Original Article

Success Rate of Szabo Technique in Ostial Coronary Pci. Techniques, Angiographic and IVUS Findings

M Mohandes, L Krsticevic, J Guarinos, A Bonet, A Camiñas, A Bardaji

Interventional Cardiology Unit, Cardiology Division, Joan XXIII University Hospital, Tarragona, Spain

Background: Percutaneous coronary intervention (PCI) in ostial coronary artery lesions has been technically difficult because it should be done with precise stent placement in ostium and absence of side branch compromise. The Szabo technique consists of side branch wiring through most proximal stent strut as well as main branch wiring through stent lumen. The side branch wire or anchor wire prevents stent advancement beyond ostial segment and makes possible the accurate stent implantation in ostium. The purpose of this study is to evaluate the feasibility and success rate of Szabo technique analysing technical, angiographic and IVUS(Intravascular Ultrasonography) findings success rate.

Methods: We analysed retrospectively in our cath lab, 13 PCIs in 13 patients with a significant lesion at a coronary artery ostium which was treated percutaneously using Szabo technique. The procedure was defined as technically successful if there was neither stent loss nor second guide wire pull back during stent advancement. A successful procedure from angiographic point of view was defined as a precise stent implantation at ostium without side branch compromise. We defined also successful procedure from IVUS point of view consisting of accurate stent placement in ostium without proximal protrusion and without any stent uncovered area.

Results: Of a total of 13 patients with 10 (76.9%) males, 46.2% had diabetes, 69.2% hypertension, 53.8% hypercholesterolemia and 23.1 % were smoker or former smoker. They aged from 37-81 years with a mean age of 63±11 years. In 11 (84.6%) patients 6F and in 2 (15.4%) patients 7F sheathless guiding catheter (Asahi Intecc Co; LTD. Japan) were used. The access was radial in 12 (92.3%) and femoral in 1 (7.7%). The culprit vessel was left anterior descending (LAD) in 9 (69.2%), right coronary artery (RCA) 2 (15.4%), circumflex- obtuse marginal (LCX-OM) 1(7.7%), and posterior descending (PDA) 1(7.7%). In 9 (69.2%) IVUS was performed through culprit vessel and in 2 (15.4%) IVUS was done also in side branch after stent implantation. In 11 (84.6%) the procedure was technically successful. Among technically successful patients all (100%) had angiographic success. IVUS examination of culprit vessel showed accurate stent placement in ostium 7 (77.8%) and slight stent proximal protrusion in 2 patients (22.2%).

Conclusions: This study shows that Szabo technique is safe and feasible for PCI in ostial coronary artery lesions with a high angiographic success rate. In a high percentage of cases the accurate position of stent in ostium can be confirmed by IVUS.

Keywords: percutaneous coronary intervention. Szabo technique; Anchor wire

Introduction

The precise stent placement in coronary artery ostium is technically difficult and poses special challenges for interventional cardiologists. “Geographic miss” that is leaving a portion of the lesion uncovered by a stent can result in early restenosis. For stent implantation in aorto-ostial lesions by conventional technique the guiding catheter has to be disengaged from the coronary ostium and withdrawn into aorta in order to allow proper stent expansion. This manoeuvre makes difficult a selective catheter engagement and subsequently a selective coronary injection and finally an ac-

Correspondence:
M Mohandes
(interventional cardiologist); interventional cardiology department; Joan XXIII University Hospital; C/Dr. Mallafrè Guasch, 4; 43007
Tel: +34-977295800 Tel: +34-627888935
E-mail: mohandesmohsen@hotmail.com

