

Comparison of Procedural and Fluoroscopy Times and Contrast Volume between Radial and Femoral Access for Cardiac Catheterization

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ABSTRACT

Background: There is controversy in the literature about the advantages of the radial vs. femoral access route for diagnostic catheterizations. This study aimed to compare the radial and femoral access for procedural and fluoroscopy times and for contrast volume. **Methods:** This was an observational, retrospective study based on the records of consecutive patients undergoing cardiac catheterization from July 2012 to December 2013. **Results:** We evaluated 192 patients and the radial access was used in 78.1% of the cases. Mean age was 63.1 ± 11.9 years, most were male (55.7%) and 21.4% had diabetes. Procedural time was lower in the radial group: 12.0 minutes (9.0 to 17.2 minutes) vs. 18.3 minutes (12.0 to 34.5 minutes), $p < 0.01$. Fluoroscopy time was 270.0 seconds (180.0 to 389.5 seconds) vs. 244.0 seconds (175.3 to 705.0 seconds), and there was no difference between groups ($p = 0.59$). Contrast volume was lower in the radial group: 100.0 mL (75.0 to 117.5 mL) vs. 100.0 mL (80.0 to 150.0 mL), $p < 0.01$. **Conclusions:** In this laboratory, which favored the radial access for cardiac catheterization, procedural and fluoroscopy times, as well as contrast volume, were lower or comparable to the femoral access.

DESCRIPTORS: Cardiac catheterization. Fluoroscopy. Contrast media. Radial artery. Femoral artery.

RESUMO

Comparação entre os Tempos de Procedimento e Fluoroscopia e o Volume de Contraste das Vias de Acesso Radial e Femoral em Pacientes Submetidos a Cateterismo Cardíaco

Introdução: Há controvérsias na literatura quanto às vantagens da via radial para cateterismos diagnósticos comparadas às da via femoral. O objetivo deste estudo foi comparar o acesso pelas vias radial e femoral quanto aos tempos de procedimento e de fluoroscopia, e ao volume de contraste utilizado. **Métodos:** Estudo observacional, retrospectivo, realizado por meio de análise documental de registros de pacientes submetidos consecutivamente ao cateterismo cardíaco, nos meses de julho de 2012 a dezembro de 2013. **Resultados:** Foram analisados 192 pacientes, sendo a via radial utilizada em 78,1% dos casos. A idade dos pacientes foi de $63,1 \pm 11,9$ anos, a maioria era do sexo masculino (55,7%) e 21,4% eram diabéticos. O tempo do procedimento foi menor no grupo radial 12,0 minutos (9,0 a 17,2 minutos) vs. 18,3 minutos (12,0 a 34,5 minutos), $p < 0,01$. O tempo de fluoroscopia foi de 270,0 segundos (180,0 a 389,5 segundos) vs. 244,0 segundos (175,3 a 705,0 segundos), sem diferença entre os grupos ($p = 0,59$). O volume de contraste foi menor nos pacientes avaliados por via radial 100,0 mL (75,0 a 117,5 mL) vs. 100,0 mL (80,0 a 150,0 mL), $p < 0,01$. **Conclusões:** Em nosso laboratório, que privilegiou a via radial como via de acesso para cateterismos cardíacos, os tempos do procedimento e de fluoroscopia, bem como o volume de contraste, foram menores ou comparáveis aos da abordagem femoral.

DESCRIPTORES: Cateterismo cardíaco. Fluoroscopia. Meios de contraste. Artéria radial. Artéria femoral.

The radial access route has been increasingly used for diagnostic and therapeutic percutaneous procedures in Brazil and worldwide. Studies have demonstrated that the use of the radial route brings comfort to the patient and reduces the risk of bleeding, vascular complications, and hospitalization time, with lower costs.¹⁻³ However, there are conflicting data regarding the use of the radial route, in relation to the amount of contrast and increased exposure to ionizing radiation, which may be related to the learning curve of the operating physician or type of procedure.^{4,5}

In this context, this study was conducted in order to compare radial and femoral access routes in relation to total procedure and fluoroscopy times, as well as the volume of contrast used in patients undergoing cardiac catheterization.

