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CASE STUDY

IVUS-Guided PCI For Bifurcation Lesion

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구 본 권





Bifurcations are complex!















1





IVUS-guided PCI for bifurcation lesion can improve outcomes

Am Heart J. 2011 Jan;161(1):180-7.

Impact of intravascular ultrasound guidance on long-term clinical outcomes in patients treated with drug-eluting stent for bifurcation lesions: data from a Korean multicenter bifurcation registry.

Kim JS, Hong MK, Ko YG, Choi D, Yoon JH, Choi SH, Hahn JY, Gwon HC, Jeong MH, Kim HS, Seong IW, Yang JY, Rha SW, Tahk SJ, Seung KB, Park SJ, Jang Y.

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Abstract

BACKGROUND: although intravascular ultrasound (IVUS) has been widely used for complex lesions during coronary intervention, IVUS for stenting at bifurcation lesions has not been sufficiently assessed. The aim of this study was to investigate the impact of IVUS guidance on long-term clinical outcomes during drug-eluting stent (DES) implantation for bifurcation lesions.

METHODS: the Korean multicenter bifurcation registry listed 1,668 patients with non-left main de novo bifurcation lesions who underwent DES implantation between January 2004 and June 2006. Using propensity score matching with clinical and angiographic characteristics, 487 patients with IVUS guidance and 487 patients with angiography guidance were selected. The long-term clinical outcomes were compared between the 2 groups.

RESULTS: baseline clinical and angiographic characteristics were well matched and showed no significant differences between the 2 groups. Twostent technique and final kissing ballooning angioplasty were more frequently performed in the I/US-guided group. Maximal stent diameters at both the main vessel and the side branch were larger in the I/US-guided group. Periprocedural creatine kinase-MB elevation (>3 times of upper normal limits) was frequently observed in the angiography-guided group. The incidence of death or myocardial infarction was significantly lower in the I/USguided group compared to the angiography-guided group (3.8% vs 7.8%, log rank test P = .03, hazard ratio 0.44, 95% Cl 0.12-0.96, Cox model P = .04).

CONCLUSIONS: intravascular ultrasound guidance during DES implantation at bifurcation lesions may be helpful to improve long-term clinical outcomes by reducing the occurrence of death or myocardial infarction.

Long-Term Outcomes of Intravascular Ultrasound-Guided Stenting in Coronary Bifurcation Lesions

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Stenting for bifurcation lesions is still challenging, and the effect of intravascular ultrasound (IVUS) guidance on long-term outcomes has not been evaluated. We assessed the long-term outcomes of IVUS-guided stenting in bifurcation lesions. We evaluated 758 patients with de novo nonleft main coronary bifurcation lesions who underwent stent implantation from January 1998 to February 2006. We compared the adverse outcomes (i.e., death, stent thrombosis, and target lesion revascularization) within 4 years, after adjustment using a multivariate Cox proportional hazard model and propensity scoring. IVUS-guided stenting significantly reduced the long-term all-cause mortality (hazard ratio [HR] 0.31, 95% confidence interval [CI] 0.13 to 0.74, p = 0.008) in the total population and in the patients receiving drug-eluting stents (DESs) (HR 0.24, 95% CI 0.06 to 0.86, p = 0.03), but not in the patients receiving bare metal stents (HR 0.41, 95% CI 0.13 to 1.26, p = 0.12). IVUS-guided stenting had no effect on the rate of stent thrombosis (HR 0.48, 95% CI 0.16 to 1.43, p = 0.19) or target lesion revascularization (HR 1.47, 95% CI 0.79 to 2.71, p = 0.21). In patients receiving DESs, however, IVUS guidance reduced the development of very late stent thrombosis (0.4% vs 2.8%, p = 0.03, log-rank test). In conclusion, in patients receiving DESs, IVUS-guided stenting for treatment of bifurcation lesions significantly reduced the 4-year mortality compared to conventional angiographically guided stenting. In addition, IVUS guidance reduced the development of very late stent thrombosis in patients receiving DESs. © 2010 Elsevier Inc. All rights reserved. (Am J Cardiol 2010;106:612-618)

CONCLUSIONS:

IVUS guidance during DES implantation at bifurcation lesions may be helpful to improve long-term clinical outcomes by reducing the occurrence of death or myocardial infarction In conclusion, IVUS-guided stenting for bifurcation lesions significantly reduced the 4-year mortality compared to conventional angiographically guided stenting.

What can be guided by IVUS?

