EuroIntervention

The Nile Concept

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The author has no conflict of interest to declare.

In the last years, the international interventional cardiology community has discussed at length the different strategies to reach an optimal result when treating bifurcation lesions. A consensus has been reached to favour the provisional stenting approach and the need for dedicated stents seems to be an attractive strategy for treating the different types of bifurcated lesion.

The Nile CroCo concept

Having in mind parameters such as ease of manipulation, efficacy of the stent, procedural time, respect of the anatomical complexity, flow dynamics and wishing to develop a delivery system accessible to all cardiologists, Minvasys designed and CE marked the first generation of the Nile Concept in 2004. It was followed in 2005 by the second generation, the Nile CroCo® with a cobalt chromium L 605 version of the stent. The third generation, the Nile PAX® with a polymer free paclitaxel stent, was approved in 2009.

The Nile Concept, in its bare metal stent (BMS) version –Nile CroCo®– and drug-eluting stent (DES) version –Nile PAX®– has the following configuration:

The 3-segment stent, designed to conform to the bifurcation anatomy, is pre-mounted on a dedicated delivery system with two independent balloon catheters, each with a rapid-exchange lumen for the two guidewires required during the procedure. The stent cell design ensures a homogenous metal-artery ratio along the bifurcation and avoids cell overstretching. The delivery system is based on two separate rapid-exchange catheters, one for stent deployment in the main branch (MB) and the other for opening the stent strut towards the side branch (SB). The system allows final balloon kissing with the same device and a strategy of MB stenting with provisional SB stenting. The SB balloon has a long proximal cone to avoid overstretch of the common part. The design incorporates an auto release sheath that wraps the shafts, therefore easing the insertion of the system as one, whilst the auto release is peeled off while advancing the delivery device, offering the possibility to manipulate the two catheters independently once the stent has been released. The system is available in two stent lengths 18 mm and 24 mm with five MB and SB combinations ranging from 2.5 to 3.5 mm for the MB catheter and 2.0 to 3.0 for the SB catheter. The system is 6 Fr compatible for all size combinations, therefore allowing a safe radial approach when required.

Pre-clinical evaluation

All Nile device designs were qualified according to applicable international device-related standards involving a large series of bench tests performed following state-of-the-art internal test protocols.

Furthermore, the device was assessed in the porcine model in challenging applications such as overlapped stents and bifurcation sites, with a focus on safety and neointimal growth evaluation. The primary endpoint was to confirm the stent technology safety at 28 days, while observations also included immediate implantation results, quantitative coronary angiography (QCA) pre-procedural, post-procedural and after 28 days, as well as histologic analysis and surveillance of animal clinical follow-up. The assessments were performed on the implanted arteries in the heart followed by histopathological and histomorphometric analysis of explanted arteries. The results were favourable in test groups, with a complete coverage of the stent struts in all studied sections already at 28 days follow-up. No MACE or thrombosis was reported during the whole study. Observation of dissected cross-sections showed a total absence of necrosis around the stent struts at 28 days follow-up.

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Clinical results

The first Nile® Multicentric Observation Registry (completed in 2005) enrolled 75 patients. Thierry Lefèvre and Gregory Pavlides, Principal Investigators, reported that the stent had been successfully implanted in more than 95% of cases with a device success of 91%. The complete reported angiographic success was 95% with very acceptable immediate MACE (2.7%) and 7-month MACE (16%) rates.

A second multicentre registry involved the second generation Nile CroCo®, the cobalt chromium version of the stent. Completed in 2007, 103 consecutive patients were included. Here again, Bruno Garcia del Blanco reported a device placement success in 96% of cases and a procedural success of 98%. The side branch was stented in only 13% of cases despite the fact that 54% of the lesions involved the SB.

The MACE rate at six months in the 85 patients with complete follow-up was 11.8% and ischaemia-driven target lesion revascularisation (TLR) was necessary in only 9.4% of cases.

