

# ORTHOSTATIC BLOOD PRESSURE AND HEART RATE MEASUREMENT

## 1 Background and Purpose.

The purpose of the supine blood pressure measurement is to provide the requisite information for the calculation of echocardiographic parameters. The combination of supine, sitting, and standing blood pressures provide information on whether orthostasis is present, as well as indirect assessment of vascular reactivity. Previous work (1) has shown that orthostasis appears to be an independent risk factor for subsequent mortality in older adults. Work by Sparrow and colleagues has suggested that postural changes in blood pressure predict the incidence of sustained blood pressure elevation as well as myocardial infarction events (2, 3). Postural changes in heart rate and blood pressure have also been proposed as markers of cardiovascular reactivity, an area of current interest in the study of determinants of blood pressure elevation and cardiovascular morbidity, about which very little is known in older adults.

## 2 Definitions and Alerts

2.1 Blood pressure measurements for notification to study participants and/or their physicians are those obtained using the random zero sphygmomanometer in the sitting position. The measurements of supine heart rate and blood pressure, and their postural changes are of research value only and are not part of participant reports.

## 2.2 Equipment

- One standard stethoscope tubing and earpieces (suggest Litman) with bell
- One standard mercury column sphygmomanometer (Baumanometer), floor model
- Fiberglass measuring tape (cm)
- Large wall clock with second hand
- BP cuffs in four sizes:
  - 1 large adult cuff
  - 1 thigh cuff
  - 1 pediatric cuff
  - 1 regular adult cuff

## 3 Methods

### 3.1 Study Environment and Instrumentation

The supine blood pressure measurement and the measurements of postural change in heart rate and blood pressure are obtained at the end of the echocardiographic measurements. A portable floor model mercury sphygmomanometer is used for ease of access and for safety of the participant. A clock or digital timepiece is located in clear view of the echocardiographer; a solid chair without arms is kept in the room, and is placed within easy reach of the echocardiography table.

### 3.2 Cuff Size

The same cuff size used for the random zero seated blood pressure measurement is used for the supine and standing measurements. The appropriate cuff size is determined from the table presented in section 3.1 of the baseline random zero seated blood pressure and heart rate measurement and is repeated here.

Table 1

CUFF SIZE INDICATED BY MEASURED ARM CIRCUMFERENCE

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<u>ARM CIRCUMFERENCE (cm)</u>	<u>CUFF BLADDER SIZE (cm)*</u>
Up to 5.9	2.5 ("newborn")
6.0 to 15.9	6.5 ("infant")
16.0 to 22.5	9.0 ("child" or "pediatric")
22.6 to 30.0	12.0 ("adult" or "regular")
30.1 to 37.5	15.0 ("large arm")
37.6 to 43.7	17.5 ("thigh")

The technician at the first station where blood pressure is measured records the cuff size in the participant's folder for use at the other work station requiring the selection of the cuff size.

The technician performing the orthostatic blood pressure measurements must be trained in the appropriate technique for measurement of the arm circumference and selection of cuff size.

### 3.3 Application of the Blood Pressure Cuff

The cuff is applied while the participant is on the examination table and prior to starting the echocardiographic examination.

- Place the appropriate cuff around the upper right arm so that:
  - The midpoint of the length of the bladder lies over the brachial artery, and
  - The mid-height of the cuff is at heart level.
- Place the lower edge of the cuff, with its tubing connections, about 1 inch above the natural crease across the inner aspect of the elbow.
- Wrap the cuff snugly about the arm, with the palm of the participant's hand turned upward.
- Secure the wrapped cuff firmly by applying pressure to the locking fabric fastener over the area where it is applied to the cuff.
- Do not wrap the cuff too tightly around the arm.

### 3.4 Determining the Maximal Inflation Level

For each participant determine the maximal inflation level, the pressure to which the cuff is to be

inflated for systolic blood pressure measurement. This assures that the cuff pressure at the start of the reading exceeds the systolic blood pressure and thus allows the first Korotkoff sound to be heard.

The procedures for determining Maximal Inflation Level are as follows:

- Attach the cuff tubing to the sphygmomanometer.
- Palpate the radial pulse.
- Inflate the cuff rapidly until the radial pulse is no longer felt (palpated systolic) by inflating rapidly to 70 mm Hg, then inflating by 10 mm Hg increments.
- Deflate the cuff quickly and completely.
- Inflate the cuff to 30 mm Hg above the palpated systolic pressure for all readings (maximal inflation level).

