

# Myocardial perfusion abnormalities in asymptomatic type 2 diabetic patients

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**Objective:** The prevalence of coronary artery disease (CAD) is high in patients with diabetes. Because ischemia and infarction are often silent in diabetic patients, diagnosis of CAD occurs inevitably late. It is essential to identify the presence of CAD in diabetic patients to start early treatment. Therefore, the aim of this study was to determine the prevalence of abnormal myocardial perfusion in asymptomatic type 2 diabetic patients using myocardial perfusion imaging.

**Methods:** Fifty-nine patients with type 2 diabetes, who did not have any history of CAD, but did have risk factors underwent myocardial perfusion single-photon emission computed tomography (SPECT) imaging using <sup>99m</sup>Tc-tetrofosmin and a 2-day stress–rest protocol. Two nuclear medicine specialists independently interpreted the images. Statistical analysis was performed to determine if there is a correlation between the presence of perfusion abnormalities and the history of diabetes (duration of disease, type of treatment, level of control, and presence and type of complications). The influence of other factors such as age, sex, smoking history, and family history of CAD, with abnormal scans were also studied.

**Results:** Of the 59 patients, abnormal scans were detected in 22 (37%) including 16 with reversible defects due to stress-induced ischemia. Hence the prevalence was 37%. Duration of diabetes, use of insulin, nephropathy, and neuropathy were significantly associated with abnormal scans ( $p = 0.048$ ,  $p = 0.045$ ,  $p = 0.006$ , and  $p = 0.03$ , respectively). Additionally, positive family history of CAD was highly associated with perfusion abnormalities ( $p < 0.001$ ). No significant association was found between other risk factors, such as hyperlipidemia and the presence of perfusion defects.

**Conclusions:** We found a high prevalence of myocardial perfusion abnormalities in asymptomatic type 2 diabetic patients. Perfusion abnormalities on myocardial perfusion SPECT images were associated with disease duration, insulin use, nephropathy, and neuropathy. Asymptomatic diabetic patients might be candidates with CAD abnormalities that can be studied using myocardial perfusion SPECT.

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**Keywords:** Diabetes, Silent myocardial ischemia, Single photon emission computed tomography, <sup>99m</sup>Tc-tetrofosmin

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## Introduction

Coronary artery disease (CAD) is the leading cause of death in patients with diabetes. Silent myocardial ischemia and unrecognized myocardial infarction is higher in diabetic population than in nondiabetics [1–4]. Silent ischemia is defined as objective documentation of myocardial ischemia in the absence of angina or anginal equivalents. Early diagnosis of CAD is important to start effective treatment and reduce cardiovascular complications and mortality.

A variety of techniques is available in the management of patients with CAD, such as rest and stress electrocardiography (ECG), rest and stress echocardiography, rest and stress myocardial perfusion single photon emission computed tomography (SPECT), multislice spiral computed tomography, electron beam computed tomography, magnetic resonance imaging (MRI), and coronary angiography.

Myocardial perfusion SPECT imaging is a well-established, noninvasive, and safe imaging procedure.

Type 2 diabetes is a prevalent disease in the Kuwaiti population. Unfortunately, type 2 diabetes is also spreading to adolescents and even children in Kuwait. There is a high prevalence of risk factors for cardiovascular disease and consequently elevated risk for morbidity and mortality from CAD in Kuwaitis with type 2 diabetes [5]. The aim of this study was to determine the prevalence of abnormal myocardial perfusion in asymptomatic type 2 diabetic patients using rest and stress myocardial perfusion SPECT imaging and to study the impact of variables such as age, sex, duration of diabetes, treatment type, complications, and level of control.

## Materials and methods

This was a cross-sectional, observational, descriptive, and analytical study that included 59 consecutive type 2 diabetic patients with no symptoms and no prior diagnosis of CAD but presence of any risk factor including hypertension, smoking, family history, and/or hyperlipidemia, who were referred for myocardial perfusion SPECT imaging from primary care polyclinics to Mubarak Al-Kabeer Hospital over a 1-year period. All study participants were informed of the methods and objectives and a written informed consent was obtained from each patient. The Institutional Ethics Committee of the Faculty of Medicine,

### Abbreviations

CAD	Coronary artery disease
SPECT	Single photon emission computed tomography
ECG	Electrocardiogram
ECHO	Echocardiography
MSCT	Multi-slice spiral computed tomography
EBCT	Electron beam computed tomography
MRI	Magnetic resonance imaging
CA	Coronary angiography
QGS	Quantitative gated SPECT
SD	Standard deviation
MSCT-CA	Multi-slice computed tomography-coronary angiography
DIAD	Detecting ischemia in asymptomatic diabetics

Kuwait University and the Ministry of Health approved the study.

A conventional 2-day stress–rest protocol was performed on all the patients. Treadmill exercise with modified Bruce protocol and if there was a contraindication to physical exercise, pharmacological stress using dipyridamole or dobutamine was performed. A 740–925 MBq (20–25 mCi) dose of <sup>99m</sup>Tc-tetrofosmin was injected at peak stress and images were obtained 60 minutes after the injection. The rest studies were done on a separate day. An activity of 740–925 MBq (20–25 mCi) of <sup>99m</sup>Tc-tetrofosmin was injected at rest and imaging was started 60 minutes after radiopharmaceutical injection. The images were obtained using GE Millennium MG dual head  $\gamma$  cameras (General Electric Company, Fairfield, CT, USA) equipped with low energy general purpose and low energy high resolution collimators. The patients were in a supine position with a three-lead ECG attached for gating purposes. Imaging was acquired using an elliptical orbit with 72 projection data sets. The matrix size was 64  $\times$  64 pixels, with a zoom of 1.33 and a 20% symmetrical energy window centered over the 140 keV photopeak. Processing of the images was done using filtered back projection techniques. A Butterworth filter with a cut-off frequency of 0.43 cycles/pixel and power of 7 were used. The quantitative gated SPECT program of Cedars Sinai was used to generate three-dimensional and tomographic images of the heart that were displayed in vertical long axis, horizontal long axis, and short axis. Visual analysis was performed by two expert readers who were blinded to the patients' clinical status at the time of evaluation. Any disagreement was resolved by consensus. Perfusion defects were categorized as mild, moderate, and severe perfusion defects and absent perfusion. Additionally, the

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