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Peripheral pulse palpation: an unreliable physical sign

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Fifty observers, including two fully trained vascular surgeons, were asked to determine the presence or absence of the femoral and distal pulses of four patients with peripheral vascular disease and one asymptomatic subject (50 pulses assessed). Pulses felt by both vascular surgeons were deemed to be palpable. Among the other observers, the sensitivity of palpation was 95% or over for the femoral pulse, but 33% to 60% for observers of varying experience feeling for the posterior tibial pulse. Up to 20% false-positive observations were reported. Disease was diagnosed in over 10% of examinations of healthy limbs and was missed in over 10% of symptomatic limbs. The accuracy of pulse palpation was strongly correlated with the systolic blood pressure in the underlying artery. Accuracy was greater among more experienced observers, suggesting that careful teaching of this skill is likely to be beneficial. Even so, pulse palpation alone is an unreliable physical sign and should only be used in combination with objective measurements as a guide to clinical management.

Despite the availability of numerous invasive and non-invasive methods of assessing peripheral vascular disease, the decision to refer a patient with symptoms suggestive of ischaemia for a vascular opinion still depends to a large degree on the presence or absence of palpable peripheral pulses. Palpation of the pulses is also an essential part of the specialist assessment of arterial disease and may influence decisions on investigation and management.

Previous studies have demonstrated that the dorsalis pedis pulse is impalpable in 3.1% to 13.8% of young adults and the posterior tibial pulse in 0% to 2.6% *(1–3)*. Doppler ultrasound examination has shown that the dorsalis pedis is genuinely absent in up to 1.9% of normal subjects, but failure to detect a posterior tibial signal is rare. Lack of symptoms and the presence of other pulses rule out the possibility of arterial disease in these circumstances.

A considerable lack of agreement between observers in the detection of peripheral pulses has also been shown, both in healthy subjects and in patients with arterial disease *(1,4,5)*. These studies used a small number of relatively experienced observers and no attempt was made to compare palpability with an objective measurement such as pulse pressure.

Patients with acute or chronic ischaemia may present initially to doctors who have no specific vascular training, including general practitioners, diabetologists and traumatologists. Our experience in teaching medical students and junior doctors suggests that many have difficulty in assessing the pulses reliably. This study aims to determine the accuracy with which a large number of observers of varying degrees of experience can detect peripheral pulses and to relate palpability to arterial pressure.

Patients and methods

The femoral, popliteal, anterior tibial, posterior tibial and dorsalis pedis pulses were assessed in both legs of four patients with peripheral vascular disease and one asymptomatic patient (five symptomatic legs) by 50 observers. The observers comprised two consultant vascular surgeons, 18 other surgeons or surgical trainees, 5 non-surgical specialists, 10 junior doctors (within 4 years of graduation) and 15 medical students. All the assessments were completed within a single 4-h period and the patients were at rest, semirecumbent, throughout.

The observers, who were not informed of the patients' symptoms, were asked to record on standard forms

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Table I. Arterial pressure mmHg (P), pressure index (I) and expert opinion regarding palpability (X) for each pulse in the study. S = symptomatic leg

			Popliteal			*Anterior tibial*			*Posterior tibial*			*Dorsalis pedis*		
Patient	*Side*	*Femoral X*	*P*	*I*	*X*	*P*	*I*	*X*	*P*	*I*	*X*	*P*	*I*	*X*
1	Right S	+	125	0.82	−	98	0.64	−	0	0	−	98	0.64	−
	Left	+	150	0.99	+	120	0.80	+	124	0.81	+	110	0.72	+
2	Right S	+	115	0.83	−	0	0	−	85	0.62	−	0	0	−
	Left S	+	60	0.43	−	65	0.47	−	0	0	−	85	0.62	−
3	Right	+	240	1.07	+	220	0.98	+	240	1.07	+	220	0.98	+
	Left S	+	110	0.49	+	75	0.33	−	120	0.53	+	110	0.49	−
4	Right	+	130	1.05	+	125	1.01	+	90	0.73	−	85	0.69	+
	Left	+	130	1.05	+	90	0.73	+	90	0.73	−	100	0.81	+
5	Right S	−	95	0.53	−	85	0.48	−	85	0.48	−	70	0.39	−
	Left	+	160	0.90	+	140	0.79	+	145	0.81	+	140	0.79	+

whether each pulse was present or absent, without qualification. There was no limit on the time allowed for assessment. Collusion between observers was strongly discouraged.

The systolic blood pressure in the vessels palpated was measured by the authors using appropriately sized sphygmomanometer cuffs and a continuous wave Doppler ultrasound probe. The Doppler pressure in the right arm of each patient was also measured and a pressure index was calculated for each pulse as the ratio between the systolic blood pressure and radial artery pressure.

