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Treatment and outcome of coronary artery perforations using a dual guiding catheter technique

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ABSTRACT

Objectives: To evaluate the success rate and outcome of coronary artery perforation treatment using a dual guiding catheter technique.
Background: Coronary artery perforation is a rare but severe complication during percutaneous coronary intervention (PCI) with high mortality. The use of a second guiding catheter is a helpful technique to minimize hemorrhage through the perforation during interventional repair.
Methods: We screened all patients between March 2004 and December 2014 who underwent PCI in our department for the occurrence of peri-interventional coronary perforation that was treated using a dual catheter technique. Patient and lesion characteristics as well as outcome were determined.
Results: We identified 8 patients who experienced coronary artery perforations (Ellis grade III) during coronary intervention and were treated using a dual guiding catheter approach. The procedure was technically successful (placement of covered stent and sealing of perforation) in 6 patients. Pericardiocentesis was required in 3 patients (38%). Total mortality was 12% (n = 1). No coronary or peripheral vascular access complication occurred due to the use of a second guiding catheter.
Conclusions: We suggest that the dual guiding catheter technique is a useful and alternative approach to treat severe Ellis grade III coronary artery perforations that occur in the context of percutaneous coronary interventions.

1. Introduction

Coronary artery perforation during percutaneous coronary intervention (PCI) is a rare but severe complication with a high morbidity and mortality [1–8]. The incidence of this complication is reported to range from 0.1 to 0.5% [2,5,6,9], potentially resulting in emergency coronary bypass surgery (11–39%) and associated with myocardial infarction (13–34%) as well as pericardial tamponade (12–31%) [9,12,16,18]. According to severity, coronary perforations are commonly classified using Ellis grades I–III [5]. Ellis grade III is classified as contrast extravasation through a frank (≥1 mm) perforation. Some authors speculate on a decreased incidence of coronary perforations due to the less frequent use of atheroablative devices (e.g., directional atherectomy, rotablator and excimer laser) in the last years [2]. However, the overall number of perforations has not decreased over the last years, probably due to increasing complexity of PCI practice [10]. Several predictors, such as complex coronary anatomy, chronic total occlusion, and the use of rotational atherectomy and intravascular ultrasound have been identified [18,19]. Balloon angioplasty alone without stent implantation is reported to have a lower incidence of perforation in general. Ellis et al. showed an incidence of perforations with only balloon angioplasty of 0.1%, whereas it was significantly higher using a rotablator (1.3%) or excimer laser (1.9%) [5]. Additional use of glycoprotein IIb/IIIa antagonists dramatically increases the complication rate [10]. Several techniques are available for treatment, ranging from prolonged balloon inflation to the implantation of covered stents [10,11,17]. For the treatment of severe perforations (Ellis grade III, Fig. 1 a and b), immediate sealing by balloon reinflation, followed by implantation of a membrane-covered stent is the most common interventional approach [11]. However, retrieving the balloon and inserting a covered stent may require some time and it is possible that the stent will not reach or cross the lesion. Hence, the perforation may be without sealing for an unpredictably long period of time. In this context, the use of a dual guiding catheter approach is a helpful technique to reduce the duration of uncontrolled hemorrhage through the perforation [2,13–15]. After placing a second guiding catheter and guide wire, the covered stent can be advanced and placed immediately proximal to the sealing balloon. In a rapid maneuver, the sealing balloon can be retracted and the covered stent advanced and implanted. The operator can work without detrimental haste. If initial delivery of the covered stent fails, re-insertion of the blocking balloon can be performed quickly which provides time

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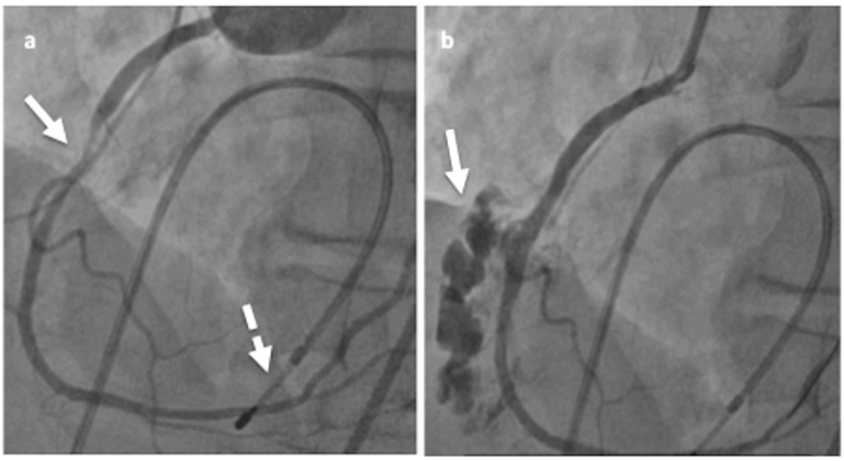

Fig. 1. a and b: Stenosis in the proximal right coronary artery (a, arrow) and Ellis grade III perforation (b, arrow) after placement of an Absorb® bioresorbable vascular scaffold (3.5/28 mm). The dashed arrow shows a temporary pacemaker because of 3rd degree AV-block due to a STEMI of the posterior wall.

to consider options for a second attempt (smaller covered stent, additional guide wire, upsizing the guiding catheter, etc.). So far, no large case series have been analyzed regarding the success rate and complications of interventional treatment of coronary artery perforations using a dual guiding catheter approach.

