例，主动脉瘤 7 例，主动脉溃疡 2 例，男性 19 例，女性，4 例，平均年龄(59.3 ± 14.8)岁。性别、年龄、疾病种类、吸烟、糖尿病、高血压对两组支架手术均无明显影响(P > 0.05)。近端锚定区、近端直径、LSA 与 LCCA 的距离、LSA 段主动脉直径，两组数据的差异不具有统计学意义(P > 0.05)。单烟囱支架组 LSA 成角(37.2 ± 6.0)小于 Castor 单分支支架组(55.1 ± 10.6)，差异具有统计学意义(P < 0.05)。

Table 1. General information of 42 patients
表 1. 42 例患者一般资料

一般情况	Castor 支架组(19 例)	单烟囱支架组(23 例)	P 值
性别			0.490
男	16	19	
女	3	4	
年龄	55.1 ± 10.9	59.3 ± 14.8	0.092
Stanford B 型主动脉夹层	13	14	0.612
主动脉瘤	5	7	0.769

Continued

主动脉溃疡	1	2	0.670
合并症			
高血压	12	19	0.138
糖尿病	1	3	0.847
吸烟	11	13	0.519
主动脉弓部解剖参数			
近端锚定区(mm)	10.1 ± 1.7	12.9 ± 1.2	0.148
近端直径(mm)	30.2 ± 2.2	31.4 ± 1.5	0.993
LSA 段主动脉直径(mm)	30.2 ± 1.0	31.1 ± 21.3	0.493
LSA 与 LCCA 的距离(mm)	10.4 ± 1.3	13.0 ± 1.2	0.125
LSA 成角(˚)	55.1 ± 10.6	37.2 ± 6.0	0.001

3.2. 手术及随访资料(表 2)

Castor 单分支支架组及单烟囱支架组手术均获得成功，且术后均无脑卒中、截瘫及死亡患者。Castor 单分支支架组随访时间为(18.9 ± 5.9)个月，单烟囱支架随访时间为(15.5 ± 8.7)个月，随访期间均无死亡病患者。Castor 单分支支架术后 I 型内漏 1 例，单烟囱支架组术后 I 型内漏 7 例，术后内漏患者均接受随访。Castor 单分支支架组患者平均手术时间为(101.1 ± 8.4) min，单烟囱支架组患者平均手术时间为(127.8 ± 8.7) min，差异具有统计学意义($P < 0.05$)。Castor 单分支支架组患者平均住院时间为(9.6 ± 1.7)天，单烟囱支架组为(9.6 ± 1.6)天，差异无统计学意义($P > 0.05$)。Castor 单分支支架组患者随访期间支架通畅率为 100%，单烟囱支架组患者随访期间支架通畅率为 91.3%，差异不具有统计学意义($P > 0.05$)。Castor 单分支支架组术后 6 月、术后 1 年主动脉假腔直径显著缩小、真腔直径显著扩大，且较单烟囱支架组变化更明显，差异具有统计学意义($P < 0.05$)。Csator 单分支支架组术后假腔完全血栓化概率(84.2%)明显高于单烟囱支架组(65.2%)，差距具有统计学意义($P < 0.05$)。

Table 2. Operative and follow-up data of 42 patients
表 2. 42 例患者手术及随访资料

手术及随访资料	Castor 支架组(19 例)	单烟囱支架组(23 例)	P 值
平均住院时间(天)	9.6 ± 1.7	9.6 ± 1.6	0.883
手术时间(min)	101.1 ± 8.4	127.8 ± 8.7	0.028
手术成功率	100%	100%	1.000
随访时间(月)	18.9 ± 5.9	15.5 ± 8.7	0.938
并发症			
住院期间死亡	0	0	1.000
随访期间死亡	0	0	1.000
住院期间支架通常率	100%	100%	1.000
随访期间支架通畅率	100%	91.3%	0.188
脑卒中	0	0	1.000
截瘫	0	0	1.000
I 型内漏	1	6	1.000
随访 3 月 I 型内漏率	1/19	6/23	-
随访 6 月 I 型内漏率	1/19	7/23	-

Continued

随访 1 年 I 型内漏率	1/19	7/23	-
夹层真假腔直径(mm)			
术前真腔直径	12.5 ± 3.0	11.5 ± 1.7	0.206
术前假腔直径	19.6 ± 2.8	21.1 ± 2.2	0.084
术后 6 个月真腔直径	25.1 ± 1.4	23.8 ± 1.4	0.010
术后 6 个月假腔直径	6.8 ± 1.1	10.7 ± 1.5	0.001
术后 1 年真腔直径	27.0 ± 1.3	25.0 ± 1.1	0.001
术后 1 年假腔直径	6.2 ± 1.0	8.9 ± 1.1	0.001
假腔完全血栓化	17/19	14/23	0.049

3.3. 左锁骨下动脉成角(表 3)

