6. Peripheral Arterial Waveform Descriptors: Absent, Vague, and Contradictory

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PURPOSE: Doppler waveform characterization and its meaning are basic to the education of vascular surgeons and ultrasound professionals. Normal waveforms are described as triphasic. As arterial disease compromises blood flow, waveforms become biphasic, then monophasic. Recent surveys of ultrasound professionals indicate major inconsistencies regarding definitions and characteristics of waveforms. The purpose of this study is to identify this confusion and propose a potential solution.

METHODS: Ultrasound and vascular surgery reference books and arterial waveform publications were reviewed to: 1) determine whether waveforms were defined; 2) verify that waveform descriptors were clearly stated; 3) document whether diastolic flow reversal was associated with a biphasic waveform; 4) examine evidence linking pandiastolic flow to biphasic or monophasic waveforms; and, 5) examine whether waveforms are defined despite the absence of a zero-flow reference point. Publications focused only on quantitative waveform analysis were excluded from analysis.

RESULTS: A total of 80 publications were reviewed and 63 analyzed. Triphasic waveforms were used in 79% and specifically defined in 75%, biphasic used in 49% and defined in 30%, and monophasic used in 75% and defined in 46%. Diastolic flow reversal was associated with biphasic waveforms in only 37%; the relationship was unknown in 63%. Pandiastolic flow was linked to a biphasic wave in 13%, a monophasic wave in 24%, and had no known relationship in 63%. 27% percent of publications contained one or more illustrations without a zero-flow reference point.

CONCLUSIONS: Traditional peripheral arterial waveform descriptors were undefined in 21% of all publications. Biphasic waveforms were rarely defined, unreferenced, or absent in nearly half. While pandiastolic flow was more often associated with monophasic than biphasic terminology, this contradictory feature is missing in nearly two-thirds of the publications. Inconsistency and lack of standardization of waveform descriptors have led to widespread confusion and may contribute to a poor understanding of the pathology causing the waveform. We recommend that an authoritative vascular body assume the responsibility to properly define Doppler waveforms so that they properly reflect the underlying pathology.