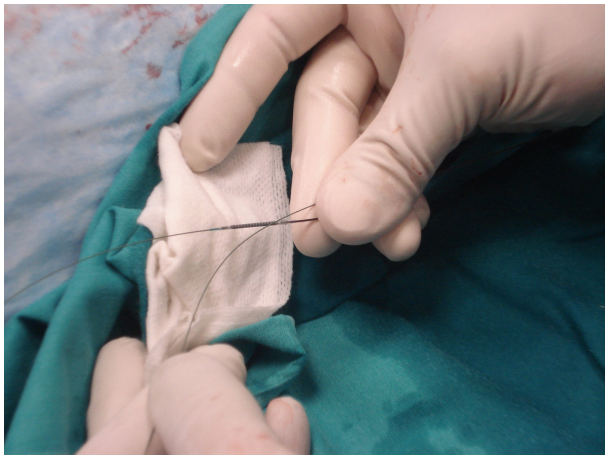


Figure 1: Before stent introduction into guiding catheter the operator crosses the proximal end of the second wire (anchor wire) through the most proximal stent cell while stent balloon is inflated at low atmosphere.

curate stent implantation. Moreover, protruding excessively a stent through aorta for aorto-ostial lesions will often prevent re-engagement of guiding catheter in a further coronary procedure. If the stent is placed proximally when an intracoronary ostial lesion is being treated the side branch vessel origin could be jailed by the stent. Besides, cardiac motion can cause whole angioplasty apparatus swing making difficult a precise stent positioning. Several techniques have been described to solve this pitfall including use of multiple angiographic orthogonal views before stent implantation, placement of a second wire in nonstented vessel as a marker, use of companion balloon inflated at low pressure in side branch, partial stent preinflation before its implantation in ostial segment in order to minimize stent oscillation[1] and finally rapid heart pacing during stent implantation.[2] Special devices have also been designed for precise stent positioning in an aorto-ostial lesions like Ostial Pro system.[3]

Szabo S, et al. described for the first time in 2005 a new technique for an accurate aorto-ostial stent implantation.[4] The technique consists of wire crossing through the coronary artery with ostial lesion and advancement of a second wire 2-3 cm out into the aorta. At this point the stent is loaded onto the first wire by conventional method and the back end of the second wire also called “tail wire” is introduced through the most proximal stent cell. While the operator advances the stent over these two wires the second wire anchors and stops the stent exactly at the ostium where it will be deployed. The technique was initially tested in plastic wet heart models and ex-vivo sheep heart-aorta specimen before its definitive use in human model. One of clear advantages of this technique is to allow interventional cardiologists to overcome visual limitations for precise ostial stent implantation and without relying solely on angiography.

Patients and Methods

We analysed 13 PCIs performed in 13 patients referred to our cath lab between March 2008 and March 2009 in order to use Szabo technique for precise ostial stenting. In all patients the coronary angiogram revealed a significant lesion at a coronary artery ostium.

