THE PULSELESS CLUB FOOT

JACOB G. EDELSON, NAJAH HUSSEINI

From the Soroka Medical Center, Beer-Sheba

Previous reports have suggested that the blood supply derived from the anterior tibial artery is absent or markedly diminished in 85% of severe, untreated club feet. To investigate these claims, we used a Doppler technique to study the arterial pulses in 40 children with 63 club feet. In feet with mild or moderate deformities the anterior tibial pulse was always present; in feet with severe deformities it was absent in two out of 30 feet in children under three years and in seven out of 18 feet in children over three years.

These results confirm that the incidence of pulselessness increases with the severity and duration of deformity, but not to the extent previously suggested by angiographic studies. The significance of these findings is discussed.

It has been suggested that in the great majority (85%) of patients with severe, untreated club feet the anterior tibial artery is absent in the foot (Ben-Menachem and Butler 1974; Greider et al. 1982; Hootnick et al. 1982). Such a supposition, if correct, has undoubted relevance to the operative treatment of club foot, since the currently popular and extensive posteromedial release mobilises the posterior tibial artery widely and could thus jeopardise the principal remaining blood supply to the foot. Furthermore, the anterior tibial artery and its distal continuation, the dorsalis pedis, normally make significant contributions to the blood supply of the talus and to the adjacent medial soft tissues (Haliburton et al. 1958; Mullfinger and Trueta 1970). Deformity of these latter structures is greatly held to be the significant pathology in club feet (Irani and Sherman 1963; Settle 1963; Shapiro and Glimerich 1979; Ippolito and Ponseti 1980; Coleman 1983). Consistent absence of the dorsalis pedis at a formative stage could therefore be an important factor in the aetiology of club foot.

One wonders why such a significant and straightforward abnormality should have been missed over the many years of investigation into club foot, and why a majority of investigators should specifically have said that the extra-osseous blood supply to the area was normal (Irani and Sherman 1963; Waisbrod 1973; Shapiro and Glimerich 1979). The discrepancy may lie in the fact that the angiographic studies suggesting an abnormal blood supply were done on older children (average age 6.3 years), whereas the studies suggesting normal vascularity were based on dissections of stillborn or very young children. Pulselessness in the older patients may therefore be a late adaptive response to a longstanding deformity, such as has been described in other conditions (Kovinsky 1970; Ogden 1978).

Our present study was designed to clarify the situation by examining both very young children and neglected club feet in older children using a non-invasive and reproducible technique.

MATERIAL AND METHOD

Arterial pulses in the foot and ankle were investigated in 40 patients (63 feet) with typical talipes equinovarus using a Doppler technique (Wilgis et al. 1974). The age range was from 1 week to 12 years.

The deformities were graded as mild, moderate or severe; the majority were severe, or "resistant" (Attenborough 1966; Lehman 1980). A significant number of neglected cases were included because of the nature of our patient population. No children with arthrogryposis, myelomeningocele or neuromuscular abnormalities were included.

The majority of cases were treated initially with casting. However, to date, 18 of the children (33 feet) have undergone posteromedial release (Turco 1979) for unremitting deformity.

Each patient was examined by us on at least two occasions. Children undergoing operation were examined under general anaesthesia.

A search was made for the three major vessels of the lower leg using a Doppler blood flow detector (MedaSonic Model BF4A or MedaSonic "Vascubal" P92A bi-directional probe with two-channel chart recorder model R12B). The dorsal pedal pulse was detected at the ankle (Fig. 1) and at the midtarsal level over the anteromedial aspect of the foot. The posterior tibial vessel was sought 1 cm proximal to and 1 cm posterior to the medial malleolus; and the peroneal vessel 1 to 3 cm proximal to the fibula along the posterior border.
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RESULTS

An anterior tibial pulse was present in all 15 of the club feet with mild or moderate deformity. In children under the age of three years with severe deformity, the anterior tibial pulse was also present in all but two of the 30 club feet. The two pulseless feet (6.7%) were in boys aged 6 and 18 months respectively; both boys had bilateral disease but only the more severe side was pulseless.

Pulselessness was recorded in a significantly higher proportion of severely affected feet in children over the age of three years (average age 5.4 years); seven (38.9%) of 18 feet in this group had no anterior tibial pulse. However, in the remaining 11 feet the pulses were completely normal (Fig. 1).

Posterior tibial and peroneal pulses were present in every case. A lateral or peroneal variant of the dorsalis pedis artery, well described in the literature (Hollingshead 1958), was encountered in four feet (6.3%) and consisted of a laterally displaced pulse at the ankle converging somewhat more distally than usual (at the mid-foot) to resume the normal pattern.

Controls. The posterior tibial and peroneal pulses were present in both feet in all 40 control patients. The anterior tibial pulse was absent in three feet (3.2%), and a lateral variant was present in five (6.3%).

DISCUSSION

The anterior tibial artery is the most variable of the three vessels of the lower leg. It is composed of a confluence of small anastomotic connections and is formed after the posterior tibial and peroneal vessels at a relatively late stage of gestation (Patten 1953).

In normal feet ultrasound studies have failed to detect an anterior tibial artery in only 2.2% (Chavatzas 1974); dissection studies suggest an absent or severely diminished vessel in a somewhat greater number (Hollingshead 1958). In contrast, the posterior tibial and peroneal vessels are almost invariably present (Hollingshead 1958). Our control group findings are therefore within the normal range.

Absence of the distal portions of the anterior tibial artery in 85% of neglected club feet, as suggested by previous reports based on angiography, is a striking variation from the norm. We cannot confirm this figure; however, our results do show the same tendency, with a considerable increase in pulselessness correlated with severity of disease and neglect of treatment. Population variables, small sample size or the occasional vagaries of angiographic technique may account for the discrepancy between our results and those of other workers.

We found no increase in pulselessness in children with mild or moderate club feet at any age. In children under the age of three years with severely affected feet, an increased incidence over control values was noted (6.7% as opposed to 3.2%) but this was not statistically significant.

Hence it would appear that dorsal pedal pulselessness represents a secondary adaptive change to severe and long-term deformity; consequently, it is probably without aetiological significance in the development of club foot. An analogy may be drawn with the luminal closure of the medial femoral circumflex artery of the hip due to its gradual stretching in cases of high-riding and neglected congenital dislocation of the hip (Kovinsky 1970; Ogden and Moss 1978).

The vascular situation in the foot may, nevertheless, be of immediate practical significance to the surgeon. We have confirmed that a large number, albeit not a preponderance, of older children with severe club feet lack a dorsal pedal vessel. As such they will be especially vulnerable to operative procedures which might compromise the remaining posterior tibial supply. A simple, non-invasive Doppler examination of children in this category will prove a worthwhile precaution to the surgeon who is faced with the late treatment of severe club foot.
REFERENCES


Chavatzas D. Revision of the incidence of congenital absence of dorsalis pedis artery by an ultrasonic technique. Anat Rec 1974;178:289-90.