The third clinical evaluation of the Nile CroCo® included 151 consecutive patients from May 2005 to November 2009. All patients in whom a Nile CroCo® stent was intended to be used were enrolled in the study in a single institution, Hospital Universitari Vall d'Hebron, Barcelona, Spain. The complete results of this study have been submitted by Bruno Garcia del Blanco et al and accepted for publication (Table 1). One hundred and thirty-eight (138) out of 151 (91%) patients had follow-up at six months. Optimal angiographic device success in the MB occurred in 99.3% with the Nile CroCo® stent and final angiographic success in the MB was achieved in 100% of the cases. In the SB the system achieved an optimal result in 89.4% of the cases and despite using an additional stent for the SB in 9.7% the final angiographic result was considered optimal.

There was one confirmed in-hospital MACE in the 151 recruited patients (0.6%). The MACE rate at six months in the 138 patients with complete follow-up was 14%, which included an ischaemia-driven TLR observed in only 7.2% of the cases.

The latest generation, Nile PAX® –same configuration for the stent and delivery system– with a polymer free paclitaxel coating –was subject to a prospective, non-randomised, international multicentre clinical trial (BIPAX). The study included 102 consecutive patients in 10 centres in Europe and Latin America. The 30-day acute interim results reported at EuroPCR 2010, were very encouraging with a 99% device and procedural success, 0% thrombosis and 1% MACE (non-cardiac driven) (Table 2). The six months clinical follow-up results were presented at the European Bifurcation Club in Budapest, Hungary, October 2010, showing a 4% TLR, a 5% MACE and a 0% thrombosis rates. Full study results are to be presented at the EuroPCR 2011.

Table 1. In-hospital and 6-month clinical outcomes of Vall d'Hebron hospital experience.

	In-hospital N=151	6-month N=138	Cumulative events
Death	1	7	8
Cardiac	1	4	5
Non-cardiac	0	3	3
AMI	1	2	3
Q wave	0	0	0
No Q wave	1	2	3
TLR	0	10	10
PCI	0	10	10
CABG	0	0	0
MACE	2 (1.3%)	19 (12.6%)	21 (13.9%)

B. Garcia del Blanco et al. *EuroIntervention* in-press[1].

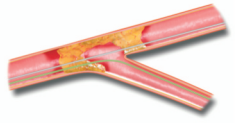
Table 2. Thirty-day results of Bipax trial.

Outcome	In-hospital	Out-of-hospital up to 30 days
Death		
Cardiac	0% (0)	0% (0)
Non-cardiac	1% (1)	0% (0)
AMI		
Q wave	0% (0)	0% (0)
No Q wave	1% (1)	0% (0)
TLR / TVR	0% (0)	0% (0)
MACE	1% (1)	0% (0)
Stent thrombosis	0% (0)	0% (0)

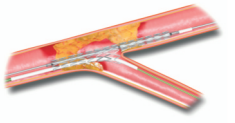
Technique of the Nile CroCo stent implantation

The implantation procedure of the Nile CroCo stent implantation is illustrated in Figure 1. Two case examples of a LAD-diagonal bifurcation lesion are illustrated in Figures 2 and 3.

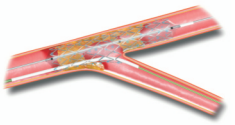
The system is introduced on the two pre-positioned guidewires. Pre-dilatation of the target lesion is necessary.



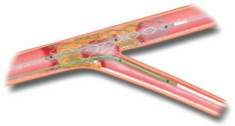
The Nile is positioned at the level of the bifurcated lesion site. The central radio-opaque marker of the main branch catheter (MBC) is aligned with the ostium of the side branch. The tip of the side branch catheter (SBC) already enters inside the side branch.



The Nile stent is expanded in the main branch of the bifurcation by inflation of the MBC. The side branch guidewire and the tip of the SBC are already placed in the side branch ostium. The stent struts do not have to be re-crossed.



The SBC is advanced over the positioned side branch guidewire through the struts of the Nile into the ostium of the side branch. Accurate placement is obtained using MBC central radio-opaque marker and SBC proximal radio-opaque marker, which must be aligned.



The SBC and MBC balloons are inflated simultaneously (kissing) in order to open the Nile stent struts at the level of the ostium of the side branch. There is no over-dilatation of the artery proximal to the carina thanks to SBC balloon design with a long proximal cone. A second stent in the side branch may be considered.