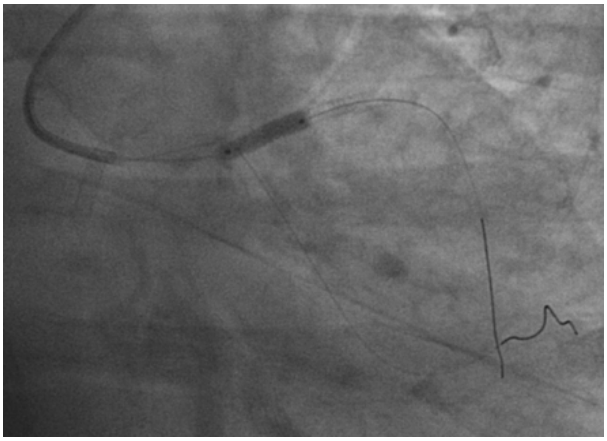


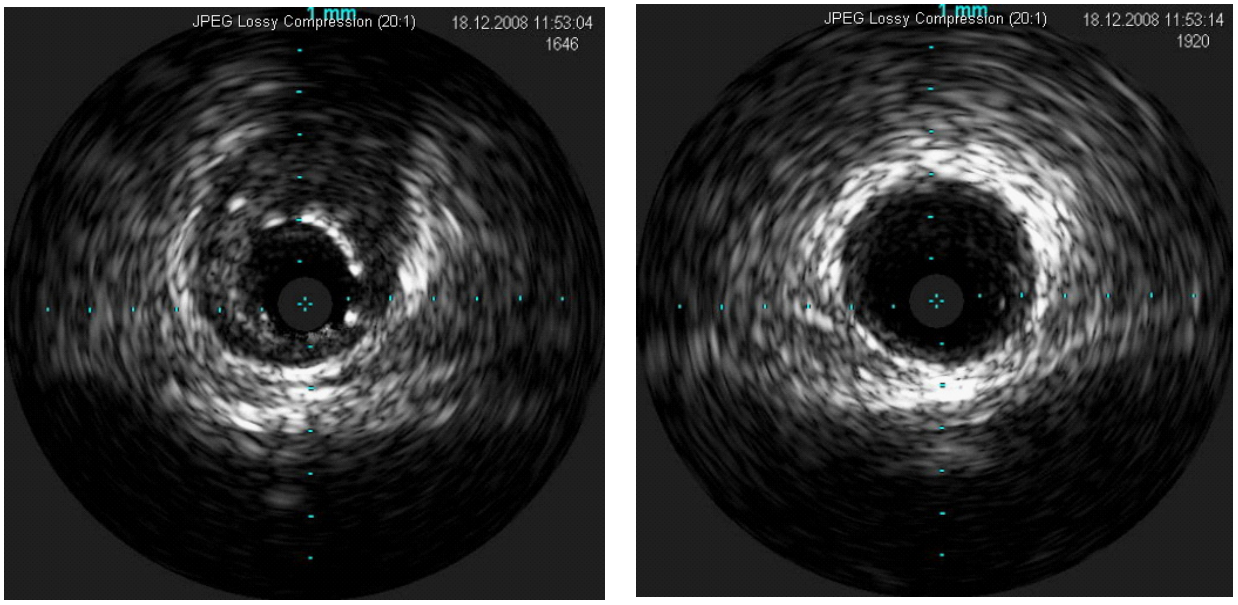
Figure 2: Second wire in LCX artery anchors stent in LAD ostium and avoids its advancement beyond ostial lesion.

Figure 3: Right oblique view of a LAD ostial lesion treated by Szabo technique with an angiographic successful result.

Baseline characteristics of patients are described in Table 1. Szabo technique was used when the operator was sure that the culprit ostial lesion did not extend proximally regarding the carina in case of intracoronary ostial lesions. The technique consisted basically of advancement of a wire through coronary artery with ostial lesion and of a second wire crossing into side branch in case of bifurcation or into aorta if the lesion was an aorto-ostial one. In this point the stent was inflated up to 1 atmosphere and the proximal end of the second wire was crossed through the most proximal stent strut (Fig. 1). After stent balloon deflation the stent was crimped manually and gently. Then the stent was advanced through the guiding catheter until reaching culprit lesion where it was stopped by the second or anchor wire which could avoid stent advancement beyond ostial segment (Fig. 2). At this moment a coronary angiogram in a proper view was performed to ensure the precise stent position and to finally deploy the stent. After stent implantation first the stent balloon and second

Table 1: Baseline clinical and procedural characteristics

Characteristics	Szabo cases (N: 13)
Male	10 (76.9%)
Age	63±11
Smoker	3 (23.1%)
Diabetes mellitus	6 (46.2%)
Hipertension	9 (69.2%)
Hypercholesterolemia	7 (53.8%)
Indication for procedure	
NSTEMI	9 (69.2%)
Unstable angina	1 (7.7%)
Stable angina	3 (23.1%)
Target lesion vessel	
LAD	9 (69.2%)
RCA	2 (15.2%)
CIRC-OM	1 (7.7%)
PD	1 (7.7%)
Access	
Radial	12 (92.3%)
Femoral	1 (7.7%)
French	
6F	11 (84.6%)
7F	2 (15.4%)
Stent	
BMS	3 (23.1%)
DES	9 (76.9%
Everolimus	4 (30.8%)
Zotarolimus	4 (30.8%)
Boilimus	2 (15.4%)