• Pre-intervention

- After main branch stent implantation
- After side branch balloon angioplasty
- After side branch stenting



Precise anatomical lesion assessment



4

Mechanism of side branch stenosis



Important of longitudinal view





- Geometry of bifurcation lesion
- Amount, character and distribution of plaque
- Location, length of carina
- Distance between carina and outer lumen of a side branch

Important of longitudinal view

Will this diagonal branch occluded?



Precise anatomical (=functional) assessment?



Diagnostic accuracy of IVUS parameters in pure ostial lesions



Koh JS, Koo BK, et al., JACC Intv, 2012

IVUS-Guided PCI For Bifurcation Lesion

- Pre-intervention
 - IVUS can provide detailed anatomical information which is very helpful to plan the intervention strategy
 - Longitudinal view is important to predict what will happen in side branch after main branch stent implantation.
 - IVUS parameters have low positive predictive values to predict the presence of ischemia.



What can be guided by IVUS?

- Pre-intervention
- After main branch stent implantation
- After side branch balloon angioplasty
- After side branch stenting



How can these be assessed by IVUS?





Pre-intervention IVUS to predict jailed SB FFR



13

Pre-intervention IVUS to predict jailed SB FFR<0.8

A. MLA within SB ostium

B. Plaque burden within SB ostium

C. MLA within the POC







IVUS can tell True vs. Pseudo-stenosis



IVUS can tell the mechanism of SB jailing

Complexity of SB jailing: Plaque, Carina, Stent.....



Different target, different strategy

- Target: SB plaque
 - Large balloon, high pressure
 - More injury, more dissection
 - →Higher chance of SB stenting
 - \rightarrow More late loss
- Target: Shifted carina -
 - Relatively small balloon, low pressure
 - Less injury, less dissection
 - \rightarrow Less chance of SB stenting
 - \rightarrow Less late loss





IVUS-Guided PCI For Bifurcation Lesion

• After main branch stent implantation



- IVUS for jailed side branches is generally not recommended.
- Main branch IVUS is helpful to define the degree and mechanism of side branch jail and to plan the treatment strategy.
- Pre-intervention IVUS is not that helpful to predict the functional significance of jailed side branch.

What can be guided by IVUS?

- Pre-intervention
- After main branch stent implantation
- After side branch balloon angioplasty
- After side branch stenting



Anatomical severity vs. Functional significance - IVUS vs. FFR in SB ostial lesions -





Min Lumen Area: 2.0mm² MLD: 1.2mm

Reference segment



Assessment of procedural results



Before Kissing balloon inflation





After Kissing balloon inflation



What happened?





After Kissing balloon inflation

What can be guided by IVUS?

- Pre-intervention
- After main branch stent implantation
- After side branch balloon angioplasty
- After side branch stenting



Excellent results?



Modified T

Kissing

Crush

Angiographically excellent, but.....

604 Costa *et al.* Crush Stenting for Bifurcation Lesions JACC Vol. 46, No. 4, 2005 August 16, 2005:599-605



Figure 4. (A) Intravascular ultrasound image showing complete crush (apposition) of the side branch (SB) stent; arrows indicate the three layers of stent struts. (B, C) Intravascular ultrasound images showing incomplete crush (apposition) of the SB stent struts (arrows).



distal

Courtesy of Dr. Murasato

Larger post-procedural MSA for larger MLA during follow-up



Hahn JY, et al. J Am Coll Cardiol 2009

Under-expansion



Average Diameter 3.2mm



Over-expansion



Reference segment Average diameter 3.7mm Eccentricity: 3.51/3.75 = 0.93





Pressure gradient in all segments: < 3mmHg



Koo BK. European Bifurcation Club 2010

IVUS-Guided PCI For Bifurcation Lesion

- After side branch angioplasty
- After side branch stenting
 - IVUS is helpful to understand the cause of procedural difficulty/complications and to determine the procedural success of side branch PCI.



• Keeping the natural anatomy is more important than acquiring more than enough lumen area.

PCI For Bifurcation Lesion: What can be guided by IVUS?

Pre-intervention



- IVUS can provide detailed anatomical information (especially, longitudinal view) to plan the intervention strategy
- IVUS parameters have low positive predictive values to predict the presence of ischemia.

After main branch stent implantation



- Main branch IVUS is helpful to define the mechanism of side branch jail and to plan the side branch intervention strategy.
- Pre-intervention IVUS is not that helpful to predict the functional significance of jailed side branch.

After side branch angioplasty/stenting



 IVUS is helpful to determine the cause of complications and to assess the procedural success (keep the natural bifurcation geometry at the end of a procedure).