DEPARTMENTAL MEMORANDUM

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COMPANY PRIVATE INFORMATION

TO: Ray Cherry

NO.: ENG-204-77

FROM: Dave Squires

DATE: 25 May 1977

SUBJECT: AMBULATORY PRESSUROMETER OPERATIONAL PROCEDURE

5-31-77
cc:
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cc: Don Anderson, Steve Shu

System Description

The Ambulatory Pressurometer System consists of the pressurometer itself together with its pressure cuff, microphone and carrying case, a modified 445 TAPE RECORDER, the Heart Rate/Pressure Trend module for the 660A, digital readout, battery charger, and associated leads and cables. A mercury column is also required for calibration.

The pressurometer automatically starts a measurement cycle every 15 minutes. Initially, the cuff is inflated to approximately 150 millimeters of mercury. Cuff pressure is then released in fixed, equal steps locked to heart rate. The first K sound detected stores current cuff pressure as systolic pressure. Subsequent K sounds update a second storage register with the current cuff pressure. When the absence of three consecutive K sounds is detected, the stored values of systolic and diastolic pressure are converted to a serial data stream and recorded on Channel 2 of the tape recorder. The cuff is then vented until the next measurement cycle.

On the second and following cycles, the pressure cuff is inflated to approximately 25mm of mercury above the last-determined systolic pressure. Measurement then proceeds as before.

In the absence of ECG signal from the tape recorder, the system defaults to a one step/2 seconds rate until K sounds are encountered. Step down then locks to the K sound rate until the diastolic point is reached. Three steps later (6 seconds), the measurement is complete and the cuff is vented.

In the event that cuff inflation is below the systolic measurement, the detection of a K sound results in immediate cuff pressure increase of $\sim$25mm of mercury. At least three consecutive heart beats must occur before a valid systolic measurement will be recognized.

Measurement cycles may be initiated or terminated at any time by depressing the pump/dump switch on the side of the instrument.

The tape recorder used is a modified Model 445 Electrocardiocorder. Both ECG and blood pressure are recorded by this instrument. Its operation is identical to the unmodified version, but provides a multiplexed ECG-DATA channel to record pressure on tape.

While in use, it provides ECG signals to the pressurometer for gating purposes and records pressure data. It may only be used with the special cable provided. Use of a standard 14464-103 patient cable has unpredictable results.

A digital readout is also provided. This unit provides 2-3 digit displays of systolic and diastolic pressure. It is required for calibration and may be used to check operation against mercury column readings.

For playback of the recorded tapes, a Model 660A Scanner is required. The Model 663 Heart Rate Trend module must be replaced with the 671 Trend module.

When the scanner is in the Trend mode, pressure data is written along with heart rate on the same scale of the trend chart. Each measurement is indicated by a 2-step pedestal indicating systolic and diastolic pressure respectively. The pressure scale is identical to the heart rate scale.

Limits on Usage

The pressurometer's criteria for systolic pressure is first K sound followed by a K sound. That is, there must be two consecutive K sounds for a valid systolic measurement. Criteria for diastolic is a valid systolic measurement and the consecutive absence of three K sounds.

For this reason, response to conditions of trigemeny, bigemeny and auscultatory gaps is subject to gross errors.

For bigemeny and trigemeny, the systolic pressure will be updated at lower pressures until two consecutive K sounds occur. The result is an artificially-low systolic pressure. If an ausculatory gap exists over a pressure range exceeding 8 millimeters of mercury, the device may determine a valid diastolic condition and end the measurement. The result is an artifically-high diastolic pressure. If the gap occurs following the systolic K sound, a new systolic point will be determined when K sounds reoccur and a low value of systolic pressure is recorded.

Terminating the cycle with the PUMP/DUMP switch does not eliminate the problem. The systolic register still contains a high value, and the following cycle will have excessive cuff inflation. A K sound must occur to update the systolic value.

The measurement system also has a criteria for accepting systolic pressure that no K sounds occur during the first 9 millimeters of the pressure release cycle. (Initial cuff pressure must exceed systolic pressure by at least 9mm/hg.) If a K sound occurs in this range, cuff pressure is increased ~25mm/hg.

If considerable artifact noise is encountered, cuff pressure may increase to 255mm/hg very quickly, resulting in very long measurement time and considerable discomfort. If a systolic measurement is determined that is actually well below the diastolic pressure, cuff inflation will never reach a point at which K sounds are recognized. The cycle will terminate after two minutes with no value recorded, and the following cycles will have identical results because the systolic storage register will never be updated. Recovery from these two conditions can be made by disconnecting the signal cable for ~15 seconds which restores initial cycle conditions.

In any case, maximum cuff pressure is limited to 255mm/hg; inflation must be complete in 16 seconds; and the complete measurement cycle must take less than two minutes to complete.

Dave Squires

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