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Evaluation of the effects of compressive dressing after interventional procedures via radial approach

Avaliação dos efeitos do curativo compressivo após procedimentos intervencionistas por via radial

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ABSTRACT - Background: External compressive devices after radial puncture for cardiac catheterization and percutaneous coronary intervention aim at hemostasis, patient comfort, and safety. The objective of the study was to evaluate patients undergoing invasive coronary procedures by radial approach, in which a low-cost compressive dressing developed at the service was used, assessing its safety and the occurrence of complications. **Methods:** Patients undergoing coronary angiography and percutaneous coronary intervention, evaluated at the time of removal of compressive dressing and after 7 days, by means of a questionnaire addressing comorbidities, clinical picture, procedure and compression time, physical assessment of hematoma and pain, and a vascular Doppler ultrasound to evaluate radial artery occlusion. **Results:** A total of 144 patients were evaluated, 138 of whom were followed up within 7 days. Events did not differ among diagnostic and therapeutic procedures. In the immediate evaluation after removal of dressing, an incidence of 4.2% of radial artery occlusion was observed, with pain reported by 23.6% of patients, graded at 2.9 ± 1.7 points in the Visual Analogue Scale (intensity of zero to ten), and no major bleeding. Hematoma occurred in one patient (0.9%), classified as type III according to the EASY criteria. In the 7-day evaluation, the incidence of radial artery occlusion was 2.2%, pain was reported in 11.1% of sample (intensity 1.8 ± 0.8), and hematoma was evident in 3.5%. **Conclusion:** The compressive dressing proved to be a safe procedure, with a low rate of complications and a low rate of local pain in patients undergoing invasive coronary procedures via radial approach.

Keywords: Cardiac catheterization; Radial artery; Hemostasis

RESUMO - Introdução: Dispositivos externos compressivos após a punção radial para cateterismo cardíaco e intervenção coronária percutânea visam à hemostasia, ao conforto para o paciente e à segurança. O estudo objetivou avaliar pacientes submetidos a procedimentos coronários invasivos por via radial, nos quais se utilizou um curativo compressivo e de baixo custo, desenvolvido no serviço, avaliando a segurança dele e a ocorrência de complicações. **Métodos:** Indivíduos submetidos à coronariografia e à intervenção coronária percutânea, avaliados no momento de retirada do curativo compressivo e após 7 dias, por meio de questionário abrangendo comorbidades, quadro clínico, tempo do procedimento e de compressão, avaliação física de hematoma e dor, e Doppler vascular sonoro para avaliação de oclusão da artéria radial. **Resultados:** Foram avaliados 144 pacientes, sendo 138 com seguimento em 7 dias. Os eventos não diferiram entre procedimentos diagnósticos e terapêuticos. Na avaliação imediata à retirada do curativo, revelou-se incidência de 4,2% de oclusão da artéria radial, com dor referida em 23,6% dos pacientes, graduada em $2,9 \pm 1,7$ pela Escala Visual Analógica (intensidade de zero a dez) e sem sangramentos graves. Hematoma ocorreu em um paciente (0,9%), com classificação III pelo critério EASY. Na avaliação de 7 dias, a incidência de oclusão da artéria radial foi de 2,2%, a dor foi referida em 11,1% da amostra (intensidade $1,8 \pm 0,8$), e o hematoma foi evidenciado em 3,5%. **Conclusão:** O curativo compressivo mostrou-se um procedimento seguro, com baixa taxa de complicações e baixa taxa de dor local nos pacientes submetidos a procedimentos coronários invasivos pela via radial.

Descritores: Cateterismo cardíaco; Artéria radial; Hemostasia

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INTRODUCTION

The use of radial access has become increasingly frequent in the contemporary scenario of percutaneous coronary intervention (PCI), given its superiority in relation to femoral access, with regard to reducing mortality, especially in acute coronary syndrome (ACS), as demonstrated by well-known clinical trials.¹⁻⁴ Furthermore, this route is associated with lower rates of vascular complications and bleeding, promoting greater comfort for the patient.⁵⁻⁷ Aiming to make local hemostasis more practical after use of radial access, dedicated devices have recently been developed to compress the puncture site. Although practical and effective, these devices add costs to the procedure and have not demonstrated superiority over the use of compressive dressings, which are universally available at relatively low cost.⁸ The objective of the study was to evaluate safety, occurrence of complications, and comfort of patients undergoing coronary angiography (CCTA) and PCI via the radial approach, in which a compressive dressing was used for hemostasis after removal of the radial sheath.

