

Diagnosis, by Doppler echocardiography, of early complications in radial approach for percutaneous coronary intervention

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Este artículo también está disponible en español

ARTICLE INFORMATION

Received: April 25, 2014

Accepted: June 4, 2014

Competing interests

The authors declare no competing interests

Acronyms

echo-Doppler: Doppler echocardiography

PCI: percutaneous coronary intervention

On-Line Versions:

Spanish - English

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ABSTRACT

Introduction: Interventional procedures can be performed by multiple access routes such as: femoral, brachial, ulnar and radial access. The latter is an acceptable and safe alternative. However, no evaluation of the integrity of the radial artery is performed after the procedure.

Objective: To determine, by Doppler echocardiography, the damage of the radial artery after an interventional procedure.

Method: Observational, descriptive, prospective and longitudinal study of 111 patients who underwent transradial interventional procedures, from July 2009 to September 2010, and underwent Doppler echocardiography of the radial artery in the first 72 hours after the procedure.

Results: There was a predominance of male patients aged from 55 to 64 years (45.9%), 24 patients (21.6%) had complications that were detected by Doppler echocardiography, of which 9 patients (8.1%) showed vascular lesions. Radial artery stenosis was the most common lesion (5.4%). Hypertension (33.4%), diabetes mellitus (29.4%), a procedural time between 25-30 minutes (58.3%), and the age group between 45-54 years were predisposing factors for the occurrence of vascular complications (77.8%) and those related to the puncture site (54.1%).

Conclusions: The use of the radial approach is a safe option for percutaneous coronary intervention, which causes, in a low percentage, the occurrence of vascular complications and complications related to the puncture site.

Key words: Percutaneous coronary interventions, Radial artery, Complications, Vascular lesions, Echocardiography, Doppler

Diagnóstico por ecocardiografía Doppler de las complicaciones tempranas del abordaje radial para el intervencionismo coronario percutáneo

RESUMEN

Introducción: Los procedimientos intervencionistas se pueden realizar por varias vías

de acceso como son: la femoral, la braquial, la cubital y la radial. Esta última es una alternativa aceptable y segura. Sin embargo, no se realiza evaluación de la integridad de la arteria radial después del procedimiento.

Objetivo: Determinar con la técnica de ecocardiografía Doppler, el daño de la arteria radial después de un procedimiento intervencionista.

Método: Estudio observacional, descriptivo, prospectivo, de corte longitudinal en 111 pacientes a los que se les realizó procedimiento intervencionista por vía radial, en el período comprendido entre julio de 2009 y septiembre de 2010, y ecocardiografía Doppler de dicha arteria, en las primeras 72 horas después del procedimiento.

Resultados: Existió un predominio de los pacientes del sexo masculino de 55 a 64 años (45,9 %), 24 pacientes (21,6 %) presentaron complicaciones detectadas a través de la ecocardiografía Doppler, de los cuales 9 (8,1 %) mostraron lesiones vasculares, y fue la estenosis de la arteria radial la más representativa (5,4 %). La hipertensión arterial (33,4 %), la diabetes mellitus (29,4 %), el tiempo del procedimiento entre 25-30 minutos (58,3 %), y el grupo etario de 45 - 54 años fueron factores predisponentes para la aparición de complicaciones de tipo vascular (77,8 %) y relacionadas con el sitio de punción (54,1 %).

Conclusiones: La utilización de la vía de acceso radial constituye una alternativa segura para el intervencionismo coronario percutáneo, que ocasiona, en un bajo porcentaje, la aparición de complicaciones vasculares y relacionadas con el sitio de punción.

Palabras clave: Intervencionismo coronario percutáneo, Arteria radial, Complicaciones, Lesiones vasculares, Ecocardiografía, Doppler

INTRODUCTION

The conventional diagnostic coronary angiography, with selective injection of contrast agent, introduced in the 50s, is currently the reference method for visualization of epicardial coronary arteries¹. It can be performed via the femoral, brachial, ulnar or radial arteries². In recent years, the radial artery approach has turned into a valid alternative to the standard femoral approach; its increasingly widespread use in cardiac catheterization laboratories has brought a lower rate of vascular complications, decreased hospital stay and a reduction in costs^{2,3}.

