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## Research Article

# Doppler Ultrasonography Screening of the Lower Limbs in Patient with Coronary Artery Disease

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ABSTRACT

**Introduction:** For patient with coronary artery disease (CAD), peripheral artery disease (PAD) is really underestimated.

**Objectives:** Establish a mapping of atherosclerotic involvement of the lower limbs using ultrasound exploration, by working on a sample of coronary artery disease (CAD) patients, recruited in cardiology at the university hospital centers of the city of Constantine.

**Patients and Methods:** Our study is descriptive, transversal, and multi-centric carried out in unit of cardiovascular explorations of the University Hospital of Constantine. The patients involved had at least one significant coronary lesion ≥ 50 on a principal coronary artery. All of our patients benefited from a lower limb Doppler ultrasonography using a 12L linear scanning probe on a General Electric vivid E9 ultrasound system. The data processing and processing used epi info 8 software.

**Results:** Atheromatous affection and implication of the lower limbs is very common and usual in patient with coronary artery disease (CAD), mostly on the infra popliteal floor. 34.67% have a hemodynamic lesion ≥ 50% on the arterial axes of the lower limbs. Taking the lion's share, with more than half of our population had predominantly distal mediacalcosis lesions.

**Conclusion:** Atherothrombotic disease or atherothrombosis demands a global patient care since for a long time and for as long as anyone can remember, the clinical translations and manifestations of atherothrombosis were treated in isolation and compartmentalized.



## Introduction

The atherosclerosis is a diffuse process that can affect different vascular regions with considerable overlap between cardiovascular disease (CVD) (like: coronary artery disease "CAD"), cerebrovascular disease (like: stroke) and peripheral arterial disease (like: PAD). In the literature among patients with coronary artery disease (CAD), 7.7% to 19.6% have already carotid stenosis coexisted and 22-42% have peripheral arterial disease [1]. These associations and compact cause a higher mortality and higher rates of vascular events [1]. However, there are few studies interested in establishing peripheral vascular check in patients with a coronary artery disease (CAD). The main intention of this current study is to map the atherosclerotic affection of the lower limbs in a population with coronary artery disease (CAD) using vascular ultrasound.

## Patients and Methods

### I Population

Our epidemiological study is observational, descriptive, analytical and multicentric, carried out on a sample of 300 confirmed patients with coronary artery disease (CAD) from the three university hospital centers

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of the city of Constantine. The patients included had at least a ≥ 50% lesion on a principle coronary artery, regardless of their age and sex, excluding those who refused to participate in this study and patients with acute limb ischaemia (ALI); informed besides free consent and patient engagement for this project are required, respecting privacy and anonymity.

### II Methods

On the day of the vacation, the patients included benefited from a collection of anthropometric measurements (weight, height, calculation of the BMI), an assortment of information (CVRF, cardio-cerebrovascular disease), a complete clinical examination, a biological assessment including the complete lipid profile (HDLc, CHOLt, TG, LDLc), fasting blood sugar, creatinine level and calculates creatinine clearance using the MDRD formula. For all our patients, a Doppler Ultrasound of lower limb (DULL) was carried out by a General Electric vivid E9 ultrasound machine started up in January 2014, using a 12L linear scanning probe, intended for peripheral vascular exploration, making it possible to obtain targeted screening and to have a precise and explicit lesion description. This exploration concerns the entire arterial tree. In each territory, the exploration is carried out in a patient at rest, in decubitus (recumbency) and systematized according to a specific protocol for each territory. A Doppler Ultrasound of lower limbs (DULL) is pathological, if the presence of at least one atheromatous plaque (atheroma) and/or a hemodynamic lesion ≥ 50% on one of the arterial axes of the lower limbs (aortoiliac, femoropopliteal and infra-popliteal), based on velocimetric criteria (measurement of systolic velocity (PSV) and the ratio of velocities by pulsed Doppler, in the site of the stenosis and before it; in the iliac level, for a stenosis ≥ 50%, a PSV> 200-250 cm/s, and a PSV ratio> 2 to 2.5; at the sub inguinal level, a ratio greater than 2.5 to 3 is generally accepted to differentiate stenosis of more than 50% [2].