Castor 单分支支架组 LSA 成角(55.1 ± 10.6)˚明显大于单烟囱支架组(37.2 ± 6.0)˚，差异具有统计学意义($P < 0.05$)。LSA 成角在 0˚~40˚，两组支架发生内漏的情况无显著差异($P > 0.05$)，而当 LSA 成角大于 40˚时，Castor 单分支支架组内漏的发生显著小于单烟囱支架组，差距具有统计学意义($P < 0.05$)。且 Castor 单分支支架术后内漏与 LSA 成角无明显的相关关系($P > 0.05$)，单烟囱支架术后内漏与 LSA 成角成显著的正相关关系($P < 0.05$)，即 LSA 成角越大，越容易发生内漏(图 1)。

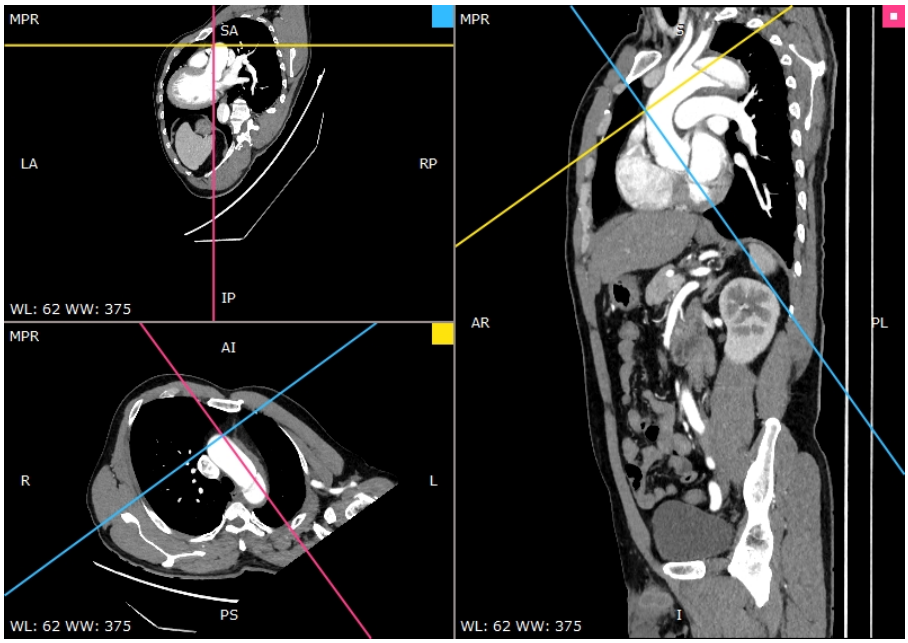

Figure 1. The angle between the line of a branch and the corresponding position of the arch
图 1. 主动脉弓分支走行与主动脉弓部相应位置切线之间的角度

Table 3. The left subclavian artery into angle compared with postoperative I type internal leakage occurred relations
表 3. 左锁骨下动脉成角与术后 I 型内漏发生关系对比

左锁骨下动脉成角	Castor 支架术后		烟囱术后 I 型内漏		P 值
	有内漏	无内漏	有内漏	无内漏	
0˚~40˚	0	1	2	15	1.000
>40˚	1	17	5	1	0.002

3.4. 关于内漏率的生存分析

Castor 单分支支架术后内漏 1 例，单烟囱支架组术后内漏 7 例，两组支架对内漏的影响差异存在具有统计学意义(P < 0.05)，且 Castor 支架组内漏率(5.3%)显著小于烟囱支架组(30.4%)。根据随访结果绘制的 K-M 生存曲线(图 2)可以看出，Castor 单分支支架组手术效果显著好于单烟囱支架组，且差异具有统计学意义(P = 0.048 < 0.05)。