With regard to vascular access, there is no clear subsequent evaluation of the integrity of the radial artery. It is very important to know the functional and structural evolution of this artery, not only for the potential impact it has on the irrigation of the hand (which will be also covered by the ulnar artery), but also by the possible use of this way for future coronary studies, or the potential use of this artery in aorto-coronary bypass or arteriovenous fistula⁴.

Doppler echocardiography (echo-Doppler) is a technique that allows visualization of small branches that are not seen easily with the conventional technique. It also shows the direction of blood flow and facilitates

visualization of areas of turbulence or flow disturbances inside the vessel. Thus, it is very useful in the diagnosis of vascular complications.

There are few studies that demonstrate morphological and functional changes after the transradial access for percutaneous coronary intervention (PCI), and no studies on this subject has been conducted in our country. Therefore, the objective of this research was to determine, by echo-Doppler, the lesions of the radial artery resulting from a diagnostic or therapeutic cardiac catheterization; and to establish the relationship with some risk factors.

METHOD

An observational, descriptive, prospective and longitudinal study was conducted. It assessed, at the Department of Imaging, the patients from the Department of Interventional Cardiology of the Hermanos Ameijeiras Clinical-Surgical Hospital who had undergone transradial PCI procedures for diagnostic or therapeutic purposes from July 2009 to September 2010.

Processing Methods

The universe of study consisted of 324 patients. For the sample size calculation the EPIDAT 3.1 program was used. The patients were selected by simple random method, setting the following parameters:

- a) Universe: 324 patients
- b) Proportion of population (unknown) P: 0.5
- c) Error 5%
- d) Confidence level: 95%

The sample was composed of 111 patients.

Exclusion Criteria

Immunocompromised patients were excluded, as well as decompensated diabetic patients with a history of acute or chronic peripheral vascular disease, patients who had previously undergone transradial PCI, and pregnant women.

Procedure

The patients included in the study were asked written informed consent and underwent an echo-Doppler of the radial artery used for PCI in the first 72 hours after the procedure. Images were recorded and, in positive cases, they were preserved in photographs taken with a still recorder. All images were interpreted by the same physicians, specialists in the field. The findings in the study were recorded in the data collection sheet.

Variables

Complications were analyzed in two groups: extra-vascular complications related to the puncture site (hematoma), and vascular lesions as such (thrombosis, stenosis, dissection and pseudoaneurysm).

Other variables assessed included age, sex, personal medical history and duration of PCI.

Data analysis and techniques to use

The information was summarized and introduced into a database created in SPSS version 13.0. Percentage was used as a summary measure for qualitative data. Contingency tables were prepared by applying the nonparametric chi-square test through the above mentioned program to determine the level of statistical significance, considering as statistically significant result a 95% confidence level, that is, $p < 0.05$.

The results are shown in tables and charts.

RESULTS

Table 1 shows the prevalence of male patients within the age group of 55 to 64 years (48.7%).

Chart 1 shows that 24 patients (21.6%) had complications that were detected by Doppler ultrasound, of which 15 were associated to the puncture site and 9 (8.1%) were vascular lesions. Of these, the stenosis was the most common complication (5.4%) (**Table 2**).

Table 1. Distribution of patients according to age and sex.

Age groups (years)	Sex			
	Female		Male	
	Nº	%	Nº	%
35 - 44	3	7,5	5	6,8
45 - 54	11	31,2	31	41,7
55 - 64	14	40,0	37	48,7
65 and over	8	21,3	2	2,8
Total	35	100	76	100

Source: Data collection sheet.