METHODS

Patients undergoing elective CCTA and/or PCI procedures, as well as urgent/emergency procedures in ACS, using the radial route, were evaluated at the *Hospital Encore*, after signing an Informed Consent Form. The Research Ethics Committee of *Hospital de Urgências de Goiânia*, associated with the *Plataforma Brasil*, approved the study (CAAE: 67079623.9.0000.0033).

Patients of both sexes were included, and the variables were scored using an individual questionnaire, evaluating

the absence or presence of hypertension, diabetes mellitus, dyslipidemia, smoking, sedentarism, obesity, early coronary artery disease (CAD) in the family, history of acute myocardial infarction (MI), angina and CCTA/PCI via the same radial artery. We quantified the number of previous procedures using the same radial artery, medications used continuously, and detailed the patient's clinical condition (asymptomatic, stable angina, unstable angina, MI with or without ST-segment elevation), type of procedure (elective CCTA, elective PCI, emergency CCTA with or without PCI), and analysis of radial puncture (number of attempts, chosen laterality, procedure time, and introducer sheath caliber). The recommended compression time was 4 hours.

Unfractionated heparin was administered intravenously at a dose of 5,000 units (IU) in all diagnostic procedures, and 100 IU/kg in therapeutic interventions. Sublingual Isordil (5 mg) was administered to all patients for elective procedures. Conscious sedation was performed in all patients, with fentanyl and midazolam, in addition to lidocaine for local anesthesia.

The local compressive dressing followed the technique performed by the cath lab at the *Hospital Encore*, which included an adhesive tape measuring 50x4cm and a P3 styrofoam cylinder measuring 4-cm high and 2.5-cm in diameter. One end of the adhesive tape was folded by 1 cm, and the cylinder was positioned 20-cm away from the other end, proceeding with the folding of the first one over the second one. A gauze was positioned above the radial puncture, which was compressed by the styrofoam cylinder, and the catheter introducer was removed afterwards. At the compression site, an adhesive tape with the date of the procedure and the time of removal of the compressive material was attached (Figure 1).



Figure 1. Representation of the occlusive dressing developed in the service. (A) The styrofoam cylinder is positioned 20cm away from one end. Then the tape is folded, leaving 4cm of tape exposed. (B) Writing the patient identification. (C) A gauze is compressed above the radial puncture by the styrofoam cylinder.

The puncture site was immediately evaluated after removing the dressing, by asking the patient about pain intensity using the Visual Analogue Scale (VAS), from zero to ten points, and checking whether there was any hematoma, following the classification of the Early Discharge After Transradial Stenting of Coronary Arteries (EASY) study: type I, <5cm in diameter; type II, <10cm in diameter; type III, ≥10cm, without reaching the elbow; type IV, hematoma extending beyond the elbow; and type V, any hematoma with ischemic injury to the hand.⁶ The patency of the radial artery was analyzed through palpation, auscultation, analysis of thrills/murmurs, and vascular Doppler ultrasound, with no associated imaging study. We used a portable Doppler device able to locate arterial pulses, using a 10-Mhz transducer, with high level of sensitivity. To reduce interference from the ulnar artery, it was compressed at the time of the evaluation, and the simultaneous absence of sound in the radial pulse was considered an altered vascular Doppler result, indicating radial artery occlusion (RAO). All Doppler measurements were performed by the same professional.

The patients returned 7 days later for the same evaluation conducted at hospital discharge, except for some patients who, due to their inability to attend the service again, sent a photograph of the radial puncture region, with a report on the presence or absence of local discomfort.

RESULTS

A total of 144 patients were evaluated between March and August 2023, and their clinical characteristics and the procedures performed are described in tables 1 and 2, respectively. The mean age of patients was 66.6±11.5 years, and 68.1% were male. The most prevalent comorbidities were hypertension (73.6%), dyslipidemia (66.7%), and diabetes mellitus (44.4%). A sedentary lifestyle was prevalent

in 84% of patients. Six patients were evaluated at the 7-day follow-up only by telephone/photograph, allowing the score of pain and hematoma, except for the assessment of arterial patency. For the procedure, 54.2% of patients were asymptomatic, 33.4% had ACS, and the remaining had stable angina. In 91.7% of procedures, only one puncture attempt was performed to catheterize the radial artery, with a 5F caliber in 55.6%, 6F in 38.9%, and 7F in 5.6%. The mean procedure time was 31.0±8.3 minutes, and the compression time was 4 hours in 94.4%. Of the patients included, 61.1% had previously undergone manipulation in the same radial artery, with a mean of 1.6±1.4 punctures.

