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## 冠状动脉慢性完全闭塞合并分叉病变介入治疗

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**【摘要】**慢性完全闭塞病变成为经皮冠脉介入术治疗“最后的堡垒”。成功开通闭塞病变,可改善心绞痛症状、生活质量、左室射血分数和远期预后。慢性闭塞合并分叉病变时,介入治疗操作更复杂。随着各种正向/逆向技术发展和新型器械的应用,闭塞血管开通率逐渐提升,但分支闭塞风险仍较高。分支闭塞导致围手术期心肌梗死和主要心脏不良事件发生率升高。慢性闭塞合并分叉病变介入治疗过程中容易出现冠状动脉夹层和假腔,影响分支血流。使介入手术难度增加、成功率降低和并发症增多。

**【关键词】**慢性完全闭塞病变;分叉病变;经皮冠脉介入术;主要心脏不良事件

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## Percutaneous Coronary Intervention for Chronic Total Occlusion with Bifurcation Lesions

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**【Abstract】** Chronic total occlusion (CTO) of coronary artery becomes the “last bastion” of percutaneous coronary intervention. Successful opening of chronic obstructive diseases can effectively improve angina symptoms, quality of life, left ventricular ejection fraction and long-term prognosis. If chronic occlusion of coronary artery is accompanied with bifurcation lesions, the operation of interventional therapy is quite complex. With the development of various forward/reverse techniques and the application of new equipment, the opening rate of occluded vessels is increased gradually, but the risk of side branch occlusion is still high. Bifurcation occlusion leads to increased perioperative myocardial infarction and major adverse cardiac events. CTO with bifurcation lesions is prone to coronary dissection and pseudolumen during interventional procedure, which affects the branch blood flow, and it increased the difficulty of interventional surgery, reduced the success rate and increased the complications.

**【Key words】** Chronic total occlusion; Bifurcation lesions; Percutaneous coronary intervention; Major adverse cardiac events

经皮冠脉介入术(percutaneous coronary intervention, PCI)治疗慢性完全闭塞病变(chronic total occlusion, CTO)日益受到心血管介入专家的关注和重视。成功开通 CTO 病变血管后,可缓解心绞痛发作,改善心脏功能和预后。随着新技术和新器械的发展,对有经验的术者而言,即便是复杂的 CTO 病例,仍能取得很高的操作成功率,并取得满意的短期、中期和长期结果。据统计,分叉病变占常规 PCI 治疗的 20% 左右,分叉病变存在可导致操作成功率降低和并发症发生率升高。因而 CTO 合并分叉病变患者 PCI 治疗过程中,如何在开通 CTO 的同时减少分支受累,对介入心脏病医生提出了更高的要求。

### 1 CTO 合并分叉病变的定义和流行病学

冠状动脉 CTO 定义为冠状动脉 100% 闭塞,远端 TIMI 0 级血流,且闭塞时间 > 3 个月<sup>[1]</sup>。

冠状动脉 CTO 病变占接受冠状动脉造影检查患者的 15% ~ 25%<sup>[2,4]</sup>。右冠状动脉是最常见的 CTO 血管,约占 CTO 血管的一半<sup>[4]</sup>。既往行冠状动脉旁路移植术(CABG)的患者 90% 合并 CTO 病变<sup>[4]</sup>,而急性 ST 段抬高型心肌梗死患者中有 10%。

临床研究中,常将 CTO 合并分叉病变定义为 CTO 闭塞近端纤维帽(5 mm 内)、闭塞段内或远端纤维帽(5 mm 内)合并有分支存在(直径 ≥ 2 mm)<sup>[5-6]</sup>。目前有报道提示 CTO 合并分叉病变概率为 25.8% ~ 47%<sup>[5-8]</sup>。

### 2 CTO 开通的临床意义

正如 FFR 研究<sup>[9]</sup>所示,无论侧支循环如何,CTO 供血范围的存活心肌是存在缺血的。CTO 血管再通旨在改善相应缺血区域的心肌灌注<sup>[10]</sup>。CTO 患者成功行 PCI 带来多重效益。首先,缓解心肌缺血,降低心绞痛的严重程度和频率,提高生活质量<sup>[11]</sup>;其次,未经