### III Statistical Analysis

Patient data as well as all the examinations were carried out by the same cardiologist (principal investigator), subsequently recorded initially on a datasheet established for this purpose/reason, later transferred to a database (EXCEL 2013 file) designed for the same purpose. Statistical analysis is performed using epi info 8 software. Results are presented with 95% confidence intervals, as mean, median, standard deviation, and minimum and maximum values, for the quantitative variables. Whereas, percentages with their standard deviation for the categorical variables. The comparison tests used are: Pearson's Chi-Squared Test ($\chi^2$ test) and Fisher's exact test to calculate and conclude the percent difference comparisons. Student's t-test or Mann-Whitney U test are used to calculate and extract the comparison of means. The threshold of statistical significance is considered reached when the risk of error is less than 5% (p value of <0.05).

## Results

### I Characteristics of the Common Population

Between June 2015 and March 2016, we gathered/assembled 300 patients with coronary artery disease (CAD) (Table 1). The mean age of this population was 61.3 ± 11.3 years with age extremes ranging from 23 to 85 years, and a median of 62 years, with significant male predominance (78.3%), this population was relatively thin (mean BMI 27.92 ± 4.66 kg/m2, mean waist circumference measurement about 95.55 ± 11.20 cm). The majority of our patients with coronary artery disease (CAD) have more than three CVRFs (72.7%). The principal CVRFs were age (69%), followed by hypertension (HBP) (58.7%), sedentism (57.3%), dyslipidemia (52.7%), overweight (49%) and diabetes (47.4%). Whereas the least observed CVRFs were active smoking (32.3%), obesity (29.3%), and a family history of early cardiovascular disease (CVD) (26.4%). Diabetes is associated with hypertension and dyslipidemia in 36%, 47.3% of cases, respectively; while the triple association is observed in 37.7%. Personal medical history of cerebrovascular diseases (ischaemic and haemorrhagic stroke, TIA), were observed in 2.7%. The majority of our patients (60.7%) had coronary angiography for an acute coronary syndrome (ACS), while the rest for stable ischemic heart disease (SIHD). 41.67% had mono-trunk implication, 30.7% bi-trunk implication and 22% tri-trunk implication and 5.6% left common trunk.

**Table 1:** Characteristics in the global population.

| VARIABLES | RESULTS (n ou %) |
|---|---|
| Mean age | 61 ,3 ± 11,3 years |
| Sex ratio M/W | 3,6 |
| Number ≥ three CVRF | 72,7% |
| Age ≥ 50 years (M) et ≥ 60years (W) | 69% |
| HBP | 58,7% |
| sedentism | 57,3% |
| dyslipidemia | 52,7% |
| diabetes | 47,4% |
| Active smoking | 32,3 % |
| Overweight | 49% |
| Obesity | 29,3% |
| Android obesity | 32% |
| Familial coronary artery disease(CAD) | 26,4% |
| Chronic kidney diseaseCKD | light: 9,7% ; moderate: 5% severe: 1,3% |
| Personal medical history with cerebrovascular disease | 2,7% |
| Mono-trunk implication | 41,67% |
| Bi-trunk implication | 30,7% |
| tri-Trunk implication | 22%. |
| Atteinte du TCG | 5,6% |

### II Doppler Ultrasonography of the Lower Extremity Arteries Report

During our investigation, a Doppler ultrasonography of the lower extremity arteries was performed for all patients with coronary artery disease (CAD) in order to permit a detailed study of the arterial tree from the abdominal level to the periphery. The lesions identified are the existence of plaques, hemodynamic lesions (≥ 50%), thrombosis, or mediacalcosis.