In the outcomes analyzed, as described in table 3, when the immediate assessment was carried out upon removal of the dressing, a prevalence of 4.2% of RAO was observed, with pain reported in 23.6% of patients. Of these, the pain score was 2.9±1.7 on the VAS (intensity from zero to ten) and with no severe bleeding. Hematoma occurred in only one patient (0.9%), classified as EASY type III. In the 7-day evaluation, the incidence of RAO was 2.2%, with reported pain in 11.1% (intensity 1.8±0.8), and hematoma was evident in 3.5% (five patients with EASY classification type III, IV, I, I, and III, respectively).

Table 1. Clinical-epidemiological characteristics of participants

Characteristics	
Male	98 (68.1)
Age, years	66.6±11.5
Weight, kg	77.1±14.6
Height, m	1.7±0.1
Body mass index, kg/m ²	27.4±4.3
Hypertension	106 (73.6)
Type 2 diabetes mellitus	64 (44.4)
Dyslipidemia	96 (66.7)
Active smoking	16 (11.1)
Previous smoking	42 (29.2)
Sedentary lifestyle	121 (84.0)
Positive family history of CAD	28 (19.4)
Prior CAD	36 (25.0)

Results expressed as n (%) or mean ± standard deviation.
CAD: coronary atherosclerotic disease.

Table 2. Clinical picture and data related to invasive procedures

Characteristics	
Silent ischemia	78 (54.2)
Stable angina	18 (12.5)
Non-ST-segment elevation ACS	25 (17.4)
ST-segment elevation MI	7 (4.9)
Elective cardiac catheterization	52 (36.1)
Elective PCI	47 (32.6)
Emergency cardiac catheterization	33 (22.9)
Emergency PCI	12 (8.3)
Previous cardiac catheterization	88 (61.1)
Prior PCI	48 (33.3)
Prior ipsilateral radial access	79 (54.9)
Puncture attempts	
One	132 (91.7)
Two	10 (6.9)
Three	2 (1.4)
Procedure time, minutes	31 ± 8.3
Compression time, hours	
4	136 (94.4)
3	6 (4.2)
1	2 (1.4)
Introducer caliber, F	
5	80 (55.6)
6	56 (38.9)
7	8 (5.6)

Results expressed as n (%) or mean ± standard deviation.

ACS: acute coronary syndrome; MI: myocardial infarction; PCI: percutaneous coronary intervention.

Table 3. Results of the immediate evaluation and after 7 days, considering the outcomes studied

Variables	Immediate assessment (n=144)	7-day assessment (n=138)
Pain	34 (23.6)	16 (11.1)
Pain score	2.9±1.7	1.8±0.8
Hematoma, type	1 (0.9)	5 (3.5)
I	0	2
III	1	2
IV	0	1
Wide pulse	143 (99.3)	137 (99.3)
Thrill	0	0
Murmur	0	0
Altered Doppler	6 (4.2)	3 (2.2)

Results expressed as n (%) or mean ± standard deviation or n.

At the initial assessment, 50% of patients with altered Doppler (absence of radial sound associated with ulnar compression) showed normalization at the 7-day follow-up, and, in the entire sample analyzed, the radial pulse on palpation was normal, allowing us to infer a retrograde pulse in cases of RAO. Regarding pain, 23 patients moved from pain to no pain. On the other hand, six patients who had no pain started to present some level of pain/discomfort.

DISCUSSION

In the present study, the compressive method used was associated with a low incidence of RAO after catheterization (4.2% immediately, and 2.2% within 7 days), corroborating data already described in the literature.²⁻⁴ There was a low incidence of RAO and of events, such as hematoma and discomfort, associated with low to moderate VAS scores, immediately, and after 7 days. The incidence of hematoma is also consistent with the literature,⁶⁻⁸ with only one patient reaching classification IV in the EASY study scale. No clinical risk factors were observed related to RAO, either at discharge or at 7-day follow-up.

