Quick Compendium on Bifurcation Lesions: The TRYTON Side Branch Stent
A Concise Compilation of Contemporary, Relevant Studies

Presented by Cath Lab Digest

Cover Image

1. A New Classification of Coronary Bifurcation Lesions.

Published Literature

2. A Randomized Trial of a Dedicated Bifurcation Stent Versus Provisional Stenting in the Treatment of Coronary Bifurcation Lesions.

3. Outcomes of a Dedicated Stent in Coronary Bifurcations with Large Side Branches: A Subanalysis of the Randomized TRYTON Bifurcation Study.


Figure 1. Medina classification of coronary bifurcation lesions.

The Medina Classification considers the three components of bifurcation: The main branch proximal (MBP), the main branch distal (MBD), and the side branch (SB). It assigns a binary value (1,0) according to whether each of the segments is compromised or not. This figure shows the possible morphologies.
Philippe Généreux and colleagues report in the Journal of the American College of Cardiology the results of the prospective, single-blind, multicenter, randomized, controlled TRYTON clinical trial.1

The TRYTON trial was designed to evaluate the safety and effectiveness of the TRYTON side branch stent used with a drug-eluting stent (DES) in comparison to a provisional approach (stent only when percutaneous transluminal coronary angioplasty (PTCA) does not accomplish optimal results2,3) for bifurcation lesions. From December 2010 to November 2012, the study enrolled a total of 704 patients with angina and/or ischemia involving a true coronary bifurcation lesion. Patients were enrolled at 58 sites (30 in Europe and 28 in the United States), and were randomly assigned to the provisional strategy (n=349) or the Tryton bifurcation stent strategy (n=355). Only patients with significant narrowing (≥50%) and a true bifurcation lesion (Medina classification 1,1; 1,0,1; or 0,1,1) were enrolled in the trial. Patients with left main coronary artery disease, trifurcation lesions, total occlusion, severely calcified lesions, ST-elevated myocardial infarction (MI), non-ST-elevated MI, and those with angiographic evidence of thrombus were excluded from the study.

Target vessel failure (TVF) (defined as the composite of cardiac death, target vessel MI, and clinically driven target vessel revascularization [TVR] in the main branch [MB] or side-branch [SB] at 9 months was the primary endpoint of this study. The secondary angiographic endpoint was SB in-segment % diameter stenosis of the bifurcation stent compared with SB balloon angioplasty at the 9-month follow-up.

The primary endpoint, TVF (9-month follow-up), was 17.4% in the Tryton group compared with 12.8% in the provisional group (P=0.11). The significant difference in TVF was mainly due to higher rate of periprocedural MIs (13.6% vs 10.1%, P=0.019) after bifurcation stent implantation. Of note, most periprocedural MIs were small CK-MB elevations (~90% <10x ULN CK-MB elevation) and the increase in periprocedural MIs did not result in clinically significant adverse events, such as cardiac death or the need for revascularization. The secondary endpoint, the SB in-segment diameter stenosis at 9 months after randomization, was lower in the bifurcation stent group compared with the provisional group (31.6% vs 38.6%, P=0.002 for superiority).

The authors identified certain limitations of the TRYTON study as follows: (i) Only 41% of the study population met the entry criteria for SB diameter size (≥2.25 mm per QCA, equivalent to ~2.5 per visual estimate). (ii) This study did not investigate the implication of bifurcation stents in lesion length >5 mm.

In summary, this study showed that a bifurcation 2-stent strategy in true bifurcations did not meet the noninferiority TVF endpoint (vs 1-stent provisional strategy). However, as identified by the authors, the major reason for the failure of this study was the inclusion of nearly 60% of the patient population with smaller SBs (<2.25mm). The study concluded that provisional stenting should remain the preferred strategy for treatment of non-left main true coronary bifurcation lesions. Therefore, to assess the suitability of the Tryton stent for the “intended” patient population compared with provisional stenting strategy for the treatment of non-left main true coronary bifurcation lesions, Généreux and colleagues performed a subanalysis of the randomized TRYTON bifurcation study.4

Outcomes of a Dedicated Stent in Coronary Bifurcations with Large Side Branches: A Subanalysis of the Randomized TRYTON Bifurcation Study
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The authors conducted a subanalysis with focus on primary endpoints in only eligible patients, based on original selection criteria. The subanalysis identified 289 patients (143 provisional and 146 Tryton stent; 41% of original cohort) with a SB ≥2.25 mm by QCA, as indicated in label. The original primary composite endpoint of TVF was numerically lower and was within the non-inferiority margin (Figure 2) in the Tryton group compared with the provisional group (11.3% vs 15.6%, P=0.38). The difference in the primary endpoint (TVF) was mainly driven by numerically lower rates of target vessel MI (Tryton 9.2% vs provisional 12.1%, P=0.56). In-segment percent diameter stenosis of the SB was significantly lower in the Tryton group compared with the provisional group (30.4% vs 40.6%, P=0.004). Also, lesion success, procedure success, and device success were achieved more frequently in the Tryton stent group compared with the provisional group.

Disclosure: Funded by Tryton Medical, Inc. Authors included consultants, employees, and the Board of Directors from Tryton Medical, Inc.
Based on these favorable findings, a Tryton Confirmatory Study was designed in collaboration with U.S. FDA to confirm results seen in the intended population of the Tryton Pivotal RCT, and confirm ability of the physicians to enroll appropriate patients (with appropriately sized SBs). In the Tryton Confirmatory Study, Généreux et al enrolled 133 patients and was shown to support the safety and efficacy of the Tryton side branch stent for treatment of bifurcation lesions involving large SBs.

