Accuracy of the Ankle-Brachial Index in the Assessment of Arterial Perfusion of Heel Decubitus Ulcerations

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Statement of Purpose and Literature Review

The development and treatment of decubitus ulcerations are a significant and expensive sequela of the aging population. Specific to the lower extremity, this is particularly true in those that are non-ambulatory, those that are bedridden for any period of time, and in the presence of certain co-morbidities including peripheral arterial disease and diabetes mellitus. Part of the initial clinical work-up of any patient with lower extremity tissue loss involves an assessment of the arterial blood flow by means of non-invasive vascular testing (ankle-brachial index [ABI] and pulse volume recording). Unfortunately however, this may be misleading in patients with heel decubitus ulcerations if the ABI provides information primarily about arterial flow to the dorsum of the foot instead of the posterior heel, or in the presence of vessel calcification leading to falsely elevated results.

The objective of this retrospective, observational investigation was to determine if non-invasive vascular testing provides accurate and reliable results in patients with heel decubitus ulcerations.

Methodology

Following approval by our institution’s IRB, we performed a retrospective chart review of consecutive inpatients with heel tissue loss consistent with decubitus ulcerations and with consultation by the Foot and Ankle Surgery service. Demographic patient information was collected in addition to the side and location of the ulceration. If available, non-invasive vascular testing results were evaluated for the presence of any non-compressible readings and differences in calculation of the ABI based on the anterior tibial artery vs. the posterior tibial artery.

References

Ninety-two decubitus ulcerations in 83 patients meeting inclusion criteria were identified over the 12-month data collection period. Thirty-six (43.73%) of the 92 were right-sided ulcerations, 38 (45.83%) of the 92 were left-sided ulcerations, while 9 (10.84%) patients had bilateral lesions. The mean ± SD (range) age was 60.47 ± 15.18 years (28-90 years). Forty-three (51.81%) of the 83 patients were male. Seventy-nine (95.28%) of 83 patients were diabetic and 20 (24.10%) of 83 were on hemodialysis. The location of the ulceration described as “plantar” in 29 (31.52%) of 92 feet, “posterior” in 20 (21.74) of 92 feet, “posterior-lateral” in 17 (18.48%) of 92 feet, “posterior-medial” in 5 (5.43%) of 92 feet, and was undocumented in 21 (22.83%) of 92 feet. An ABI was performed on 67 (80.72%) of the 83 patients with 75 (81.52%) of the 92 feet. A vascular surgery consultation was obtained on 37 (44.58%) of the 83 patients with performance of some type of arterial testing in 62 (74.63%) of 83 patients. Thirty-two (38.78%) of 83 patients had any type of vascular or podiatric procedure during their admission, and 8 (9.64%) of 83 underwent major limb amputation.

In terms of the specific ABI findings, non-compressible vessels were observed in 35 (46.67%) of the 75 feet. Twenty-six (34.67%) of 75 feet, just the PTA in 6 (8.0%) of 75 feet, and just the ATA in 3 (4.0%) of 75 feet. No digital pressure reading was observed in 36 (48.0%) of 75 feet. When at least one compressible vessel was observed allowing for calculation of the ABI (n=49), it was done based on the PTA in 23 (46.94%) of 49 feet and based on the ATA in 26 (53.06%) of 49 feet.

Discussion

We believe that the results of this study provide health care professionals working with heel decubitus ulcerations clinically relevant information which has the potential to affect medical decision making. Based on the specific results of this study, we primarily conclude that non-invasive vascular testing may be inaccurate and unreliable in many patients with heel decubitus ulcerations.

We found evidence of non-compressible vessels leading to no quantitative information or potentially falsely elevated results in 46.67% of feet. Further, in those patients with compressible vessels, we found that the ABI was calculated based on the anterior tibial artery (and thus not a direct measure of heel perfusion) in 53.06% of feet. Physicians are encouraged to consider the angiograms and direct arterial supply to an area of tissue loss, as opposed to a more general measure of foot perfusion.

Figures

Non-invasive vascular testing is often utilized in those patients in order to assess arterial inflow and outflow potential. For example, this test was performed on 31% of the patients in our retrospective series. However, these results may be inaccurate or unreliable in the presence of arterial claudication leading to non-invasive vascular testing in our series speaking to a large percentage of potentially unreliable results.

Further, by convention the ABI is reported as the higher value of the anterior tibial artery (ATA) or posterior tibial artery (PTA) at the ankle. Because of this, the ABI may not provide any direct information about the perfusion of the heel. Figure A above demonstrates an angiogram with a single vessel ATA run-off without appreciable PTA or posterior artery (PA). The reported ABI in this case would almost certainly be calculated based on the ATA which does not speak to the perfusion of the heel. Figure B presents another potential problem with the ABI. Here there is single vessel run-off through the PA which may supply the heel, but is not measured or recorded in standard non-invasive testing. Figure C demonstrates a case with ATA and PTA run-off. The heel is likely supplied through the ATA, but the ABI would most likely be reported based on the ATA. In our series of 92 feet with tissue loss involving the posterior heel or other personal angiosomes, the ABI was reported based on the ATA 53% of the time speaking to a large percentage of potentially inaccurate results.

Results

Heel tissue loss involves a large percentage of patients with underlying arterial insufficiency. In our series of 92 feet with heel tissue loss, 83 patients were male. Seventy-nine (95.28%) of 83 patients were diabetic and 20 (24.10%) of 83 were on hemodialysis. The location of the ulceration described as “plantar” in 29 (31.52%) of 92 feet, “posterior” in 20 (21.74) of 92 feet, “posterior-lateral” in 17 (18.48%) of 92 feet, “posterior-medial” in 5 (5.43%) of 92 feet, and was undocumented in 21 (22.83%) of 92 feet. An ABI was performed on 67 (80.72%) of the 83 patients with 75 (81.52%) of the 92 feet. A vascular surgery consultation was obtained on 37 (44.58%) of the 83 patients with performance of some type of arterial testing in 62 (74.63%) of 83 patients. Thirty-two (38.78%) of 83 patients had any type of vascular or podiatric procedure during their admission, and 8 (9.64%) of 83 underwent major limb amputation.

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