The main finding of the study was hemostasis after radial access procedures can be equally achieved using a compressive dressing made at the service, not interfering in late patency of the artery used. Maintaining radial artery patency is important not only for arterial supply of the upper limb, but also to keep access for future percutaneous interventions. Several measures influence the patency of the radial artery, including technical issues related to puncture and cannulation of the vessel, and those related to materials used (hydrophilic introducers, dedicated catheters, etc.) and adjunctive pharmacology. Some studies have shown the simple routine administration of 5,000 IU of heparin can reduce the rate of RAO by up to ten times.⁹

Compared to external devices, a Brazilian study with 528 patients conducted by Assaf Neto et al. observed RAO with compressive dressing and hemostatic bracelet

in consecutive and non-randomized patients, in which no difference was demonstrated between the groups under analysis at 7 days after the procedure (3.8% versus 7.1%; $p=0.20$).⁸ Two other studies analyzed the effectiveness of the TR Band device compared to other forms of radial artery hemostasis. Pancholy et al. carried out a study with 500 patients and showed a reduction in RAO with TR Band as compared to HemoBand (4.4% versus 11.2%).¹⁰ Rathore et al. compared the RadiStop™ and TR Band devices in 790 patients, and found no significant difference in the incidence of RAO between both (5.6% versus 8.0%; $p=0.273$).¹¹ The reduction in hospital costs is evident when we compare the unit value of the TR Band® with our dressing, which is up to 52-fold less expensive for a single procedure, due to low costs of its preparation (styrofoam, adhesive tape, and sterile gauze). To reach such an estimate of cost savings, we compared the value of the TR Band device made available by the largest local health insurance provider (with a unit value of R\$ 138.00) to the isolated costs of sterile gauze, a styrofoam plaque, and an adhesive tape roll obtained in the purchasing department of our service (R\$ 2.65).

Regarding compression time, 94.4% of dressings were maintained for 4 hours. As an exception, eight elective patients were evaluated early due to the impossibility of staying at the hospital (4.2% within 3 hours and 1.4% within 1 hour), with no difference in the complications analyzed. In the study led by Nóbrega et al. with 206 patients, complications were evaluated in two groups, with 2 and 3 hours of compression, showing no statistically significant differences in bleeding and vascular complications, demonstrating that a 2-hour compression time can be adopted, since it is safe and effective.¹²

The low incidence of radial complications using compressive dressing reinforces the reduction in mortality in ACS described in the literature, especially when compared with femoral and brachial techniques.¹² In higher risk scenarios, such as diabetic, hypertensive, obese, elderly, female patients, and smokers, in addition to history of atherosclerosis, liver disease and thrombocytopenia, the radial access demonstrates advantage over other sites. Vascular complications are minimal, such as dissection, pseudoaneurysm, hematoma, and thrombus formation. Furthermore, the radial access allowed early mobilization and discharge in the present study, providing greater comfort to patients and reducing hospital costs.¹⁻⁴

The results, therefore, prove the advantages of using the radial artery route, providing a lower risk of major bleeding and vascular complications related to the puncture site, and events capable of negatively affecting the patient's prognosis. This is mainly due to the fact the radial artery is a superficial vessel, of smaller caliber and with a posterior bone structure, allowing safe and efficient compression, not requiring any occluding device at the puncture site. Complications are rare and less complex to manage, as compared to the femoral route.^{5,6}

This study has important limitations that must be highlighted. It was an observational study, not carried out as a randomized clinical trial, which limits extrapolating findings shown here to general clinical practice, since it is not possible to confirm superiority of the technique described in relation to others used in the daily routine of Interventional Cardiology centers. Another important point is the fact that six patients were evaluated remotely (telephone and photograph sent via mobile phone), rendering physical examination and RAO assessment using a portable Doppler device impossible, which could weaken the results related to such individuals.

CONCLUSION

The compressive dressing proved to be a safe procedure, with a low rate of complications and a low rate of local pain in patients undergoing coronary angiography and percutaneous coronary intervention via radial approach.

SOURCE OF FINANCING

None.

CONFLICTS OF INTEREST

The authors declare there are no conflicts of interest.

CONTRIBUTION OF AUTHORS

Conception and design of the study: FACC, MLP, GD and AGA; data collection: FACC, ALS, Oliveira LXAO and PFD; data interpretation: FACC, AGA, MLP, DR and GG; text writing: FACC and GG; approval of the final version to be published: FACC, PFD, MLP, AGA and GG.

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