

Papaverine use for radial artery sheath entrapment

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Introduction

Transradial approach currently represents the preferred arterial access approach for percutaneous coronary procedures primarily due to the reduced access-site complications compared with femoral access (1). However, because of its thinner caliber and higher sensitivity to mechanical and humoral stresses than other somatic vessels, radial artery is prone to spasm (2). In general, spasm is a benign complication that can be resolved with nitrates or Ca²⁺-channel blockers, but in some rare cases, the spasm is so severe and prolonged that it may lead to radial sheath entrapment, with documented rare cases of radial avulsion (3).

Methods

We retrospectively evaluated the diagnostic or interventional percutaneous coronary procedures performed by us in 2018 to evaluate the rate of radial sheath entrapment due to severe spasm and to describe the effect of papaverine use. All the procedures were performed in a single cath lab by six different physicians, and an intra-arterial infusion of 2.5 mg of verapamil was used at the beginning of all the procedures. A non-hydrophilic 11-cm radial sheath (Callisto™ R-Access II Introducer, Comed B.V. Heerenveen, The Netherlands) was used for radial artery cannulation. In case of radial artery entrapment due to severe spasm after the use of intra-arterial nitrates and verapamil, multiple intra-arterial boluses of 3 mg of papaverine were used to remove the sheath.

Results

In 2018, at Sandro Pertini Hospital in Rome, we performed 1208 coronary angiographic procedures [576 diagnostic procedures and 632 percutaneous coronary interventions (PCIs)] using radial

access in 1048 of these procedures (759 right radial and 289 left radial). Four procedures (0.4%) were complicated by severe radial vasospasm with sheath entrapment at the time of sheath withdrawal. In all four cases, the procedure was a PCI and three patients were female (Table 1). Furthermore, in all four cases, heparin was injected through the radial sheath according to the patient weight (100 U/kg) at the beginning of PCI. At the end of all procedures, the operators could not remove the sheaths; radial artery angiography showed the patency of the radial arteries, confirming the severe spasm. To resolve the spasm, initially intra-arterial (i.a.) nitrates and verapamil injection, sedation, and warm drapes placed on the patients' arms were used. If these measures were found to be ineffective to remove the sheath from the artery, the operator used repeated 3-mg i.a. boluses of papaverine every 2 min (minimum dose was 9 mg and maximum dose 15 mg; Table 1). In all four cases, after few boluses, the radial sheath gently slid out. The Doppler control of the radial artery 24 h after the procedure showed the patency of the radial artery.

Discussion

Radial artery spasm is a frequent and generally benign complication of transradial procedures and can be easily resolved using intra-arterial drugs, such as nitrates or verapamil, or using general sedation (4, 5). In rare cases, the radial artery spasm can be so severe and prolonged that it may cause sheath entrapment. In such cases, a forced withdrawal of the sheath may result in a severe complication, such as radial avulsion (3). In our study, we documented the rate of severe spasm causing radial artery sheath entrapment at an experienced center for transradial access. Moreover, we are the first to describe that the use of intra-arterial papaverine is an effective, safe, and easy method to avoid a possible severe complication during transradial procedures. Papaverine

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Table 1. Patient's characteristics

| | P1 | P2 | P3 | P4 |
|-----------------|--------------|-------------|-------------|--------------|
| Age | 78 | 82 | 79 | 60 |
| Sex | Female | Female | Female | Male |
| Weight | 61 | 59 | 57 | 89 |
| Height | 163 | 160 | 158 | 185 |
| Diagnosis | NSTEMI | STEMI | NSTEMI | CSA |
| Access | Right radial | Left radial | Left radial | Right radial |
| Papaverine dose | 12 mg | 9 mg | 9 mg | 15 mg |
| Procedure | PCI | PCI | PCI | PCI |
| FT (min) | 12 | 16 | 11 | 22 |

CSA - chronic stable Angina; FT - fluoroscopy time; NSTEMI - non ST elevation myocardial infarction; PCI - percutaneous coronary intervention; STEMI - ST-elevation myocardial infarction

is a benzylisoquinoline, an opium-derived alkaloid with vasodilator properties, and is commonly used in visceral muscles spasm. It causes vascular smooth muscle relaxation by inhibiting phosphodiesterase and increasing cAMP activities, causing a decrease in calcium influx and inhibiting the release of calcium from intracellular stores (6). These actions are independent of the endothelium. After bolus injection, it exhibits a rapid onset of action; however, the vasodilation is not very prolonged (lasting approximately 2 min). Few studies have described the use of papaverine as a vasodilator drug, for example, for preventing arterial spasm in bypass grafting and renal artery spasm in laparoscopic surgery; however, only one case report has described the use of papaverine to resolve catheter entrapment due to severe radial artery spasm (7-10).

A limitation of our study is the use of a non-hydrophilic sheath that is more prone to spasm (11). Probably with the use of hydrophilic sheaths, the rate of severe spasm with radial entrapment could be even lower; however, the operators who perform transradial procedures may encounter this event. In such cases, the knowledge of the possible use of intra-arterial papaverine is a further weapon that may help resolve this complication. Another limitation is the use of nitrates, verapamil, and warm drapes preceding the use of papaverine; we cannot exclude a possible late effect of these measures or a combined effect with papaverine.

Conclusion

In conclusion, radial artery sheath entrapment due to severe spasm is a rare but possible complication during transradial percutaneous coronary procedures. The use of intra-arterial papaverine is an effective and safe solution to remove radial sheaths. Further studies with larger sample size are needed to confirm our results.

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