**III Iliac Axis Lesion**

The percentage of patients with at least one atheromatous lesion of the iliac axis (common iliac artery, internal iliac artery, external iliac artery) was 47.7%, a very remarkable and significant difference between the two sexes, without the presence of mediacalcosis at this level (Tables 2-4).

**Table 2:** Distribution of iliac lesions.

| | men | women | Total | P |
|---|---|---|---|---|
| Without lesion | 107 (45,53%) | 50 (76,92%) | 157 (52,3%) | 0,001 |
| Iliac lesion | 128 (54,46%) | 15 (23,1%) | 143 (47,7%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 3:** Distribution of the right iliac artery lesions.

| | Men | women | Total | P |
|---|---|---|---|---|
| Plaques | 107 (45,53%) | 16 (24,6%) | 123 (41,0%) | 0,001 |
| stenosis | 18 (7,65%) | 1 (1,5%) | 19 (6,34%) | |
| Thrombosis | 1 (0,4%) | 0 (0,0%) | 1 (0,34%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 4:** Distribution of the left iliac artery.

| | Men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 109 (46,3%) | 15 (23,1%) | 124 (41,3%) | 0,001 |
| stenosis | 18 (7,65%) | 0 (0,0%) | 18 (6%) | |
| Thrombosis | 1 (0,4%) | 0 (0,0%) | 1 (0,34%) | |
| Total | 235 (100%) | 65 (100%) | 300 (00%) | |

**IV Femoro-Popliteal Axis Lesion**

The percentage of patients with at least one atheromatous lesion of the femoral axis (common femoral artery, superficial femoral artery, deep femoral artery) was 56.0%; this implication is more frequent than the one of the axis iliac, very notable and significant difference between the two sexes and without the presence of mediacalcosis on this level (Tables 5-11).

**Table 5:** Distribution of the femoro-popliteal lesions.

| | men | women | Total | P |
|---|---|---|---|---|
| Without lesion | 86 (36,6%) | 46 (70,8%) | 132 (44,0%) | 0,001 |
| Axis lesion | 149 (63,4%) | 19 (29,2%) | 168 (56,0%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 6:** Distribution of the right common femoral artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 94 (40%) | 28 (42,8%) | 122(40,7%) | 0,024 |
| Stenosis | 18(7,65%) | 0% | 18(6,0%) | |
| Thrombosis | 2(0,9%) | 1(1,5%) | 3(1%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 7:** Distribution of the left common femoral artery lesions.

| | men | Women | global Population | P |
|---|---|---|---|---|
| Plaques | 92 (39,2%) | 28 (42,8%) | 120 (40%) | 0,03 |
| Stenosis | 21 (8,93%) | 1 (1,5%) | 22 (7,33%) | |
| Thrombosis | 1 (0,4%) | 0% | 1 (0,34%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 8:** Distribution of the right superficial femoral artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 103(43,82%) | 24(36,90%) | 127(42,3%) | 0,033 |
| Stenosis | 31(13,2%) | 1(1,5%) | 32(10,7%) | |
| Thrombosis | 0(0%) | 0(0%) | 0(0%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 9:** Distribution of the left superficial femoral artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 110(46,80%) | 22(33,84%) | 132(44 %) | 0,014 |
| Stenosis | 34(14,46%) | 2(3,07%) | 36(12%) | |
| Thrombosis | 0(0%) | 0(0%) | 0(0%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 10:** Distribution of the right femoro-popliteal lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 30 (42,9%) | 98 (41,7%) | 128 (42,7%) | 0,001 |
| Stenosis | 4 (1,8%) | 2 (3%) | 6 (2%) | |
| Thrombosis | 0 (0%) | 0 (0%) | 0 (0%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**Table 11:** Distribution of the left femoro-popliteal lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 90 (38,1%) | 24(37,2%) | 114(38%) | 0,002 |
| Stenosis | 12(5,2%) | 4(6,1%) | 16(5,3%) | |
| Thrombosis | 0(0%) | 0(0%) | 0(0%) | |
| Total | 235 (100%) | 65 (100%) | 300 (100%) | |

**V Infra Popliteal Axis Lesion**

The percentage of patients with at least one lesion of the infra-popliteal axis (anterior tibial artery, posterior tibial artery, fibular artery) was 73.0%, constituting the most frequent implication of the arterial axes of the lower limbs; these lesions are dominated by mediacalcosis (Tables 12-18).