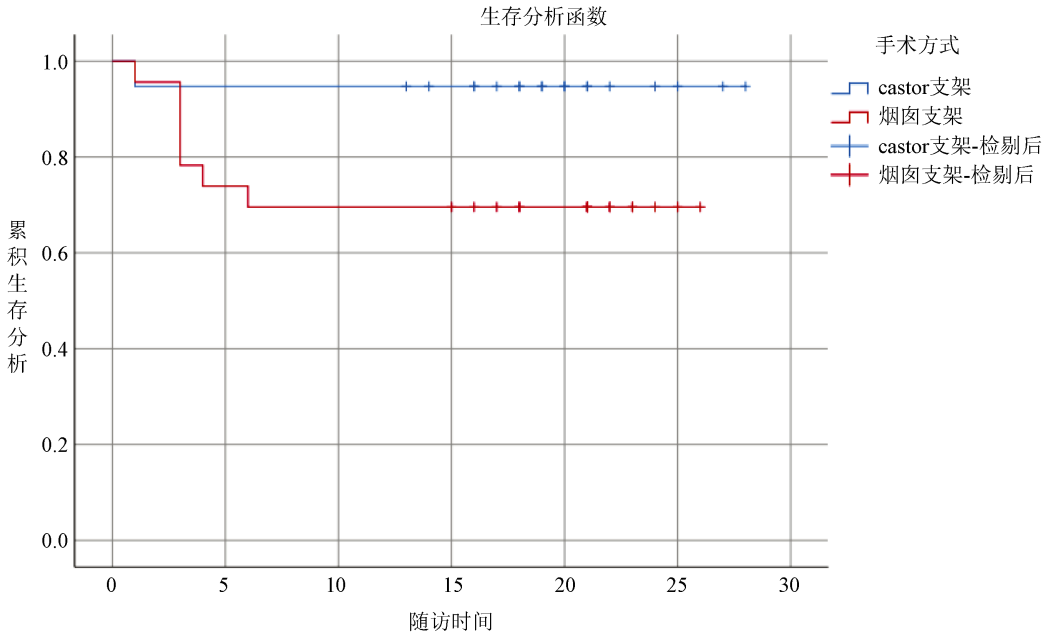

Figure 2. Survival analysis results of the Castor bracket group and the stack bracket group by K-M method
图 2. Castor 支架组与烟囱支架组 K-M 法生存分析结果

3.5. 统计学分析

采用 SPSS25 进行统计学分析。计数资料采用卡方检验，相关性分析采用 Spearman 相关性分析，Logistic 回归模型分析影响因素，Kaplan-Meier 生存曲线进行生存分析，P < 0.05 说明差异具有统计学意义。

4. 讨论

目前胸主动脉腔内修复术(thoracic endovascular aortic repair, TEVAR)已经成为治疗胸主动脉夹层、胸主动脉瘤等胸主动脉疾病的主要手段[6]。累及主动脉弓分支，尤其是左锁骨下动脉的胸主动脉疾病，由于近端锚定区不足，常规的胸主动脉腔内修复术受到限制。Caronno 等认为覆盖左锁骨下动脉不会增加脑血管意外和脊髓缺血[7] [8]。但是近几年，随着对 TEVAR 手术的认知进一步加深，国内外学者倾向于认为，左锁骨下动脉完全封堵后不仅会导致左上肢缺血，更会增加中风和脊髓损伤的风险[9] [10]。Buth 等研究表明，预防性的重建左锁骨下动脉可以有效降低脑卒中及脊髓损伤的概率[11] [12] [13]。因此，重建左锁骨下动脉对改善患者生活质量、降低脑血管意外有重要意义[14]。目前国内重建左锁骨下动脉、扩展近端锚定区主要方法为应用 Castor 单分支支架或者单烟囱支架。Castor 分支型主动脉覆膜支架是第一款用于完全腔内治疗累及左锁骨下动脉，或破口与左锁骨下动脉距离 < 15 mm 胸主动脉疾病的分支型覆膜支架系统。Castor 单分支支架具有操作简单、贴附性强、有效降低内漏风险等优势[15]。烟囱技术由

Greenberg 等[16]于 2003 年首次报道，具有创伤小、技术要求低等优点。研究报道，烟囱支架技术术后内漏发生率为 15%~30% [17] [18] [19] [20]。本组实验中，Castor 单分支支架 19 例，术后及随访内漏 1 例，支架通畅率 100%；单烟囱支架 23 例，术后及随访内漏 7 例，支架通畅率 91.3%。随访发现单烟囱支架组术后内漏率及近中期支架通畅率不及 Castor 支架。主动脉弓部的解剖条件为导致 TEVAR 术后内漏的重要原因[21] [22]。近端锚定区、近端直径、LSA 段主动脉直径、LSA 与 LCCA 的距离对两组支架的影响不明显。左锁骨下动脉成角超过 40˚，单烟囱支架组术后内漏率明显升高，Castor 单分支支架优势较明显，而左锁骨下动脉成角不大于 40˚时，单烟囱支架内漏率与 Castor 单分支支架差别不明显。烟囱支架组内漏率明显高于 Castor 支架组，且 LSA 成角越大发生内漏的风险越高，而 Castor 支架内漏的发生与 LSA 成角无明显的相关关系。术后假腔完全血栓化为 TEVAR 术后主动脉重建的重要评价标准。假腔完全血栓化往往提示管腔重塑良好，是 TEVAR 手术取得良好预后结果的重要临床指标[23] [24] [25]。本组实验中 Castor 单分支支架组术后假腔完全血栓化概率明显高于单烟囱支架组，这表明 Castor 单分支支架更有利于术后管腔重塑。

5. 总结

Castor 单分支支架与单烟囱支架均可用于近端锚定区不足时主动脉弓左锁骨下动脉的重建，左锁骨下动脉成角较小(<40˚)的情况单烟囱支架安全有效，而 Castor 单分支支架受左锁骨下动脉成角的影响较小，适用范围更广，左锁骨下动脉成角较大时选择 Castor 单分支支架可以有效避免术后内漏。两种支架近中期通畅率较好，远期通畅率有待进一步观察。

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