METHODS

Study design

This was an observational, retrospective study, conducted through documentary analysis of medical records of all patients undergoing coronary angiography at the Hemodynamics and Interventional Cardiology Service, Hospital Universitário, Faculdade de Medicina de Itajubá, Minas Gerais, from June 2012 to December 2013. Each patient had his/her data logged and stored in the Interventional Cardiology Service, under the responsibility of the unit's cardiologist and nurse. Medical records from patients who underwent coronary artery bypass graft surgery (CABG) or *ad hoc* angioplasty were excluded. Medical records with insufficient data to perform data collection were also excluded.

The project was approved by the Research Ethics Committee of Platform Brazil, under protocol N° CAE 25235413.0.

Variables of interest

The variables selected for analysis were age, gender, body mass index (BMI), diabetes mellitus, hypertension, and previous cardiac catheterization. Access route (radial or femoral), total volume of contrast used, and

total procedure and fluoroscopy times were analyzed. Data were collected based on the description by the operating physician in the patient's logging instrument. These variables were organized and inserted into a Microsoft Excel 2010 database.

Statistical analysis

Categorical variables were presented as absolute and relative frequencies, and compared using the chi-squared test. Continuous variables were presented as means and standard deviations or medians and interquartile ranges, and were compared by Student's *t*-test for normally distributed data (Shapiro-Wilks test). Otherwise, a non-parametric test (Mann-Whitney U test) was used. Pearson's correlation coefficient was used to estimate the correlations between variables.

P values < 0.05 were considered significant. Calculations were performed with the aid of R 3.0.2 (R Core Team, 2014) statistical software.

RESULTS

A total of 291 patients who underwent coronary angiography from June 2012 to December 2013 were considered for the study. Of these patients, 41 (14.1%) were excluded for indication of *ad hoc* angioplasty, 31 (10.7%) for having incomplete data, and 27 (9.3%) due to previous CABG.

Of the 192 patients included in this analysis, it was observed that 150 (78.1%) underwent coronary angiography via the radial route, and 42 (21.9%) via the femoral route. The mean age of patients was 63.1 ± 11.9 years. Most were male (55.7%) and 21.4% had diabetes. When comparing the radial and femoral groups, no differences in age, gender, or prevalence of diabetes mellitus and hypertension were observed. However, patients in the radial group had less previous diagnostic catheterizations (Table 1).

The total procedure time was 13.5 minutes (9.8-18.7), and it was significantly shorter in the radial group: 12.0 (9.0-17.2) vs. 18.3 minutes (12.0-34.5), *p* < 0.01. The fluoroscopy time was 266.0 seconds (180.0-411.5), with no difference between groups (Table 2). The volume of

TABLE 1
Clinical characteristics of patients undergoing coronary angiography

	Total (n = 192)	Radial (n = 150)	Femoral (n = 42)	<i>p</i> value
Age, years	63.1 ± 11.9	62.4 ± 11.2	65.8 ± 14.0	0.14
Male gender, n (%)	107 (55.7)	89 (59.3)	18 (42.8)	0.09
Body mass index, kg/m ²	26.7 ± 5.0	26.6 ± 4.9	26.9 ± 5.4	0.99
Diabetes mellitus, n (%)	41 (21.4)	30 (20.0)	11 (26.2)	0.51
Arterial hypertension, n (%)	153 (79.7)	117 (78.0)	36 (85.7)	0.38
Previous cardiac catheterization, n (%)	62 (32.3)	39 (26.0)	23 (54.8)	< 0.01

TABLE 2
Technical data of the procedure

Variable	Total (n = 192)	Radial (n = 150)	Femoral (n = 42)	p value
Procedure time, minutes	13.5 (9.8-18.7)	12.0 (9.0-17.2)	18.3 (12.0-34.5)	< 0.01
Fluoroscopy time, seconds	266.0 (180.0-411.5)	270.0 (180.0-389.5)	244.0 (175.3-705.0)	0.59
Volume of contrast medium, mL	100.0 (75.0-125.0)	100.0 (75.0-117.5)	100.0 (80.0-150.0)	< 0.01

Values presented as median and interquartile range (1st quartile–3rd quartile).

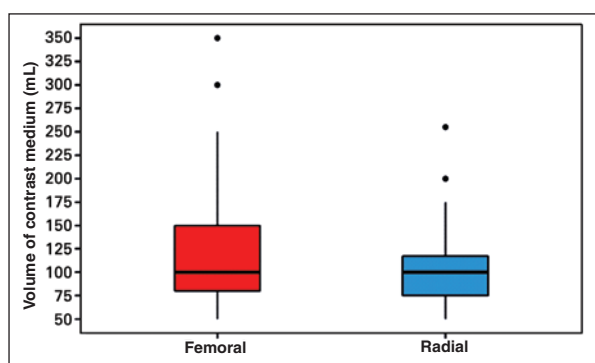


Figure 1 – Volume of contrast medium, according to access route.