**Table 12:** Distribution of the infra-popliteal axis lesion.

| | men | women | Total | P |
|---|---|---|---|---|
| Infra- popliteal axis without | 69(29,4%) | 12(18,5%) | 81(27,0%) | 0,08 |
| Infra- popliteal axis with lesion | 166(70,6%) | 53(81,5%) | 219(73,0%) | |
| Total | 235(100%) | 65(100%) | 300(100%) | |

**Table 13:** Distribution of the left anterior tibial artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 80(34%) | 12(18,5%) | 92(30,7%) | 0,01 |
| Stenosis | 24 (10,2%) | 1(1,5%) | 25(8,4%) | |
| Thrombosis | 24 (10,2%) | 6(9,2%) | 30(10,0%) | |
| Total | 235(100%) | 65(100%) | 300(100%) | |
| Mediacalcosis | 134(57%) | 35(53,8%) | 169(56,3%) | 0,759 |

**Table 14:** Distribution of the right anterior tibial artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 74 (31,5%) | 7 (10,8%) | 81 (27%) | 0,011 |
| Stenosis | 21 (8,9%) | 5 (7,7%) | 26 (8,6%) | |
| Thrombosis | 28 (11,9%) | 5 (7,7%) | 33 (11%) | |
| Total | 235(100%) | 65(100%) | 300(100%) | |
| Mediacalcosis | 132 (56,2%) | 35 (53,8%) | 167 (55,7%) | 0,807 |

**Table 15:** Distribution of the left posterior tibial artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 92(39,1%) | 12 (18,5%) | 104 (34,7%) | 0,006 |
| Stenosis | 14 (6%) | 3 (4,6%) | 17 (5,7%) | |
| Thrombosis | 22 (9,4%) | 5 (7,7%) | 27 (9%) | |
| Total | 235(100%) | 65(100%) | 300(100%) | |
| Mediacalcosis | 133(56,6%) | 35(53,8%) | 168(56,0%) | 0,784 |

**Table 16:** Distribution of the right posterior tibial artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 92(39,1%) | 14(21,5%) | 106(35,3%) | 0,007 |
| Stenosis | 11(4,6%) | 2(3,1%) | 13(4,3%) | |
| Thrombosis | 24(10,2%) | 5(7,7%) | 29(9,7%) | |
| Total | 235(100%) | 65(100%) | 300(100%) | |
| Mediacalcosis | 133 (56,2%) | 35(53,8%) | 167(55,7 Population %) | 0,807 |

**Table 17:** Distribution of the right peroneal artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 97 (41,3%) | 15 (23,1%) | 112 (37,3%) | 0,025 |
| Stenosis | 9 (3,8%) | 0 (0%) | 9 (3%) | |
| Thrombosis | 22 (9,4%) | 8 (12,3%) | 30 (10,0%) | |
| Total | 235(100%) | 65(100%) | 300(100%) | |
| Mediacalcosis | 133 (56,6%) | 36 (55,4%) | 169 (56,3%) | 0,857 |

**Table 18:** Distribution of the left peroneal artery lesions.

| | men | women | global Population | P |
|---|---|---|---|---|
| Plaques | 101(43%) | 13(20%) | 114(38%) | 0,002 |
| Stenosis | 10(4,2%) | 0(0%) | 10(3,3%) | |
| Thrombosis | 22(9,4%) | 8(12,3%) | 30(10%) | |
| Total | 235(100%) | 65(100%) | 300(100%) | |
| Mediacalcosis | 131 (55,7%) | 36 (55,4%) | 167 (55,7%) | 0,880 |

**VI Distribution of Atherosclerotic Lesions According to the Data of the Doppler Ultrasound of Lower Limbs**

104 patients had at least one hemodynamic atherosclerotic lesion ≥ 50% on the arterial axes of the lower limbs representing 34.67%. These lesions predominate in the femoro-popliteal axis, but thrombotic lesions are found much more on the infra-popliteal level. More than half of our population of patients with coronary artery disease had mediacalcosis as lesion (Table 19).

