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Endovascular Revascularization as a Treatment Option for Peripheral Arterial Disease due to Diabetes in Saudi Arabia: Public Awareness Survey

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Abstract

Objectives Diabetic foot disease is a common and serious complication of diabetes that represents a major global health concern with high mortality and morbidity rates. Successful revascularization and improved perfusion have had fundamental roles in reducing the rate of amputation in diabetic foot patients over the last decade. Creating public awareness plays a key role in early treatment and prevention of amputation. The aim of this study was to determine if people are aware of endovascular revascularization as a therapeutic option for diabetes-related peripheral artery disease.

Methods The study is a community-based observational descriptive cross-sectional study that was conducted to assess Saudi population knowledge and awareness about endovascular revascularization as a treatment option of diabetic foot disease through interventional radiology. The self-administered online survey was randomly distributed with a maximum of 20 multiple choice questions through social media channels.

Results Endovascular revascularization as a treatment of diabetes-related peripheral artery disease through interventional radiology was unknown to 90.2% of the participants. Awareness has been influenced by many factors including age, occupation, and family history.

Conclusion This study highlights the importance of raising public awareness about endovascular revascularization as a treatment option for diabetes-related peripheral arterial disease in suitable patients.

Keywords
- diabetes-related peripheral arterial disease
- endovascular revascularization
- interventional radiology
- Saudi Arabia

Introduction

Diabetic foot disease (DFD) is a common and serious complication of diabetes that represents a major health concern with high associated mortality and morbidity rates. DFD is classified under the umbrella of "critical limb ischemia" (CLI), which varies in symptoms from rest pain to ulcers and tissue loss.[1] DFD is attributed to many causative factors, the most common of which are peripheral sensory

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neuropathy and peripheral arterial disease (PAD).[2] In Saudi Arabia, the prevalence of peripheral sensory neuropathy among patients with diabetes is 29.1%.[3] PAD has a prevalence rate of approximately 23.1% in the Saudi diabetic population.[4] Foot ulcers are associated with an increased risk of lower limb amputation in patients with diabetes.[2]

A study conducted in Saudi Arabia showed that the findings of two previous studies as well as three methodological publications led to the prediction that approximately 325 amputations are likely to occur annually in Jeddah, compared with 741 in Riyadh and 3,970 in Saudi Arabia.[5] Thus, the main goal of peripheral ischemic foot ulcer treatment is limb preservation.[2] A multidisciplinary team, including interventional radiologists, vascular surgeons, foot surgeons, podiatrists, endocrinologists, family physicians, and physiotherapists, is essential for the effective treatment of PAD. Successful revascularization and improved perfusion have had fundamental roles in reducing the rate of amputation among diabetic foot patients over the last decade.

Treatment options have been developed for non-healing ischemic DFD, including surgical bypass for the occluded vessels (performed through vascular surgery) or endovascular revascularization (i.e., percutaneous transluminal angioplasty or stenting), which is mostly performed through interventional radiology. Nonsurgical treatment has many advantages. Specifically, effective nonsurgical treatment presents an achievable, safe, minimally invasive, low-risk, and cost-effective set of procedures for limb salvage in a high percentage of diabetic patients.[6] However, because of the rapid development of new technology, public awareness of the effectiveness of endovascular options in the treatment of diabetic PAD has not been thoroughly investigated, especially in Saudi Arabia. Raising public awareness plays a key role in early treatment and prevention of amputation. This study aimed to assess the level of awareness and knowledge among the Saudi population regarding interventional radiology as an option for the treatment of DFD.

Materials and Methods

In this cross-sectional study, the self-administered online survey for the year 2021 was distributed at random through social media platforms. A simple random sample of 1,776 participants was calculated using a Raosoft sample size calculator.[7] The minimum sample size needed to conduct this study with a confidence interval of 99% was 664.[7] Data were collected using Google forms (Google Sheets) and were coded and processed using Microsoft Excel and the Software Statistical Package for the Social Science (SPSS) version 23 (SPSS, Inc., Chicago, Illinois, United States).

The survey questionnaire started with an informed consent document, and all participants provided their written informed consent for participating in the study.

The survey questionnaire contained 20 multiple choice questions divided into three main sections (►**Supplementary Material S1**, available online only). The first section consisted of demographic data, including nationality, region, gender, age, education level, employment in the medical field (students or working professionals), and family history of diabetes (►**Table 1**).

