Coronary stent infection: a rare but severe complication of percutaneous coronary intervention

Beat A. Kaufmann, Christoph Kaiser, Matthias E. Pfisterer, Piero O. Bonetti

Division of Cardiology, University Hospital Basel, Switzerland

Summary

During the last two decades, the number of percutaneous coronary interventions (PCI) has steadily increased in Switzerland, as has the use of coronary stents. However, reports of coronary stent infections are very rare. In the present article we review all published cases of coronary stent infections. All patients presented with symptoms of infection within the first four weeks after PCI. Clinical hallmarks of stent infection were fever and chest pain. Blood cultures were positive in all patients. Despite the use of intravenous antibiotics in all except one patient and surgical drainage of the infectious focus in the majority of affected individuals mortality was high (40%). Thus, coronary stent infection, although exceedingly rare, represents a life-threatening complication and should be considered in the differential diagnosis of patients presenting with fever during the first few weeks after PCI.

Key words: stent; infection; percutaneous coronary intervention

Introduction

During the last two decades, the number of percutaneous coronary interventions (PCI) has steadily increased worldwide, including in Switzerland [1–3]. Currently, approximately 12 000 PCIs are performed in Switzerland each year, whereby coronary stents are implanted in up to 90% of all cases [2]. Foreign body implantation predisposes to the development of infections by damaging or invading epithelial or mucosal barriers, by supporting growth of micro-organisms and by impairing host defense mechanisms. Indeed, implantation of medical devices represents one of the most important risk factors for nosocomial infections, accounting for an estimated 45% of all nosocomial infections [4]. Surprisingly, however, reports of coronary stent infections are exceedingly rare. In the present review, we summarise and discuss clinical data on the published case reports of coronary stent infections.

Published case reports of coronary stent infections

To date, only ten cases of PCI-associated coronary stent infections have been reported in the literature. Data of the ten patients with documented coronary stent infection are summarised in table 1 [5–14]. Patients' age ranged from 38 to 80 years. Only one patient had received a drug-eluting stent (DES), all other patients had a bare metal stent (BMS) implanted. Clinical symptoms of coronary stent infection appeared between two days and four weeks after the index procedure. Symptoms included fever in all subjects and chest pain in five individuals. Two patients suffered acute myocardial infarction as a consequence of the coronary stent infection. All affected patients showed positive blood cultures. In seven patients *Staphylococcus aureus* was the causative micro-organism, whereas in two individuals *Pseudomonas aeruginosa* and in one subject *coagulase-negative, oxacilline-resistant Staphylococcus* was responsible for coronary stent infection. In one patient, multiple organ septic emboli developed as a complication of coronary stent infection, including abscesses in the liver and the lungs as well as bilateral bacterial endophthalmitis. The imaging modalities to diagnose coronary stent infection included transthoracic and transoesophageal echocardiography, computed tomography, magnetic resonance imaging (MRI) and in four cases coronary angiography with a finding

of a false coronary aneurysm. All but one patient received intravenous antibiotics as first line treatment, in six subjects an additional surgical procedure was performed, and in four individuals the stent was completely or partially removed. A total of four patients died, whereby three of these died despite antibiotic and surgical treatment and one died before appropriate treatment was initiated.

Table 1

Published case reports of coronary stent infections.

Reference	Age/ sex	Stent type	Symptoms	Time of presentation after initial procedure	Vessel and complication	Diagnostic tool	Organism	Therapy	Outcome
Gunther et al. [5]	66/f	Palmaz-Schatz	Fever	4 weeks	RCA; abscess + pericardial empyema	TEE	S. aureus	IV antibiotics + stent removal	Death
Leroy et al. [6]	49/m	Palmaz-Schatz	Fever	1 week	LAD; false aneurysm	Coronary angiogram	P. aeruginosa	IV antibiotics + surgery	Death
Bouchart et al. [7]	38/m	Palmaz-Schatz	Fever, chest pain	4 days	LCX; false aneurysm	CT scan, coronary angiogram	P. aeruginosa	IV antiobiotics + debridement + stent removal	Survived
Grewe et al. [8]	54/m	AVE Microstent	AMI, fever	4 days	LAD; Vessel destruction	None	S. aureus	None	Death
Rensing et al. [9]	67/m	Not specified	Fever, chest pain, AMI	4 days	LCX; abscess	CT scan	S. aureus	IV antibiotics	Survived
Liu et al. [10]	72/m	NIR	Fever, chest pain	18 days	LAD; false aneurysm	Coronary angiogram	S. aureus	IV antibiotics + debridement + partial stent removal	Survived
Bangher et al. [11]	55/m	Jostent Flex	Fever, chest pain	14 days	RCA; pericarditis	TEE	CNRS Candida spp.	IV antibiotics + IV antimycotics + stent removal	Survived
Golubev et al. [12]	53/m	Jomed covered stent	Fever	2 days	Vein graft; abscess	TTE, TEE	S. aureus	IV antibiotics, Abscess drainage	Death
Singh et al. [13]	56/m	Cypher (sirolimus-eluting stent)	Fever	4 days	LAD, mycotic aneurysm	Coronary angiogram	S. aureus	IV antibiotics	Survived
Hoffman et al. [14]	80/m	Jomed heparin coated	Fever, chills	5 days	LAD	CT scan	S. aureus	IV antibiotics	Survived