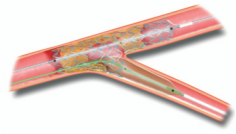
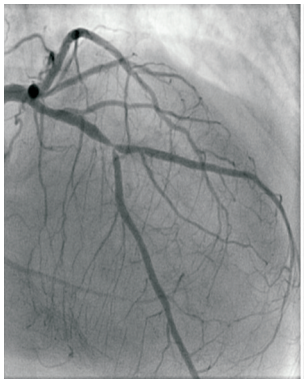
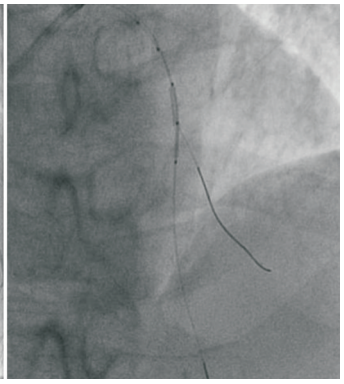


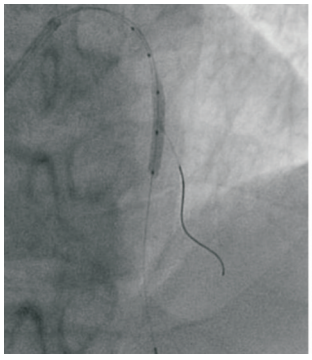
Figure 1. Schematic of the Nile CroCo stent implantation.



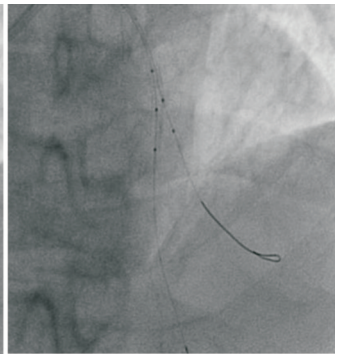
LAD-diagonal bifurcation stenosis



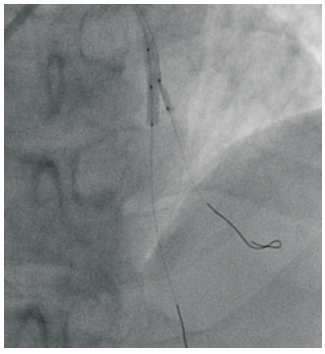
Stent mid marker placed on the carina



Stent deployment



Side branch balloon positioning



Kissing balloon

Figure 2. Case example no. 1.

In summary, the Nile concept has three major advantages:

1. A special stent designed for provisional stenting

This concept is specifically designed to permit a provisional stenting of the majority of Medina classified lesions and in particular true bifurcation lesions (1,1,1). It also gives the possibility, if needed, to easily place an additional stent at the origin of the side branch without protrusion in the main vessel.

The wide range of stents available in length and size for the main branch and side branches permit to treat the majority of bifurcation lesions.

2. A low profile device

The Tandem Configuration of the two balloons provides a very low profile system that considerably facilitates the delivery and offers a good tractability and lesion crossability.

In case of wire wrapping, this system offers the possibility to easily remove one wire (side branch or main branch wire) into the balloon and to advance it again in the vessel distality.

The Nile concept provides a low profile, 6 Fr compatible, which can be easily used via the transradial approach.

