Does Squatting Worsen Lower Limb Ischemia in Patients with Peripheral Arterial Disease?

Gargeshwari Krishnamurthy Guru Raghavendra

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Abstract Peripheral arterial disease (PAD) is an important cause of morbidity and mortality in the world affecting up to 20% in people over 70 years of age. The prevalence is increasing in India due to combined effects of increased life expectancy, increased tobacco smoking and increased prevalence of diabetes mellitus. The aim of the study was to examine the hypothesis whether squatting posture reduces blood flow to lower limbs resulting in worsening of symptoms of lower limb ischemia in patients with PAD. 10 patients with arterial disorders due to thromboangiitis obliterans (TAO), atherosclerosis and diabetic macro vascular disease were selected for patients and were compared with 10 healthy volunteers as controls. Clinical examination and duplex scan of posterior tibial artery (PTA) and dorsalis pedis artery (DPA) performed in standing and squatting position in a clinical environment. They were asked about symptoms of numbness, ischemic pain and the results were noted. Results were tabulated and analysed using Microsoft Excel®. Members in the control group complained of numbness of both the limbs after a period of 30 min on an average. In the patients group, members while squatting complained of numbness in the involved limb within 5 min. They complained of ischemic pain in the involved limb within 10 min and developed numbness in the opposite limb in within 15 min. Posterior tibial artery and dorsalis pedis artery pulsations disappeared for the entire duration of squatting in both groups as confirmed by duplex scanning. It may be recommended that patients with established peripheral vascular disease

should avoid squatting position, even if it is for a very short period of time. It is desirable to advice such patients to use appropriate structures as supports which will allow them to work without squatting. This may also necessitate a change in occupation.

Keywords Peripheral arterial disease · Squatting · Ischemia reperfusion injury

Introduction

Peripheral artery disease (PAD) is an increasing health problem around the world. Several population-based studies have reported the prevalence to be between 6% and 18% over the age of 55 years [1–3]. PAD rises with age and has been found to be approximately 20% in people over 70 years of age [4] and up to 60% in the over 85 age group [2].

Prevalence of PAD is increasing in India because of the combined effect of increased life expectancy, tobacco smoking, and prevalence of diabetes mellitus. It equally affects people of both higher and lower socioeconomic strata; however, people belonging to lower socioeconomic strata have worse prognosis.

Most common occupation in rural India is agricultural work, which demands being in squatting posture for long durations (Fig. 1). Some of the other occupations that require squatting are carpentry, house-maid work, fabrication, and construction. It is also important to consider that only urban population has access to western commode. Squatting during evacuation has been reported to have health benefits [5]. As a result of all these factors, people with established diseases are required to assume squatting posture for some duration everyday.

G. K. G. Raghavendra (✉)
Wansbeck General Hospital,
Ashington NE63 9JJ, United Kingdom
e-mail: drgkgururao@yahoo.com

Fig. 1 Typical squatting position

We hypothesized that squatting worsens lower limb ischemia by reducing blood flow through main arteries. This may result in ongoing ischemic injury with rapid worsening of the symptoms and poor outcome. This study aims to test this hypothesis.

Materials and Methods

Ten patients with arterial disorders due to thromboangiitis obliterans, atherosclerosis, and diabetic macrovascular disease were selected and were compared with 10 age and sex matched healthy volunteers taken as controls (Table 1). An initial clinical examination and duplex scan of posterior tibial artery (PTA) and dorsalis pedis artery (DPA) were

Table 1 Comparison between the patient and control group

	Patients <i>n</i> =10	Control <i>n</i> =10
Average age (Years)	58.7	57.4
Sex ratio (Male: Female)	6:3	7:3
Disease (Number)		
TAO ^a	5	N/A ^b
Diabetes	3	N/A ^b
Atherosclerosis	2	N/A ^b
Average times (in minutes)		
Numbness in affected leg	3.1	N/A ^b
Numbness in opposite leg	0.5	N/A ^b
Ischemic pain affected leg	7	N/A ^b
Total time squatting	13.2	33.7
Numbness in either	N/A ^b	30
Side in controls		

^a TAO=Thromboangiitis obliterans

^b N/A = Not applicable

performed in standing position for members of both the groups. Each member was then made to squat in a clinical environment. They were asked about the symptoms of numbness, ischemic pain, and the results were noted. PTA and DPA pulsations were examined in squatting position, and findings were confirmed by using duplex ultrasound examination using high-standard departmental vascular duplex machine. Results were tabulated and analyzed using Microsoft Excel (Fig. 2).

Results

Members in the control group, on squatting, complained of numbness in one or both the limbs at 30 min on an average. None of them complained of ischemic pain. PTA and DPA pulsations disappeared for the entire duration of squatting and were confirmed by the duplex ultrasound (Fig. 3). On returning to the standing position, the pulsations returned back promptly, but the numbness remained for 3–4 min.

Fig. 2 Flow chart of the methodology used. PAD = peripheral arterial disease; PTA = posterior tibial artery; DPA = dorsalis pedis artery

Fig. 3 Duplex scanning of artery in standing and squatting position demonstrating complete cessation of blood flow during squatting

Members in the patients group, on squatting, complained of numbness in the involved limb within 5 min. They complained of ischemic pain in the involved limb within 10 min and developed numbness in the opposite limb between 10 and 15 min. None of the patients were able to continue to squat after 15 min due to increasing severity of pain. In patients who already had clinically impalpable pulsations, the flow was confirmed to be absent with duplex scanning. In patients who had palpable clinical pulsations, the flow disappeared during the entire period of squatting and this was confirmed with duplex scanning (Fig. 3). On returning back to the standing position, the numbness and pain continued for some time before getting better.

Discussion

Squatting results in kinking of the femoral artery at the hip and the popliteal artery at the knee. This results in reduction, and possibly complete cessation, of blood flow to the lower limbs through these main arteries. In persons with healthy arterial system, the circulation is reestablished promptly once back in the normal position with no residual damage.

In patients with already compromised blood flow because of PAD, the squatting position leads to early development of numbness and ischemic pain. This might result in further ischemic insult to the peripheral tissues. The arterial anastomoses are also dilated to their maximum and cannot cope with increased demand for blood supply. Once the patient is back to the normal position, there is a possibility of ischemia reperfusion (IR) injury. This IR injury is well known and is mediated by superoxide and adenosine [6]. This cycle of events may result in further

damage to the already compromised tissues and accelerate the disease with each and every episode of squatting.

This study demonstrates that there is absence of blood flow in peripheral arteries during the entire period of squatting, as confirmed by the duplex scan. This might explain why the disease progresses more rapidly in people belonging to low socioeconomic strata. There may be other factors such as less access to health facility and inability to adapt to a change in occupation.

Conclusions

This study shows that squatting position reduces blood flow through the main arteries of the lower limbs. This results in the early onset of symptoms in patients with established peripheral arterial disorders. It may be recommended that these patients should avoid squatting position, even if it is for a very short period of time.

It is desirable to advise such patients to use appropriate structures as supports, which will allow them to work without squatting. This may also necessitate a change in occupation. A larger study is required to confirm our findings with examination at tissue level as to the extent of damage in the tissues during the squatting episodes. This will help in better management of the patients with PADs.

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