AMI, acute myocardial infarction; CNRS, coagulase-negative oxacilline-resistant staphylococci; CT, computed tomography; IV, intravenous; LAD, left anterior descending coronary artery; LCX, left circumflex coronary artery; MRI, magnetic resonance imaging; RCA, right coronary artery; TEE, transoesophageal echocardiography; TTE, transthoracic echocardiography.

Bacteraemia related to percutaneous coronary interventions

The exact incidence of coronary stent infections is unknown. However, the low number of published case reports suggests that coronary stent infections represent a rather uncommon complication of PCI. In line with this presumption is the low frequency of clinically significant bacteraemia related to invasive nonsurgical cardiologic procedures found in various studies. In a retrospective analysis of patients showing positive blood cultures during a period of seven weeks following a PCI procedure, Samore et al. reported a frequency of PCI-related bacteraemias of 0.64% [15]. The micro-organisms most commonly involved were *Staphylococcus aureus, coagulase-negative staphylococci, and group B streptococci*. In a methodologically similar retrospective study, Muñoz et al. found a frequency of clinically relevant bacteraemias of 0.11% during the first three days following an invasive nonsurgical cardiologic procedure including PCI, diagnostic coronary angiography and cardiac electrophysiologic studies [16]. In contrast to the analysis by Samore et al., gram-negative bacteria accounted for the majority of cases in the study by Muñoz et al. In a prospective study, Shea et al. collected blood cultures from the indwelling arterial sheath immediately after and 30 minutes after PCI in patients undergoing a total of 164 PCI procedures [17]. Bacterial isolates were recovered in 8% of blood cultures. *Staphylococcus epidermidis*, the most commonly isolated organism, was present in 74%. Notably, bacteraemia due to *Staphylococcus aureus* was deemed to be clinically significant in only one patient. Ramsdale et al. prospectively investigated 147 patients undergoing complex

PCI, again drawing blood cultures immediately after and 12 hours after PCI from the indwelling arterial sheath [18]. The authors reported an incidence of bacteraemia immediately after and 12 hours after PCI of 18% and 12%, respectively, with *coagulase-negative staphylococci* being the most commonly isolated organisms. Notably, the detection of bacteraemia was not associated with any clinical sequelae. However, despite their prospective design, the significance of the studies by Shea et al. and Ramsdale et al. is limited by the fact that blood cultures were drawn directly from the indwelling arterial sheath, which was left in place for up to 12 hours. Therefore, contamination of blood cultures by the indwelling sheath is a likely explanation for the reported high rates of positive blood cultures in these two studies. This presumption is further supported by the high rate of bacteraemia due to *coagulase-negative staphylococci*. The largest prospective study to assess the frequency of bacteraemia after cardiac catheterisation in patients undergoing a total of 960 interventional procedures was performed by Banai et al. [19]. These authors analysed blood cultures, which were withdrawn from the arterial sheath immediately after arterial puncture and at the end of the procedure. In addition, a third blood culture sample was withdrawn from a peripheral vein 4 hours later. The incidence of positive blood cultures immediately after the procedure was 7.3% after diagnostic catheterisation and 4.6% after PCI. Four hours later, positive blood cultures were noted in 3.9% and 4.1%, respectively. However, only four cases of bacteraemia (1× *Staphylococcus aureus*, 3× *Klebsiella species)* were considered to be clinically significant. Moreover, all of these cases were related to an intravenous line and none to the cardiac procedure itself. Taken together, these data suggest that clinically significant bacteraemia represents an extremely rare complication of cardiac catheterisation and PCI. Thus, the low number of documented coronary stent infections is not surprising.

Clinical presentation and diagnosis of coronary stent infection

In all published case reports, coronary stent infection manifested within the first four weeks after stent implantation with fever being the clinical hallmark of this complication, whereas chest pain was present in only 50% of the affected individuals. Importantly, blood cultures were uniformly positive in all patients. Thus, stent infection should be suspected and blood cultures should be withdrawn in all patients presenting with fever within the first weeks after coronary stent implantation even in the absence of chest pain, ECG abnormalities or elevation of cardiac enzymes.