治疗的 CTO 意味着不完全血运重建<sup>[12]</sup>,与随访时持续的左心室功能障碍相关。因此,再通 CTO 达到完全血运重建,可改善左心室功能<sup>[13]</sup>;第三,CTO 具有致心律失常潜力,有 3% 的 CTO 患者合并恶性室性心律失常<sup>[5]</sup>。在植入式心律转复除颤器的患者研究显示,与无 CTO 的患者相比,CTO 受试者因恶性室性心律失常所致的休克比率更高<sup>[14]</sup>。并且在无心肌瘢痕的情况下,也可观察到室性心律失常,因此可能与缺血现象有关。相比药物治疗和冠状动脉搭桥治疗,CTO 患者更倾向于接受 PCI 治疗。但目前只有观察数据<sup>[15]</sup>表明 CTO 血管再通可降低死亡率。且相对非 CTO 血管,开通 CTO 需更高医疗费用、更多化验室检查和更高的围术期风险。因而,CTO 病变患者行 PCI 需把握适应证<sup>[16]</sup>。已有研究显示 CTO 血管再通可缓解心绞痛症状,减轻心肌缺血,改善左心室功能<sup>[10]</sup>。对 CTO 供血区域有存活心肌存在,采用最佳药物治疗仍有心绞痛发作或呼吸困难症状的患者,进行 CTO 再通实现完全血运重建是有意义的。在无症状患者中,建议进行缺血性负荷评估,如果缺血面积 ≥ 10%,同样建议行 CTO 血管再通治疗<sup>[17]</sup>。

### 3 分叉病变介入治疗特点

介入治疗过程中,分叉病变存在意味着操作难度增加,围术期心肌梗死比例增高,导致主要心脏不良事件(major adverse cardiac events, MACE)增加。

#### 3.1 解剖因素

有对分叉病变研究<sup>[18-19]</sup>显示,分支开口病变 ≥ 50% 狭窄是分支闭塞的独立危险因素。此外,分支病变长度、直径和分支闭塞相关。一项应用血管内超声研究<sup>[18]</sup>显示,分支弥漫动脉粥样硬化斑块病变发生分

支闭塞情况多于局限狭窄病变。此外, Hahn 等<sup>[18]</sup>研究提示主支近端病变是预测分支闭塞的独立危险因素, 而主支远端病变则与分支闭塞无关。相应的血管内超声斑块体积分析研究证实斑块移位与 PCI 后主支近端斑块容积减少相关, 与远端斑块容积减少无关。这些研究结果提示, 主支近端斑块对分支闭塞影响更大。对特殊分叉病变, 如左主干分叉病变中分支闭塞较非左主干病变要少。可能与操作者在左主干病变中, 更多选择双支架策略以避免回旋支闭塞相关。虽然分支角度被认为是分叉 PCI 的重要因素, 但分支角度与分支闭塞或临床结果研究数据较少。部分临床研究<sup>[18]</sup>提示分支角度不影响分支 TIMI 血流和长期临床结果。

### 3.2 操作因素

分叉病变 PCI 过程中, 界嵴和斑块移位、夹层延伸到分支都是分支闭塞的可能原因<sup>[20]</sup>。在多数情况下, 主支支架后恢复闭塞分支血流很困难。有研究<sup>[5]</sup>提示非 CTO 分叉病变对分支预扩张或保留导丝并不能防止分支闭塞, 但分支拘禁导丝起到指引作用, 有助闭塞分支的再开通。近些年来, 拘禁球囊技术用来降低分支闭塞风险。拘禁球囊技术是必要时支架技术的改进, 未膨胀的球囊拘禁于支架结构外, 占据分支开口空间, 减少界嵴或斑块移动, 避免分支闭塞<sup>[21]</sup>。Kim 等<sup>[22]</sup>回顾性分析分叉病变采用单支架简单处理策略时, 发现在拘禁球囊技术组分支丢失率明显降低, 但这项技术不能完全避免分支闭塞。特别是后扩张时, 支架球囊采用高压扩张, 可能出现界嵴移动到分支或远端夹层。近期临床研究<sup>[23]</sup>提示拘禁半扩张球囊似乎更有效。对于复杂冠状动脉分叉病变, 拘禁半扩张球囊有很高即刻操作成功率, 无 MACE 或分支闭塞<sup>[24]</sup>。

### 3.3 临床因素

有研究提示急性冠脉综合征患者, 主支支架术后更多伴随分支闭塞<sup>[5]</sup>。血管内超声成像提示急性冠脉综合征患者中, 罪犯病变有更多血栓和斑块负荷, 是导致分支闭塞的重要因素。