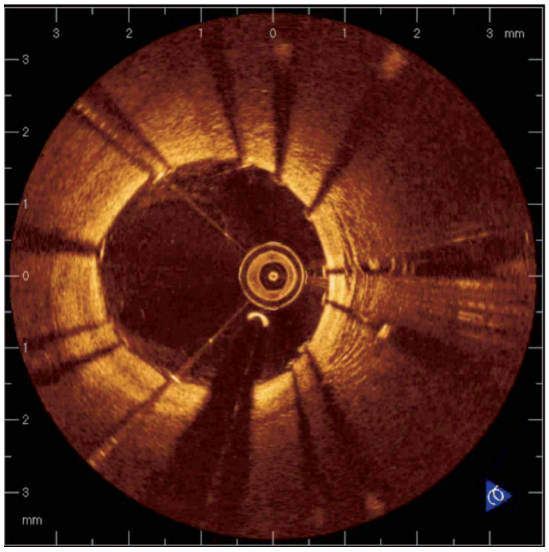
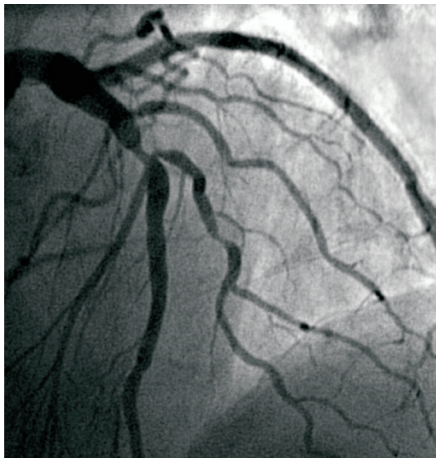
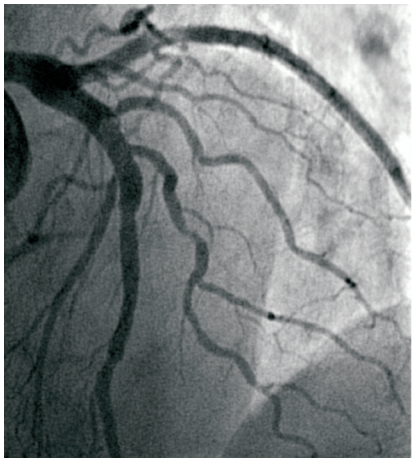


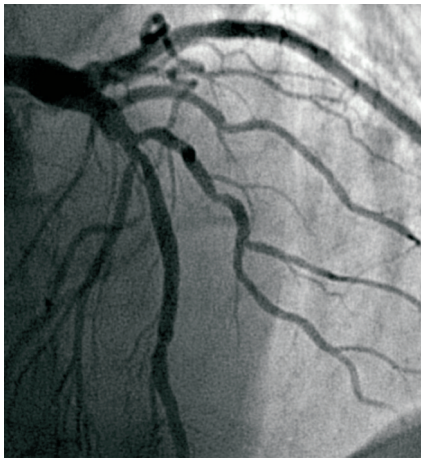
Figure 4. LAD stent segment proximal to bifurcation: good strut apposition.



LAD-diagonal stenosis



Post-procedural angiogram after Nile CroCo (3.5×2.5 mm) implantation



8-month angiographic follow-up

Figure 3. Case example no. 2.

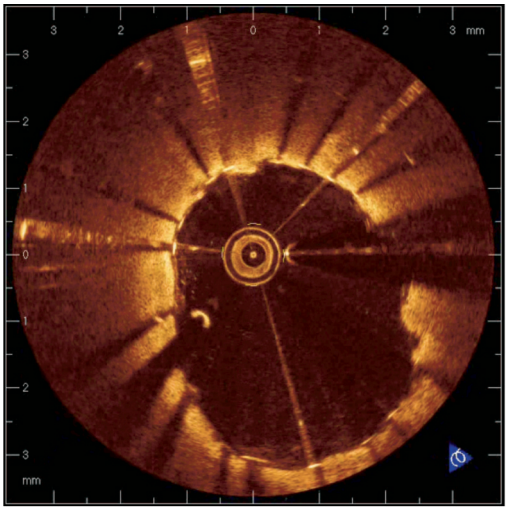


Figure 5. Stent at the LAD-bifurcation segment: good apposition of stent struts in LAD and at the ostium of the diagonal.

3. Promising clinical results

The results of the BIPAX trial clearly showed the efficacy and safety of this concept with an extremely low rate of events at 30 days as well as low TLR rates at six months. An example of good stent apposition is illustrated in figures 4 and 5.

In conclusion, the Minvasys Nile stent concept is an innovative and efficient stent design for the treatment of bifurcation lesions with provisional stenting approach. The Nile concept features make it one of the best concepts currently available to treat bifurcation lesions.

Reference

1. Garcia del Blanco G, Bellera Gotarda N, Martí G, Otaegui I , Serra Garcia V, Ferreira I, Batalla Sahun N, Domingo Ribas E, Angel J, Candell Riera J , Garcia-Dorado García D. Clinical and procedural evaluation of the Nile Croco dedicated stent for bifurcation. Results of one center initial experience with the first 151 consecutive non-selected patients. *EuroIntervention* 2011, in press.