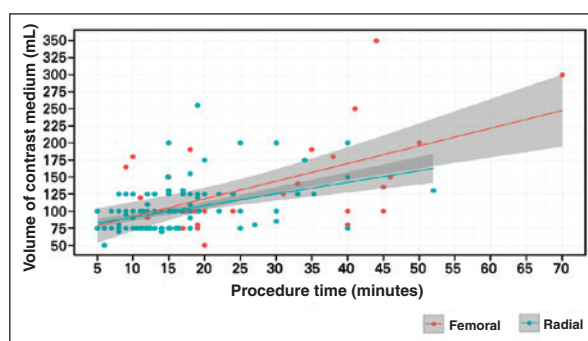


Figure 2 – Scatter plot between volume of contrast medium and procedure time, by access route.

contrast medium used was lower in patients evaluated by radial route, and although the median of the two groups was equal (100 mL), the variation in the femoral group was greater ($p < 0.01$; Figure 1).

Finally, a correlation was observed between volume of contrast medium and procedure time. Figure 2 presents this correlation for each of the access routes. The estimated correlation between measurements for the radial group was 0.44 (95% confidence interval [95% CI]: 0.305-0.563) and for the femoral group was 0.607 (95% CI: 0.372-0.769).

DISCUSSION

This study aimed to evaluate medical records of patients submitted to cardiac catheterization in order to compare the radial and femoral routes regarding total procedure time, fluoroscopy time, and volume of contrast medium used in the procedure.

When radial and femoral access routes in percutaneous cardiac interventions are compared, the ideal strategy must be the one that reduces vascular and bleeding complications.⁶ In the present study, 78.1% of the medical records had tests performed via radial route. This suggests that the operating physician was in line with the global trend, using the radial route technique.^{3,7}

The use of this route began approximately 20 years ago,⁸ and some authors consider it as a default strategy

for cardiac procedures in a catheterization laboratory,⁹ since the technique presents lower bleeding and vascular complication rates, brings more comfort for the patient, and allows for a shorter hospital stay with lower costs when compared with the femoral route.^{2,7,10,11}

Nonetheless, the femoral route remains the most used technique in hemodynamic laboratories for diagnostic cardiac catheterizations and percutaneous coronary interventions, both on national and international scenarios.⁶

In many studies, the learning curve is considered as one of the limitations to the use of the radial route.^{12,13} This factor is linked to the characteristics of the vessel, with its smaller size compared to femoral artery; to anatomical variations; and to the potential risk of spasm in this artery, resulting in longer procedures and greater exposure to ionizing radiation.^{3,6} The learning curve is closely related to the technical improvement of the operating physician, which should minimize patient exposure during the procedure.^{8,12,13}

In this study, the total exam time was longer in the group with femoral access, possibly due to the need to exchange catheters.¹³ When the procedure is performed via radial route, the operating physician usually employs only one pre-shaped catheter, versus three for the femoral route.¹² The use of pre-shaped catheters, combined with the shorter procedure time and the smaller volume of contrast medium used in the

radial *versus* femoral route favor the former technique as first choice. Additionally, studies recommend the radial route, because this technique results in fewer vascular complications, brings greater comfort to the patient, and decreases the length of stay and costs.^{2,10,11,14}

As for fluoroscopy time, no statistically significant difference was observed between the two groups analyzed in this study. This finding conflicts with data from studies in the literature, which tend to favor femoral access, due to their suggestion of an increased exposure to radiation with the use of the radial route.^{3,4}

In the study by Mattos et al.,³ the fluoroscopy time was longer in the radial group, but it was also found that operating physicians with an extensive experience in radial puncture performed the catheterization procedures with similar radiological exposure for these two access routes.

The present data show that there was a relationship between volume of contrast and exam time, suggesting a non-dependent correlation of the access route. Moreover, not only the amount of contrast used, but also the exam time and radiation exposure were associated with the operating physician's experience.^{3,12,13} Thus, this is an interesting subject for future research.

Study limitations

Since this was an observational cross-sectional study, it was not possible to evaluate clinical outcomes and the learning curve of the operating physicians, nor was it possible to compare data between operating physicians.