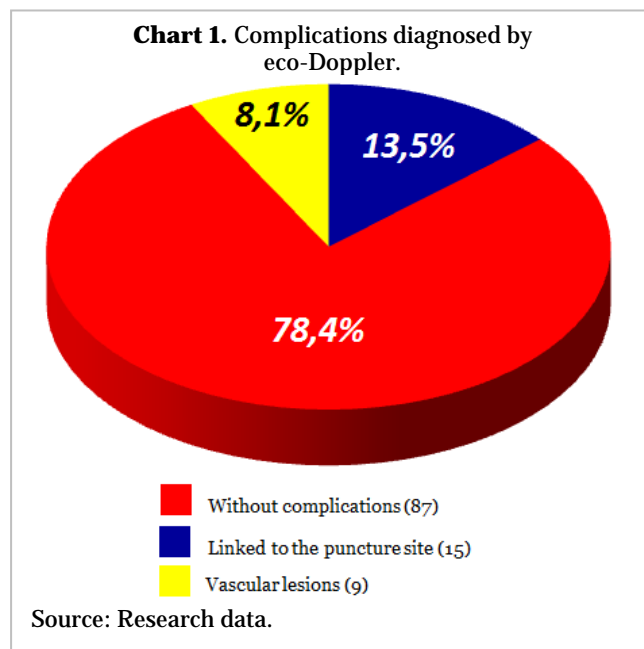


Table 2. Type of vascular lesions of the radial artery diagnosed by echo-Doppler.

Vascular complications	Nº	%
None	102	91,9
Thrombosis	1	0,9
Stenosis	6	5,4
Dissection	1	0,9
Pseudoaneurysm	1	0,9
Total	111	100

Table 3. Relationship of personal medical history with the presence of complications.

Personal medical history	Complications	
	Nº	%
Hypertension *	8	33.4
Diabetes mellitus **	7	29.2
Hypercholesterolemia	3	12.5
Obesity	1	4.1
More than one disease	5	20.8
No other disease	0	0
Total	24	100

* $\chi^2 = 37,541$; $p = 0.001$ ** $\chi^2 = 26,548$; $p = 0.002$ **Table 4.** Relationship between the duration of PCI and the complications found by echo-Doppler.

Duration of PCI	Complications	
	Nº	%
Less than 15 minutes	4	16,7
15 - 19 minutes	3	12,5
20 - 24 minutes	0	0
25 - 30 minutes*	14	58,3
More than 30 minutes	3	12,5
Total	24	100

* $\chi^2 = 36.578$; $p = 0.000$

In patients with hypertension (33.4%) and diabetes mellitus (29.2%) complications occurred more frequently (Table 3).

Most of the complications detected by the echo-Doppler (58.3%) occurred in patients in whom PCI time 25-30 was minutes (Table 4).

Complications, found with the echo-Doppler, associated with the puncture site (54.1%) and vascular lesions (77.7%) were more frequent in the age group from 45 to 54 years (Table 5).

DISCUSSION

The age group with a higher number of patients was between 55 and 64 years of age, with male predominance. These results agree with those found by Dauvergne *et al.*⁵ in their study, where males predominated and the average age of the patients was 63.17 ± 10.4 years.

The major complications detected in the echo-Doppler were hematoma at the puncture site (13.5%) and stenosis of the radial artery (5.4%), a result that contrasts with the study of Sanmartín *et al.*⁶, where there was a predominance of arteriovenous fistula, perforation of the radial artery and pseudoaneurysm.

It is striking, although there was a small number of complications, that patients remained asymptomatic at the end of the PCI; however, we believe that the number of asymptomatic patients is not negligible for a procedure that is comparatively superior to the transfemoral approach^{7,8}. Although you cannot ignore the obvious reduction in complications and the better results obtained when using the transradial access in relation to other approaches^{5,8,9}. It is noteworthy that no patient had a torpid evolution with regard to these complications and did not required transfusions or corrective surgery.

It was also noted that patients with hypertension and diabetes mellitus were more prone to vascular complications, which may be explained by the association of these diseases with the early onset and excessive progression atherosclerosis¹⁰.

Regarding the occurrence of vascular complications at the puncture site, in relation to procedural time, it was observed that they increased in patients in whom the PCI lasted 25 to 30 minutes. Both variables showed a linear relationship, demonstrating that the delay during the procedure is closely related to the complications of the procedure. In this regard we can infer that the skill of the operator is closely related to the

learning curve, which is a determining factor in the appearance or not of complications¹¹. In no similar study, previous to our research, there was any reference to relation between the time of the procedure and the presence of complications.

Most complications and vascular lesions were observed in patients aged 45-54 years, without finding a reason for this result. Furthermore, there are no reports of similar findings in the literature reviewed. It is noteworthy that in the patients within the age range 55-64 years, despite having greater comorbidity, the number of complications was clearly lower compared to other groups, and had no vascular lesions. This is in contrast with the literature reviewed, in which it is stated that the complications of PCI have a directly relationship with increasing age^{12,14, 15}.