**Disclosure:** One of the study authors, Aaron V. Kaplan, is the Founder and Board Member of Tryton Medical, Inc.
The TRYTON Side Branch Stent is indicated for improving the side branch luminal diameter of de novo native coronary artery bifurcation lesions [Medina Classification 1.1; 0.1.1; 1.0.1] with a side branch diameter stenosis of ≥50% and a lesion length ≤5.0 mm, along with reference vessel diameters ≥2.5 mm to ≤3.5 mm in the side branch and ≥2.5 mm to ≤4.0 mm in the main branch. The device is intended for use in conjunction with commercially available balloon expandable drug-eluting coronary stents in the main branch.

RELEVANT PRECAUTIONS:
- Side branch pre-dilatation is required and should only be performed with an angioplasty balloon appropriate for a vessel ≥2.5 mm in diameter by visual assessment or ≥2.25 mm in diameter by QCA, inflated to nominal pressure. • Following pre-dilation, angiography should be performed following the administration of intracoronary nitroglycerin to reassess vessel dimensions with attention to the side branch reference vessel diameter (RVD) to ensure that it is of appropriate size. The side branch RVD should be based on the most angiographic normal appearing segment distal to the lesion. • Use of this product should be performed only in hospitals with access to emergency coronary artery bypass graft surgery that can be performed quickly in the event of a potentially injurious or life-threatening complication. • When the delivery catheter is exposed to the vascular system, it should be manipulated while under high-quality fluoroscopic observation. If resistance is met during manipulation, determine the cause of the resistance before proceeding. Excessive manipulation may cause dislodgment of the stent from the delivery catheter or vessel damage. • Balloon pressure should not exceed the rated burst pressure of the delivery catheter. Use of a pressure monitoring device is required to prevent over-pressurization. • Do not attempt to reposition a partially deployed stent. Attempted repositioning may result in severe vessel damage. • When recrossing a recently implanted stent, care should be taken to assure the guide wire is placed within the lumen and not in between the stent and the vessel wall. Otherwise, inadvertent dislodgment of the stent may occur leading to faulty positioning of the stent. • Do not attempt to pull an unexpanded stent back into the guiding catheter, as stent damage or stent dislodgement may occur. Movement in and out through the distal end of the guiding catheter should not be performed as the stent may be damaged when retracting the undeployed stent back into the guiding catheter. To withdraw the TRYTON Side Branch Stent system, the entire system with the guiding catheter should be removed as a single unit. • If a guide catheter extension is utilized to deliver/position the TRYTON Stent and it becomes necessary to withdraw/remove an unexpanded TRYTON Stent/Stent Delivery System, do not withdraw the TRYTON Stent/Stent Delivery System into the guide catheter extension. Withdrawal of the TRYTON Stent/Stent Delivery System into a guide catheter extension may cause dislodgement of the TRYTON Stent from the Stent Delivery System. • Main branch artery preparation including pre-dilation, stent positioning and deployment should be completed following main branch stent instructions for use. • Stent retrieval methods [use of additional wires, snares, and/or forceps] may result in additional trauma to the coronary vasculature and/or the vascular access site. Complications may include bleeding, hematoma or pseudoaneurysm. • The TRYTON Side Branch Stent has not been evaluated in pediatric cases or cases of in-stent restenosis or previously stented lesions.

RELEVANT CONTRAINDICATIONS: The TRYTON Side Branch Stent is contraindicated in the following conditions or uses:
- Vessels that are totally occluded • Vessels that have moderate to severe calcification • Target lesions that have excessive tortuosity unsuitable for stent delivery and deployment • Angiographic evidence of thrombus in the target vessel • Lesions in which complete angioplasty balloon inflation cannot be achieved during pre-dilatation • TRYTON stent placement without angioplasty pre-dilatation of the main branch and side branch (i.e. direct stenting is contraindicated) • TRYTON stent placement alone, without implantation of a main branch stent • An untreated significant (>50%) stenosis proximal or distal to the main branch or side branch target lesion • Side Branch Stent • Impaired runoff in the treatment vessel with diffuse distal disease • Ejection fraction ≤30% • Anticipated use of rotational atherectomy.

RELEVANT WARNINGS:
- Use of the TRYTON Side Branch Stent in appropriately sized main vessels and side branches is required for safe and effective performance of the device. • Do not use the TRYTON Stent in small side branches (<2.50 mm in diameter by visual assessment or <2.25 mm in diameter by quantitative coronary angiography [QCA]), as its use may lead to an increased risk of adverse cardiac events such as myocardial infarction and the need for repeat revascularization. To confirm appropriately sized side branch diameters, the diameter of the pre-dilatation balloon inflated to nominal pressure may be used as a reference. Alternatively, the use of quantitative imaging methods such as on-line quantitative coronary angiography, intravascular ultrasound or optimal coherence tomography should be considered. • Excessive dilatation of the artery may cause vessel rupture and life-threatening bleeding. • Stents may not be fully expanded during deployment, particularly in resistant lesions. • Stent dislodgment from the balloon surface during deployment and/or dislodgment from the target site post-deployment can occur. • Major bleeding.

CAUTION: Federal (USA) law restricts this device to sale by or on the order of a physician. For detailed information in indications, contraindications, warnings, precautions, and adverse events, see full Instructions for Use. The Tryton Side Branch Stent, manufactured by Tryton Medical and distributed by Cordis, is now FDA-approved for use in the United States.