CONCLUSIONS

In this laboratory, which favored the radial route as the access route for cardiac catheterization, the total procedure and fluoroscopy times, as well as the volume of contrast medium, were inferior or comparable to those registered in the femoral route. In light of the present results, concerns that the cardiac catheterization by radial route may be associated with certain unfavorable characteristics of the procedure are minimized.

CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

FUNDING SOURCE

None.

REFERENCES

1. Trindade LF, Pozetti AHG, Osti AVG, Paula JGR, Barbosa RB, Santos MA, et al. desfechos clínicos em 30 dias dos pacientes submetidos a intervenção coronária percutânea eletiva com alta no mesmo dia. *Rev Bras Cardiol Invasiva*. 2012;20(4):398-402.
2. Dall'Orto CC, Lapa GA, Carneiro Neto JD, Carnieto NM, Oliveira Neto JB, Mauro MFZ, et al. Angioplastia coronária nas indicações off-label: comparação das vias radial vs. femoral. *Rev Bras Cardiol Invasiva*. 2010;18(2):177-84.
3. Mattos EI, Cardoso CO, Moraes CV, Teixeira JVS, Azmus AD, Fischer LS, et al. Exposição radiológica em procedimentos coronários realizados pelas vias radial e femoral. *Rev Bras Cardiol Invasiva*. 2013;21(1):54-9.
4. Kim KP, Miller DL. Minimising radiation exposure to physicians performing fluoroscopically guided cardiac catheterisation procedures: a review. *Radiat Prot Dosimetry*. 2009;133(4):227-33.
5. Ultramari FT, Bueno RRL, Cunha CLP, Andrade PM, Nercolini DC, Tarastchuk JCE, et al. Nefropatia induzida pelos meios de contraste radiológico após cateterismo cardíaco diagnóstico e terapêutico. *Arq Bras Cardiol*. 2006;87(3):378-90.
6. Kukowski CN, Wozniak I, Souza Filho NFS, Cordeiro EA, Rell A, Leal M, et al. Acesso radial vc. acesso femoral em pacientes com idade avançada submetidos à intervenção coronária percutânea. *Rev Bras Cardiol Invasiva*. 2014;22(2):125-30.
7. Espírito Santo CA, Melo PHMC, Takimura CK, Campos CAHM, Horta PE, Spadaro AG, et al. Tendências da utilização da via de acesso transradial em mais de uma década: a experiência do InCor. *Rev Bras Cardiol Invasiva*. 2014;22(2):120-4.
8. Tebet MA, Andrade PB, Nogueira EF, Esteves V, Matos MPB, Andrade MVA, et al. Características operacionais das intervenções coronárias percutâneas em centro que prioriza a utilização do acesso radial. *Rev Bras Cardiol Invasiva*. 2012;20(3):288-94.
9. Hamon M, Nolan J. Should radial artery access be the "gold standard" for PCI? *Heart*. 2008;94(12):1530-2.
10. Almeida MH, Meireles GCX, Silva EV, Costa Jr JR, Staico R, Siqueira DA, et al. Intervenção coronária percutânea pelas vias radial e femoral: comparação entre desconfortos relacionados ao procedimento e custos. *Rev Bras Cardiol Invasiva*. 2013;21(4):373-7.
11. Roussanov O, Wilson SJ, Henley K, Estacio G, Hill J, Dogan B, et al. Cost-effectiveness of the radial versus femoral artery approach to diagnostic cardiac catheterization. *J Invasive Cardiol*. 2007;19(8):349-53.
12. Cardoso CO, Moraes CV, Voltolini I, Azevedo EM, Santos MA, Borba RP, et al. Influência da curva de aprendizado nos procedimentos percutâneos por via transradial. *Rev Bras Cardiol Invasiva*. 2011;19(3):260-5.
13. Labrunie A, Tebet MA, Andrade PB, Andrade MVA, Conterno LO, Mattos LA, et al. Coronariografia via transradial: curva de aprendizagem, avaliada por estudo multicêntrico. *Rev Bras Cardiol Invasiva*. 2009;17(1):82-7.
14. Feldman DN, Swaminathan RV, Kaltenbach LA, Baklanov DV, Kim LK, Wong SC. Adoption of radial access and comparison of outcomes to femoral access in percutaneous coronary intervention an updated report from the national cardiovascular data registry (2007-2012). *Circulation*. 2013;127(23):2295-306.