## 4 CTO 合并分叉病变的介入治疗

### 4.1 CTO 合并分叉解剖特点

CTO 合并分叉病变患者病变更复杂, 合并多支病变概率高。有研究显示, 25.8% ~ 47% CTO 病变合并分叉病变(分支直径  $\geq 2$  mm)<sup>[5-6]</sup>, 其中真分叉(Medina 分型 1, 1, 1 或 1, 0, 1 或 0, 1, 1)病变占大多数(87%)<sup>[8]</sup>, 多支病变概率为 74.7% ~ 86.6%<sup>[5, 7]</sup>。合并分叉病变的 CTO 最常见前降支闭塞(48.4%), 无分支发出的 CTO 多见右冠状动脉闭塞(56.6%)( $P < 0.001$ )<sup>[5]</sup>。这与前降支与左回旋支相邻, 且有多个粗大对角支、间隔支分支发出等解剖特点相符。

### 4.2 介入策略选择

CTO 病变介入过程中采用前向导丝升级技术, 经常使用头端坚硬的导丝, 常进入假腔, 易出现冠状动脉夹层或导丝通过“真-假-真”途径进入远端真腔。主支血管中夹层和假腔, 直接影响 PCI 术后分支血流。此外, 正向内膜下重回真腔技术或逆向内膜下重回真腔技术, 均增加分支闭塞或者血流减慢可能。

Ojeda 等<sup>[6, 8]</sup>研究显示 CTO 合并分叉病变操作成功率较低, 伴随更多围术期心肌梗死的发生。71% 患者采用导丝进入分支保护, 30% 患者采用球囊预扩张分支开口, 只有 6% 患者采用双支架策略, 与非 CTO 分叉病变报告相似。分叉病变成功率为 81%, 单支架(必要时 T 支架)策略更常用(94%)。分叉部位夹层是双支架植入最重要的预测因子。PCI 后有 19% 分支血流  $< \text{TIMI} 3$  级。基线分支保留导丝, 分叉病变无夹层, 非真分叉病变(Medina 1, 1, 0 或 1, 0, 0 或 0, 1, 0)是预测分叉病变的手术成功因素。CTO 合并分叉病变与心肌梗死的发生率较高有关, 导丝无法进入分支导致术后分支闭塞发生率升高, 并与围术期心肌梗死相关。简单策略组和复杂策略组手术成功率两组类似。而简单策略组对比剂用量、放射线剂量和放射时间更短。随访 25 个月, 两组总 MACE 无明显差异, 但复杂处理组无 MACE 生存率有增加趋势( $P = 0.08$ )。

此外 Oreglia 等<sup>[25]</sup>报道 CTO 合并分叉病变时, 无论近端分叉、体部分叉和远端分叉, 均可应用双腔微导管开通 CTO 病变同时保留分支血管血流。双腔微导管同样可用于 CTO 逆向治疗。

### 4.3 分支闭塞影响

Hahn 等<sup>[18]</sup>研究提示对于粗大分支(直径  $\geq 2.3$  mm)的分叉病变或左主干分叉病变而言, 若出现分支闭塞, 则患者发生心源性死亡( $P = 0.002$ )和支架内血栓( $P = 0.002$ )的概率更高, 且总体 MACE 明显增加( $HR 1.64, 1.05 \sim 2.58, P = 0.03$ )。Nguyen-Trong 等<sup>[26]</sup>报道 CTO 再通过程失去分支( $\geq 1$  mm)情况很常见, 并与 2 个月时围术期心肌梗死和死亡率的风险增加有关。Chen 等<sup>[7]</sup>研究提示分支发生急性闭塞增加围术期心肌梗死发生率, 不完全血运重建和支架后 TIMI 血流是 1 年 MACE 的独立预测因素。

因此, 在 CTO 合并分叉病变中, 采用单支架策略, 一旦出现分支闭塞, 提示不良事件增加<sup>[27]</sup>。很多介入专家认为由于存在分支闭塞风险, 单支架策略不适合复杂分叉病变。

## 5 总结

开通冠状动脉 CTO 病变, 可缓解心绞痛症状, 改善心功能, 减少恶性心律失常发生。分叉病变存在增加操作难度, 降低介入治疗成功率, 导致围术期心肌梗死和 MACE 升高。CTO 合并分叉病变大多为复杂

病变,介入过程中容易出现冠状动脉夹层和假腔,从而影响分支血流。介入手术难度增加,成功率降低,并发症增多<sup>[28]</sup>。因而在开通 CTO 过程中,简化操作同时尽可能避免分支闭塞,对介入心脏病医生提出了更高要求,有待进一步研究。

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