The second section covered questions about knowledge and perceptions regarding DFD, including definition of DF, current positive family history, associated symptoms, causative factors, DFD treatment options (including conservative treatment with wound care and antibiotics, revascularization, and amputation), and individual opinions regarding DFD as a common complication of diabetes in Saudi Arabia. The third section focused on endovascular revascularization as a treatment option for DFD-related PAD. Questions included familiarity with this procedure, if the procedure was considered minimally invasive, the type of anesthesia used in this intervention, participants' opinions on whether the procedure could contribute to reducing the amputation rate, and the source of their information. The accuracy and validity of the questionnaire were confirmed by two consultants: an interventional radiologist and a family physician.

Descriptive statistics, including frequencies and percentages, were used to describe items and study variables. As these variables represent nominal data, Chi-square tests were conducted to assess differences in variable distribution as well as associations between variables based on the study objectives. Statistical significance was set at a p-value ≤ 0.05.

The study was approved by the Ethical Research Committee of the College of Medicine at the University of Hail, Saudi Arabia. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Result

A total 1,743 people participated in this study (75.4% female; 24.6% male), the majority of them were Saudi (97.4%). Their age was classified into five groups with the majority of participants in the 41 to 50 and 20 to 30 years age groups (26.4 and 25.8%, respectively). In addition to that, around two-thirds (71.8%) were university students or had Bachelor's degree (►**Table 1**).

The survey tool was distributed through social media platforms within the Kingdom of Saudi Arabia and the percentages from each region were as follows: Middle 33.6%, North 27.5%, West 13.2%, East 13.0%, and South region 12.7%.

A history of diabetes mellitus was found in 67.5% of the participants' families. Moreover, 12.1% of all respondents had a family history of DFD. By using Chi-square test was conducted to evaluate the relationship between the family history of DFD with some demographic parameters. DFD awareness was significantly associated with 34.1% of the participants ($p = 0.001$) of age group of 41 to 50 years. Similarly, with a central region of SA by 33.6% ($p = 0.000$).

The reported symptoms of patients with DFD are mentioned in ►**Table 2**. The Table shows that a majority of the patients have poor glycemic control. Regarding the knowledge of DFD, around half of the participants (56.8%) did not know what DFD is, and even those who knew about it (43.2%), 8.2% of the participants had a wrong impression of

Table 1 Demographic data

		%
Gender	Male	24.6
	Female	75.4
Nationality	Saudi	97.4
	Non-Saudi	2.6
Age	Less than 20	9.5
	20–30	25.8
	31–40	22.3
	41–50	26.4
	More than 50	16
Education level	Illiterate	0.5
	Primary, Middle, or Secondary school	20.1
	University	71.8
	Master or PhD	7.5

Table 2 Diabetic foot disease symptoms

	%
Poor glycemic control	30.3
A feeling of coldness, pain, burning sensation or tingling in the foot	24.9
Foot redness or hotness	15.7
Loss of sensory or motor function of the foot	15.1
Foot deformity	11.3

it (►**Table 3**).We sought to establish relationships associated with the correct definition of DFD and found that the level of education and occupational health were statistically significant. The relation between correct definition of DFD and level of education was characteristically associated with university students by 74.8% ($p = 0.000$). Likewise, medical students and workers showed an advantage over non-medical students by 86.9% ($p = 0.000$). Contrarily, the age in relation to knowledge of DFD was statistically insignificant ($p = 0.42$).

The highest percentage of people were unaware of the common causes of DFD (54.1%), given the fact that neuropathy and foot ischemia are the responsible causes, which 42.6% agree and 3.3% disagree.

A total of 61.3% felt that DFD is one of the most common complications of diabetes in Saudi Arabia, 33.9% had no idea about that and 4.9% believed that DFD is not considered a common complication.

Awareness of treatment of DFD varied among respondents (►**Fig. 1**) with the highest two relative percentages between 35.7% reported that by conservative treatment with wound care and antibiotics and 30.1% reported that by revascularization. We focused on asking those who had a family history of DFD regarding the treatment options. It appeared that the highest percentage (16.9%) chose amputation as a definitive treatment. Around 14.2% of diabetic patients reported the conservative treatment with wound care and antibiotics as the preferred treatment, 12.8% selected the revascularization option, and 7.7% denied any information about the options at all.