**Table 19:** Distribution of atheromatous lesions of the lower limbs.

| **Percentage of patients with at least one atherosclerotic lesion of the arterial axes of lower limbs** | **Artery** | **patients number (lesions≥50%)** | **patients number (thrombosis)** | **Percentage of patients with hemodynamic lesion** |
|---|---|---|---|---|
| Iliac Axis (47, 7%) | LIA | 18 | 1 | 6,34% |
| | RIA | 19 | 1 | 6,67 % |
| femoro-popliteal Axis (56%) | LCFA | 22 | 1 | 7,66% |
| | RCFA | 18 | 3 | 7% |
| | LSFA | 36 | 0 | 12% |
| | RSFA | 32 | 0 | 10,7% |
| | LFPA | 16 | 0 | 5,3% |
| | RFPA | 06 | 0 | 2% |
| infra popliteal Axis (73%) | LATA | 25 | 30 | 18,4% |
| | RATA | 26 | 33 | 19,6% |
| | LPTA | 17 | 27 | 14,7% |
| | RPTA | 13 | 29 | 14% |
| | LPA | 10 | 30 | 13,3% |
| | RPA | 09 | 30 | 13% |

## Discussion

PAD includes all locations and regions from the large proximal arteries to the more distal small arteries, from the abdominal aorta to the distal vessels. There is no referential rule for PAD to distinguish and choose large and small arteries. Some authors consider a small artery, the one with a diameter of less than 2.3 mm, which corresponds to the most distal arteries, but other studies compare infra-knee joint with supra-knee joint atheromatous lesions [3-6]. Peripheral arterial disease (PAD) is an indicator of atherosclerosis in other vascular regions and also associated with a huge and considerable morbidity and mortality [1]. In patients with coronary artery disease (CAD), a coexisting atherosclerotic lesion of the lower limbs has been reported in 15-42% according to the different epidemiological series [1].

In our current study, the frequency of PAD in patients with coronary artery disease (CAD)was really high (34.67%). We find that there is a distal damage more frequent than proximal. This has been demonstrated in other recent studies such as the study of De Neuville in 2008, including 754 patients, focused on the PAD description of the West Indian subject (France) by analysis of a surgical employment of database, which showed that hemodynamic damages affected the infra-popliteal level in 86% of cases, the femoro-popliteal axis in 51%, but in only 7% of cases the aortoiliac level; the Copart register in 2013, 60.2% of patients at Toulouse University Hospital and 73.5% patients of Bordeaux and Limoges University Hospital Centers have infra-popliteal lesion and in 2014, Lavinia Belaye, in a work aimed at identifying the predominant localization of PAD, and the CVRFs influencing its topography, found the predominance of distal PAD in the 268 patients included in the study, 84.70% patients had an infra-popliteal implication, and respectively a popliteal implication 55.22%, femoral 69.02% and aortoiliac 42.91% [7-9].

## Conclusion

Due to its dispersed and ubiquitous nature, atherothrombotic disease needs a serious and a strict patient's care because, for a long time, the clinical translation with manifestations of atherothrombosis disease (myocardial infarction, stroke etc.) were treated in an isolated and sectionalized manner, but today, the modern vision describes a systemic disease, which can potentially affect several and various arteries simultaneously, which justifies a minimum evaluation and a strict analysis including the three major territories: coronary, cerebrovascular and peripheral, this Is due to the magnificent progress in investigative methods, especially the non-invasive ones, pushing to a systematic and a professional search for atheromatous disease and concomitantly with a preventive treatment of silent lesions.

## Conflicts of Interest

None.

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