Visualisation and verification of the local infection may require specific cardiac imaging modalities, including transthoracic and transoesophageal echocardiography, coronary angiography, computed tomography, and magnetic resonance imaging. Given the limited available evidence, no definite recommendations can be made with regard to the best imaging method for depicting the infective focus. Thus, the selection of one or another imaging method should be based on the clinical presentation and the local expertise.

Therapy and prognosis of coronary stent infection

Intravenous antibiotics are the mainstay of therapy in patients with coronary stent infections. However, given that foreign body infections are extremely resistant to antibiotics and host defence mechanisms, surgery with debridement and/or stent removal may be required. Indeed, six of the ten patients with documented coronary stent infection underwent a surgical procedure, whereby the infected stent was removed completely in three subjects and partially in one patient. However, it is noteworthy that half of the surgical patients died, suggesting only a limited benefit of surgery in this population. Based on the currently available data, mortality may be as high as 40% despite antibiotic and/or surgical treatment. This classifies coronary stent infections as a life-threatening complication.

Coronary stent infection associated with drug-eluting stents

Theoretically, it may be speculated that the currently available sirolimus- and paclitaxel-eluting stents predispose more to infection than BMS because of their immunomodulating and antiproliferative effects [20]. Specifically, DES-induced impairment of local host defence mechanisms and delayed endothelialisation of the stent struts might increase the susceptibility to infection. However, only a single case report of a coronary stent infection after sirolimus-eluting stent implantation has been published since the introduction of DES into clinical practice. With the continuation of DES use, it will be interesting to observe whether DES implantation is associated with an increased risk of stent infection.

Prevention of coronary stent infection

Given the drastic consequences associated with coronary stent infection, prevention of this complication is of paramount importance. In this regard, compliance with current standards for the prevention of infections during cardiac catheterisation is mandatory [21]. Based on these standards, measures to prevent infection include the removal of hair from the puncture site, application of antiseptic to the skin, and the use of sterile drapes. The routine use of systemic antibiotics is not required. Operators should perform appropriate hand washing, wear a sterile gown and sterile gloves and a generally sterile environment should be maintained during the procedure. Although masks, eye shields, and caps are routinely worn in many cardiac catheterisation laboratories, their use is probably more important for protecting the operator from the patient`s blood than for protecting the patient from infection. In line with this presumption are the results of the large prospective study on bacteraemia after cardiac catheterisation by Banai et al. demonstrating a rather low incidence of PCI-associated bacteraemia although no masks or caps were used by the operators [19]. However, given the lack of randomised studies comparing the incidence of periprocedural bacteraemia with or without wearing masks and caps during cardiac catheterisation, this issue is still controversial.

Based on both retrospective and prospective studies, various risk factors for PCI-associated bacteraemia have been proposed (table 2) [15, 16, 19]. Notably, many of these risk factors can be avoided. For example, given the pivotal role of the arterial sheath as the bacterial entry site, the importance of early sheath removal (if possible) cannot be overemphasised.

In summary, the risk of coronary stent infection can be effectively reduced by strictly adhering to current standards for the prevention of infections during cardiac catheterisation and by minimizing factors that are associated with the development of periprocedural bacteraemia.

Table 2

Risk factors for bacteraemia associated with cardiac catheterisation/ PCI [15,16,19].

Difficult vascular access
Multiple skin punctures
Repeated catheterisations by the same vascular access site
Extended duration of the procedure
Use of multiple PTCA-balloons
Deferred removal of the arterial sheath
Presence of congestive heart failure
Patient's age > 60 years

PCI, percutaneous coronary intervention;
PTCA, percutaneous transluminal coronary angioplasty.

Conclusion

Fortunately, coronary stent infection represents an exceedingly rare complication of PCI. Nevertheless, stent infection should be considered in the differential diagnosis of patients presenting with fever during the first weeks after PCI. Diagnosis is based on positive blood cultures and demonstration of the infective focus by transthoracic or transoesophageal echocardiography, coronary angiography, computed tomography or MRI. Rapid institution of antibiotic treatment represents the mainstay of therapy. However, surgical drainage of the infective focus including stent removal may be necessary, although the benefit of such a procedure is uncertain. Despite optimal therapy, coronary stent infection is associated with a considerable morbidity and mortality. Thus, compliance with current standards for the prevention of infections in the catheterisation laboratory during PCI is mandatory to prevent this severe complication and to ensure that coronary stent infections remain a rarity as the number of stent implantations including the use of DES further increases.

Correspondence:
Piero O. Bonetti, MD
Division of Cardiology
University Hospital
Petersgraben 4
CH-4031 Basel
Switzerland
E-Mail: bonettip@uhbs.ch

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