Results

The two consultant vascular surgeons agreed over the palpability of 48 of the 50 pulses. They disagreed over one anterior tibial pulse (Doppler pressure 85 mmHg) and one dorsalis pedis pulse (Doppler pressure 70 mmHg). Their findings were consistent with the presence or absence of peripheral vascular disease in all of the limbs. Pulses which were felt by both were regarded as being present. The Doppler pressure, pressure index and expert opinion relating to each of the pulses are set out in Table I

Using the vascular surgeons' opinion as a reference, the sensitivity and specificity of pulse palpation by all other surgeons, all other doctors and medical students

Table II. Sensitivity and specificity of palpation in assessing peripheral pulses

	Surgeons		*Doctors*		*Students*	
	Sens	*Spec*	*Sens*	*Spec*	*Sens*	*Spec*
Femoral	98	100	97	75	95	80
Popliteal	77	94	66	75	68	85
Anterior tibial	69	93	62	93	51	84
Posterior tibial	60	98	54	87	33	80
Dorsalis pedis	82	86	77	87	59	76

Table III. Overdiagnosis (no popliteal or distal pulses felt in asymptomatic leg) and underdiagnosis (popliteal or distal pulses felt in leg where none present) of peripheral vascular disease (% assessments)

	Surgeons	*Doctors*	*Students*
Overdiagnosis	11	12	17
Underdiagnosis	12	14	40

Table IV. Correlation coefficients between Doppler pressure (P) or pressure index (PI) and proportion of positive observations

	Surgeons		*Doctors*		*Students*	
	P	*PI*	*P*	*PI*	*P*	*PI*
Popliteal	0.716	0.732	0.733	0.726	0.628*	0.665**
Anterior tibial	0.589**	0.707	0.677	0.764	0.621*	0.824
Posterior tibial	0.882	0.723	0.899	0.748	0.660**	0.607*
Dorsalis pedis	0.647**	0.590**	0.675	0.713	0.457^0	0.549*

0 = not significant; * = $P<0.05$; ** = $P<0.01$. All other values, $P<0.001$. Students t test

Table V. Proportion of observers likely to feel pulse with Doppler pressure of 120 mmHg or more (%)

	Surgeons	*Doctors*	*Students*
Popliteal	69	68	60
Anterior tibial	69	61	52
Posterior tibial	50	46	70
Dorsalis pedis	95	93	70

was calculated (Table II). Over 10% of the assessments diagnosed peripheral vascular disease (absent popliteal and distal pulses) in asymptomatic limbs and popliteal or ankle pulses were reported in over 10% of assessments of limbs where these were absent (Table III).

Correlation coefficients between pulse pressure and palpability were calculated for each palpation site in the same three groups of observers (Table IV). There was a statistically significant correlation in all cases, except for medical students palpating the dorsalis pedis pulse. A similar correlation was found between pressure index and palpability.

Using the regression equation, it was possible to calculate the proportion of observers in each group who might be expected to feel a pulse at each of the five sites when the pulse pressure was 120 mmHg. These results are set out in Table V.

Discussion

Palpation of peripheral pulses remains an essential element in the assessment of arterial disease and may influence management. In acute ischaemia, failure to detect a femoral pulse may lead to an inappropriate emergency operation, while false-positive palpation of distal pulses in an injured limb may have disastrous consequences. Mistaken assessment of the pulses may also lead to unnecessary investigations.

The high degree of consistency between the trained vascular surgeons and the correspondence between their findings and the presence of symptomatic peripheral vascular disease suggests that their assessment is reliable. This study has shown that even surgical trainees and surgeons who are not vascular specialists fail to detect 23% of palpable popliteal pulses and 40% of posterior tibial pulses. Among doctors in general and medical students, the proportions are even higher. Meade *et al. (4)* and Lawson *et al. (6)* found that interobserver agreement improved with experience, though this was not confirmed by others *(1,5)*. Our results suggest that performance does improve with training and experience, an observation which has educational implications.

The most difficult pulse to feel, as indicated by the lowest detection rate, was the posterior tibial. This is in agreement with the findings of Lawson *et al. (6)* and is probably attributable to the relatively deep situation of the artery, particularly when there is swelling around the ankle. False-positive palpation was, however, commonest for the dorsalis pedis pulse. Twitching of an extensor tendon in this area is well recognised by vascular surgeons as a possible cause of confusion.

Our study is the first in which pulse palpability has been related to arterial pressure. As expected, there is a significant correlation between pressure and palpability for all pulses, but extrapolation of the regression line suggests that a substantial proportion of observers will fail to detect a pulse even when the arterial pressure and pressure index are close to normal. This may be due to rigidity of the arteries in patients with established arterial disease or to damping of the pulse wave as a result of proximal stenosis, but poor technique is probably an important consideration.

This study shows that assessment of the peripheral pulses by inexperienced observers is unreliable, with no distal pulses being found in over 10% of examinations of asymptomatic limbs and pulses being reported in over 10% of examinations of limbs in which none were present. Pulse assessments recorded in patients' notes by junior doctors may be misleading and should not be relied upon. In planning the investigation and management of patients with symptoms suggesting peripheral vascular disease, pulse assessments should be used only in combination with blood pressure measurements or other objective criteria.

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