2. Methods

We screened all patients who underwent PCI in our department between March 2004 and December 2014 for the occurrence of peri-interventional coronary perforations that were treated using a dual catheter technique. We determined patient and lesion characteristics as well as outcome among this group. The standard approach for treatment of coronary perforation (Fig. 1 and 5) using a dual guiding catheter technique was to immediately seal the perforation with the initial PCI balloon (Fig. 2 and 6) and to then prepare a groin for a second femoral access using a 6 F sheath. Unless already present, a second operator joined the table. After slight retraction of the initially placed guiding catheter, a second 6 F guiding catheter was advanced to intubate the respective coronary ostium. Through this catheter, a standard coronary guide wire was advanced up to the blocking balloon, and during brief deflation of the blocking balloon by one operator, the other operator advanced the wire past the lesion into a distal coronary segment (Fig. 2 and 6). A covered stent (Fig. 2 Graftmaster® 3.5/16 mm, Fig. 6 BeGraft® 2.5/12 mm) was then advanced via the newly placed wire to just proximal to the blocking balloon. Subsequently, the blocking balloon was deflated and withdrawn into the original guiding catheter, while the covered stent was rapidly advanced across the perforation (Fig. 3 and 7) and implanted (Fig. 4). Delivery of further covered stents, if necessary, followed the same principle. If necessary, pericardiocentesis was performed under fluoroscopic control. No reversal of heparin activity was performed, and pain medication (morphine i.v.) was given as required.

3. Results

Between March 2004 and December 2014, 10,700 patients underwent PCI in our department. Among these, 35 patients (0.3% — mean age 69.4 + 11, male 57.1%, female 42.9%) experienced coronary artery perforations. 25 (71.4%) of the 35 cases were classified as Ellis grade III (n = 15) or Ellis grade II (n = 10). 8 patients were treated by a dual guiding approach (baseline patient characteristics are summarized in Table I). 5 (62.5%) of the 8 perforations occurred during stent implantation, 2 (25%) during balloon inflation and 1 (12.5%) during guide wire passage. The left anterior descending (LAD, n = 3) as well as the right coronary artery (RCA, n = 3) were the most frequently affected vessels (37.5%). 50% of the patients had presented with an acute coronary syndrome, 50% were classified as stable angina. Initial transradial access (6 F) was performed in 6 patients (75%), transfemoral (6 F) in 25%. For the dual guiding approach, a transfemoral access was chosen in all patients, equally distributed between the right (n = 4) and left side (n = 4). In 50% of cases (n = 4) a 6 F guiding catheter was used, while in 2 patients each, a 7 or 8 F guiding catheter was selected.

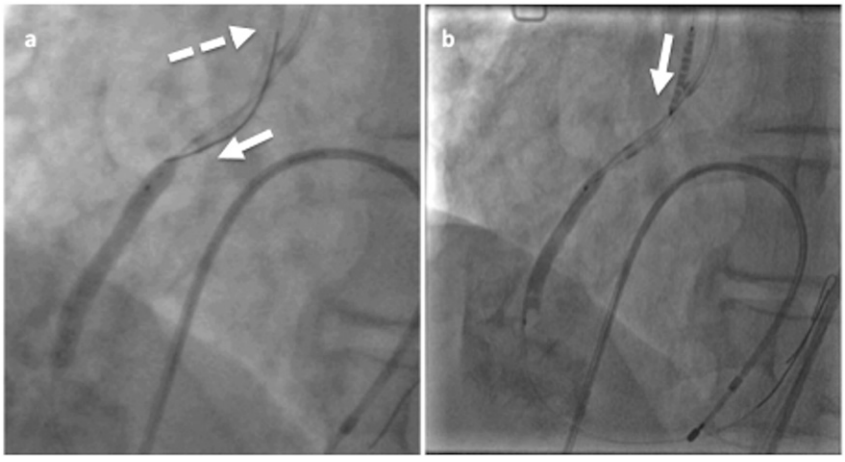

Fig. 2. a and b: A second guiding catheter is placed on the right coronary ostium and a wire is advanced up to the blocking balloon. During a very brief deflation of the blocking balloon, the second guide wire is advanced across the lesion and the blocking balloon is immediately reinflated. Using the second wire, a covered stent is advanced and "parked" just proximal to the blocking balloon (b, arrow).