Table 3 Public awareness of diabetic foot definition

Do you know what diabetic foot disease is?	%
Yes	43.2
No	56.8
Yes	**43.2%**
An open wound that is difficult to heal and loss of tissue which is commonly located on the bottom of the foot	91.8
Tightening or tearing of the ankle joint ligaments	2.9
Bony protrusion on the underside of the heel	2.9
Chronic skin disease or recurrent itching	2.4

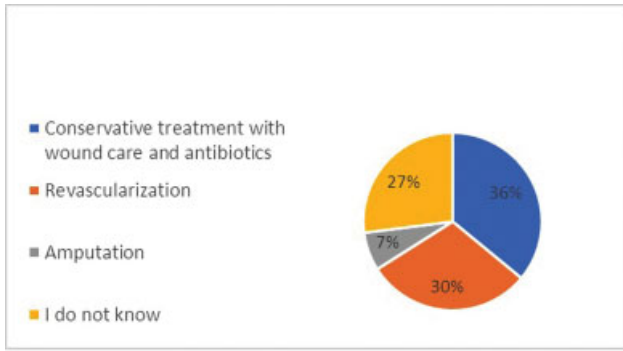

Fig. 1 Public awareness of treatment options of diabetic foot.

As for the awareness about endovascular revascularization for the treatment of DFD, the majority of patients (90.2%) had never heard about the interventional radiological approach, while only 9.8% were familiar with it.

Notably, the knowledge and awareness of endovascular revascularization have been influenced by many factors such as age, occupation, and family history. The median age group 20 to 30 years is well aware of the procedure by 30.4%. Almost equal percentage between 41 to 50 years (22.6%) and 31 to 40 years (20.0%). It was also a statistically significant outcome in relation to employment/training in the medical field (90.5%) and in family history of DFD (87.9%).

Concerns about the interventional radiology approach, to be considered as safe and minimally invasive, were investigated among the familiar group. It showed that 62.5% had no concerns, 8.3% had some worries, and 29.2% were unsure whether it is a risky procedure or not.

A total of 56.3% of the participants were aware about local anesthesia, which is the type of anesthesia used to perform this procedure, while 30.5% did not know about it, and 13.2% reported it as a general anesthesia. The fact that the endovascular revascularization can contribute to the reduction of the amputation rate of the diabetic foot was approved by

73.8% of the participants, 19% had no idea about it, and 7.1% did not agree with it.

We found that the largest source of the participants' information were social media 28.7% and internet 26.2% followed by friends or relatives 16.0%, family physician 10.2%, medical books 10.2%, and the patient's surgeon 8.6%.

Discussion

Endovascular intervention allows for a minimally invasive low-risk procedure and it can be performed under local anesthesia, and thus public health efforts are necessary to promote knowledge of this treatment modality within the Saudi population.[8]

In two studies conducted in Saudi Arabia, patients had no knowledge of interventional radiology procedures as treatment choices for their medical conditions. According to a study conducted in 2020, 74.2% of participants had never heard of radiofrequency ablation as a thyroid nodule treatment option.[9] Another study of Saudi women's awareness of uterine artery embolization found that 76.1% had never heard of this procedure.[10] This current study is the first to evaluate the Saudi population's awareness of interventional radiology procedures for the treatment of DFD. Majority of respondents in this online survey had no knowledge of interventional radiology treatment options for DFD. Involvement in the medical field, whether by employment or study, had a major impact on awareness of interventional radiology treatment options for DFD. These deficiencies arise from a lack of awareness about treatment options, whereas public health education and specialist consultation prevent amputation.

Conclusion

The findings of this study highlight the need for further efforts to raise public awareness of the importance of the role of endovascular intervention in the treatment of DFD with poor perfusion, as important medical decisions require patients to be well-informed and active in the decision-making process.

Financial Disclosures
None.

Ethics Approval
This study was approved by the Research Ethics Committee of the University of Hail (approval number: 42–5-38862). All participants provided their written informed consent. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Authors' Contributions
A.H.A.A. and N.H.R.A. contributed toward study design, literature search, questionnaire design, data collection, data analysis, data interpretation, manuscript preparation, manuscript editing, manuscript review, and approval of the current version of the manuscript. A.F.M.A. did the manuscript preparation, manuscript editing, manuscript review, and approval of the current version of the manuscript. A.A. A.A. contributed toward study design, literature search, questionnaire design, data interpretation, manuscript preparation, manuscript editing, and manuscript review.

Conflict of Interest
None declared.

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