CONCLUSIONS

The use of the radial approach is a safe option for PCI, which causes, in a low percentage, the occurrence of vascular complications and complications related to the puncture site.

RECOMMENDATIONS

It is recommended to develop a screening protocol for the vascular complications that are subsequent to transradial PCI. The echo-Doppler is very useful for this purpose.

REFERENCES

1. Obregón AG, Vila GE, Aroche R. Historia y evolución de la cardiología intervencionista. En: Obregón Santos AG, ed. Manual de Cardiología Intervencionista. La Habana: CIMEQ; 2010. p. 25-33.
2. Amoroso G, Laarman GJ, Kiemeneij F. Overview of the transradial approach in percutaneous coronary intervention. J Cardiovasc Med. 2007;8(4):230-7.

Table 5. Relationship of age groups with complications diagnosed by echo-Doppler.

Age groups (years)	Extravascular complications		Vascular lesions	
	Nº	%	Nº	%
35 - 44	1	4,1	1	11,1
45 - 54	13*	54,1	7**	77,8
55 - 64	7	29,1	0	0
65 and over	3	12,5	1	11,1
Total	24	100	9	100

* $\chi^2 = 9.669$; $p = 0.002$

** $\chi^2 = 58,000$; $p = 0.000$

3. Archbold RA, Robinson NM, Schilling RJ. Radial artery access for coronary angiography and percutaneous coronary intervention. BMJ. 2004;329(7463):443-6.
4. Niessen SE, Gurley JC, Grines CL, Booth DC, McClure R, Berk M, *et al.* Intravascular ultrasound assessment of lumen size and wall morphology in normal subjects and patients with coronary artery disease. Circulation. 1991;84(3):1087-99.
5. Dauvergne C, Doberti G, Riesco B, Jara JV, Uriarte P, Pérez V, *et al.* Seguridad de la angioplastia coronaria ambulatoria por vía transradial: Experiencia de un centro. Rev Chil Cardiol.2012;31(2):90-6.
6. Sanmartín M, Cuevas D, Goicolea J, Ruiz-Salmerón R, Gómez M, Argibay V. Complicaciones vasculares asociadas al acceso transradial para el cateterismo cardíaco. Rev Esp Cardiol. 2004;57(6):581-4.
7. Sanmartín M, Goicolea J, Meneses D, Ruiz-Salmerón R, Mantilla R, Claro R, *et al.* Angiografía coronaria con catéteres de 4 F por la vía radial: el cateterismo mínimamente invasivo. Rev Esp Cardiol. 2003; 56(2):124-7.
8. Santas E, Bodí V, Sanchis J, Nuñez J, Mainar L, Miñana G, *et al.* Acceso radial izquierdo en la práctica diaria. Estudio aleatorizado para comparar los accesos femoral, radial derecho y radial izquierdo. Rev Esp Cardiol. 2009;62(5):482-90.
9. Pedreros P, Lamich R, Aguirre A, Romero C, Chamorro H, Donoso M. Evaluación a largo plazo del impacto funcional y estructural de arteria radial post acceso en intervencionismo coronario. Rev Chil Cardiol. 2010;29(2):193-8.
10. Quevedo P, Sabaté M. Revascularización coronaria en diabéticos: evidencias, indicaciones, y complicaciones. Rev Esp Cardiol. 2007;7(Supl E):41-8.

11. Pineda F. Técnica Radial. Rev Chil Cardiol. 2010; 29(2):246-9.
12. Salgado J, Calviño R, Vázquez JM, Vázquez N, Vázquez E, Pérez R, et al. Coronariografía y angioplastia coronaria por vía radial: experiencia inicial y curva de aprendizaje. Rev Esp Cardiol. 2003;56(2):152-9.
13. Saito S, Ikei H, Hosokawa G, Tanaka S. Influence of the ratio between radial artery inner diameter and sheath outer diameter on radial artery flow after transradial coronary intervention. Cathet Cardiovasc Intervent. 1999;46(2):173-8.
14. Pérez V, Kauffmann R, Florenzano F. Angioplastia coronaria e implante de *Stent* a través de la arteria radial. Rev Méd Chile. 1999;127(9):1101-04.
15. Mick MJ. Transradial approach for coronary angiography. J Invasive Cardiol. 1996;8(Suppl D):9-12.