A B

Figure 4: A: Stent struts are seen at LAD ostium by IVUS. B: IVUS examination of left main shows absence of stent protrusion

the anchor wire were withdrawn carefully. The procedure was defined technically successful if there was neither stent loss nor guide wire pull back through the most proximal stent cell during stent advancement. A successful procedure from angiographic point of view was defined as an accurate stent implantation in ostium without side-branch compromise in case of intracoronary ostial lesions and without stent protrusion into aorta in case of aorto-ostial lesions, verified by two orthogonal angiographic views (Fig. 3). We also defined successful procedure from IVUS point of view consisting of accurate stent placement in ostium with no proximal protrusion and without any stent uncovered segment (Fig. 4). All patients received aspirin (100-300 mg) before intervention. Patients previously untreated with clopidogrel received a loading dose of this medication (300 mg) in cath lab. All patients received a 75 mg daily dose of clopidogrel after intervention. Unfractionated heparin (100 U/kg) was used during PCI. The GP IIb-IIIa inhibitors were used at operator's discretion and in these cases heparin dose was adjusted to 70 mg/kg.

Statistical analysis

We introduced all data in SPSS version 12. Continuous variables were described by mean ± SD and categorical variables were described as number and percentage.

Results

Of 13 patients ,with 10 (76.9%) males, and percutaneously treated with Szabo technique. 46.2% had diabetes, 69.2% hypertension, 53.8% hypercholesterolemia and 23.1 % were smoker or former smoker. The mean age was 63±11 years (37-81 years). The access was radial in 12 (92.3%) and femoral in 1 (7.7%). In 11 (84.6%) patients 6F and in 2 (15.4%) cases 7F special sheathless guiding catheter was used for radial approach. The culprit lesion was LAD ostium in 9 (69.2%), RCA ostium 2 (15.4%), LCX-OM 1(7.7%), and RCA-PDA 1(7.7%). In 9 (69.2%) patients IVUS was performed in culprit vessel and in 2 (15.4%) cases IVUS was

done also on side branch after stent implantation. In 11 (84.6%) patients the procedure was technically successful. Failure occurred in two cases. In one case during stent advancement the operator did not have enough back up support and lost the stent while withdrawing because they could not place it in the ostium. The conventional stent implantation method was used successfully in this case for treating ostial lesion. In another patient the anchor wire came out of side branch and through the proximal stent cell during stent advancement. In this case the stent was implanted successfully by conventional technique. Among patients with technically successful procedure all had angiographic success. Amid patients with IVUS performed through culprit vessel, accurate stent placement was verified in 7 (77.8%) and slight stent proximal protrusion was observed in 2 patients (22.2%). In one of these two cases the culprit lesion was RCA ostium and despite angiographic successful procedure IVUS examination revealed a slight stent protrusion into aorta. In the second case the culprit vessel was LAD ostium. IVUS in this case showed a little proximal protrusion into left main without angiographic compromise of LCX artery.

Discussion

Since the first description of Szabo technique and its feasibility and usefulness for precise stent positioning in ostial lesions, several series were published in literature in which the advantages and eventual drawback of this technique have been discussed. First of all it is very important to take into consideration a few technical details in order to reach a high success rate. Applegate R, et al. in a series of 13 patients undergoing PCI using Szabo technique made a few technical recommendations such as stent positioning in ostial lesion before definitive use of Szabo technique in order to verify the stent deliverability and the need of ostial predilation before stent implantation.[5] Besides, they make some suggestions about side-branch wire type implying that wires with polymer or coatings probably should be avoided in fear of an incidental coating embolization during wire withdrawal. In this series they recommended, once stent is placed in ostial segment, to inflate balloon stent up to 6 atmospheres, withdraw the anchor wire and finally inflate stent at high atmosphere. By this way the operator avoids an eventual wire jailing through the proximal stent cell. They also alluded to the eventual advantages of DES, which due to polymer coating, likely to reduce the resistance of withdrawing the second wire.

Wong Ph, et al. in a series of 41 patient with PCI at ostial lesion performed by Szabo technique showed a very high success (97.6%) confirmed by IVUS.[6] In this series all PCIs were carried out with 7F guiding catheter. They argued the possible advantage of using 7F guiding catheter was that it could reduce the resistance during stent advancing through guiding catheter caused by a strut having been lifted upwards.

Many technical aspects should be considered in anchor wire technique to ensure a safe and successful procedure. Like any new technique a training curve is necessary to maximize the rate of success. Gentle manipulation of stent during the passage of second wire through the most proximal stent cell is extremely important because upward protrusion of the strut could be a source of resistance during stent advancement through guiding catheter. Delicacy of wire insertion through the proximal stent strut is required to prevent bal-

loon injury.[7] The balloon puncture can result in stent being under-expanded during its inflation in ostium segment. It is mandatory to use high support guiding catheter for successful stent positioning. Deep positioning of second wire is required because in this way excessive stent advancement can be prevented by rigid part of the wire as this may not be achieved by the more flexible distal part of the wire. Finally as the proximal end of the stent is flared despite re-crimping, the stent withdrawal back into the guiding catheter should be done very carefully or else the stent can be stripped off the balloon as we experienced in one case.

We believe Szabo technique offers many advantages for stent implantation of ostial lesion over traditional methods. With this technique, dependence on angiographic localization is minimized, the precise stent implantation in ostial lesion is feasible without side-branch compromise or without proximal protrusion, features that have been confirmed both angiographically and from IVUS point of view by many studies. Using adequate devices and gentle manipulation of materials maximizes success rate of this technique and solve many pitfalls in such complex lesions confronting interventional cardiologists.

In our study despite a high technical and angiographic success rate of precise stent implantation with Szabo technique even with 6 Fr guiding catheter, we do believe that the results can be further improved by increasing experience and a rational and gentle use and manipulation of devices and materials during procedure. As this study was not planned prospectively the different operators made IVUS at their discretion, thus IVUS was not performed in all cases which would have been more desirable. In terms of precise stent implantation in ostium segment we believe that in experienced hands and with improved technical aspects, IVUS findings success rate can even be higher than what we observed in this series.

As mentioned earlier two failures occurred in our series. The first case during a PCI in a calcified RCA ostial, with 6F JR5 guiding catheter showed an insufficient back up support. In fact, in such cases the second wire into aorta can occasionally prevent an accurate stent positioning. In this case Predilation should have been more aggressive. Wong Ph, et al. described an unsuccessful case by Szabo technique in an ostial RCA stenosis because of the presence of sharp shepherd's crook. In the second technically unsuccessful case of our series during stent advancing for treating an ostial LAD stenosis wires of both main and side branches were pulled back several centimetres and the operator had to withdraw the stent. The stent was eventually dislodged and stripped off balloon with the final stent loss. In this case the two wires were probably not positioned deeply enough into coronary arteries. This reduced the back up support and finally led to important wire pull back during stent advancement. Taking into consideration such technical details, these failures could probably be avoided and increased the success rate of the procedure.

Before using this technique we suggest to ensure angiographically or if necessary by IVUS the absence of lesion proximal to ostial segment in case of intracoronary ostial locations. This will obviate shift plaque during stent implantation or the need for a second stent placement proximal to ostial lesions. If there is evidence of lesion becoming extended proximally we do not recommend Szabo technique be used for ostial stent implantation.

Finally in two cases we used 7F Sheatless guiding catheter by radial approach and although one should be cautious with any conclusion, we felt less resistance during stent advancement and better stent deliverability compared with 6F guiding catheter.

Conflicts of Interest no declare.

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