### 3.5 Guidelines for Blood Pressure Readings

- All readings are made to the nearest even digit.
- Any reading which appears to fall exactly between markings on the mercury column should be read to the next higher marking i.e., 2, 4, 6, 8 or 0.
- All readings are made at the top of the meniscus, or rounded surface of the mercury column.
- When the pressure is released quickly from a high level, a vacuum is formed above the mercury and the meniscus is distorted. Allow a few moments for it to reappear before reading the manometer.

### 3.6 Heart Rate Measurement

Part of the blood pressure measurement procedure is radial pulse measurement. This measurement serves two purposes: (1) to document the resting heart rate at the time of examination; and (2) to permit detection of gross irregularities of heart rhythm which may affect interpretation of the blood pressure readings.

- Palpate the radial pulse with the palm of the hand turned upward and count for exactly for 30 seconds.
- Record the number of beats in 30 seconds.

### 3.7 Blood Pressure Readings

The design and operation of the standard mercury sphygmomanometer are based upon the combined principles of compression of the brachial artery under an elastic, inflatable cuff; and direct registration of pressure levels by a mercury manometer. The observer inflates the cuff, listens for the first (systolic) and the last (diastolic) Korotkoff sounds, reads the mercury level in the column, deflates the cuff, and records the readings. The last Korotkoff sound is known as the V Phase, DBP.

Detailed instructions are given below for measuring blood pressure with a standard sphygmomanometer.

- Wait at least 30 seconds after complete deflation of the cuff, following any preceding inflation.
- Place the earpieces of the stethoscope, with the tips turned forward, into the ears.
- Apply the bell of the stethoscope over the brachial artery, just below but not touching the cuff or tubing. The brachial artery is usually found at the crease of the arm, slightly toward the body.
- By closing the thumb valve and squeezing the bulb, inflate the cuff at a rapid but smooth, continuous rate to the maximal inflation level. The eyes of the observer should be level with the mid-range of the manometer scale and focused at the level to which the pressure will be raised.
- By opening the thumb valve slightly, and maintaining a constant rate of deflation at approximately 2 mm per second, allow the cuff to deflate, listening throughout the entire range of deflation, from the maximum pressure past the systolic reading (the pressure where the first regular sound is heard), until 10 mm Hg below the level of the diastolic reading (that is, 10 mm Hg below the level where the last regular sound is heard).
- Deflate the cuff fully by opening the thumb valve; the stethoscope earpieces are removed from the ears; and the systolic and diastolic readings are entered in the spaces provided on the form.
- Remove the cuff and store the equipment safely after the last reading.

### 3.8 Supine Heart Rate and Blood Pressure Measurement Procedures

- At the end of the echocardiographic measurement, place the participant in the full supine position.
- Tell participant that a blood pressure measurement will be taken before s/he will sit on the examination table.
- Participant should not move other than to adjust into a comfortable position. (Movement of limbs contributes to elevated heart rate and blood pressure.)
- Tell participant that the first blood pressure measurement will be tighter than the ones following.
- Measure the heart rate.

- Record the heart rate and start time for the measurement of postural changes on the study form.
- Obtain the maximal inflation pressure.
- Obtain blood pressure measurement.
- Record the blood pressure on the study form.

### 3.9 Standing Heart Rate and Blood Pressure Measurement Procedures

- Tell the participant that s/he will be assisted to sit on the examination table for a short time before standing up.
- Arrange the cuff tubing to prevent them from pulling.
- Indicate to which side the participant should lower his/her legs and support the participant into the sitting position.
- Ask the participant not to talk other than to express any discomfort.
- Explain that as soon as s/he is ready, the participant will stand up and remain standing for three minutes in order to obtain one final blood pressure.
- Bring the Mayo stand close to the seated participant's right side and adjust it such that the participant's right arm rests slightly below the heart level.
- Verify that the cuff hoses and the ECG cable will not be entangled with the participant's limbs when assuming the upright position.
- Ask the participant to stand up offering as much support as needed.
- Ask participant to stand still, close to the examination table, without touching it.
- Script: Are you feeling any dizziness, lightheadedness or faintness?
  - Code "Y - Yes" when the participant reports any of the symptoms noted.
 

When participant reports "Y - Yes", have the participant sit down immediately and forego measurement of standing blood pressure. Participant should be asked to stand slowly when symptoms have resolved.
  - Code "N - No" when the participant did not report any of the symptoms noted.

- To prevent the blood pressure cuff from sliding, participant's arms are kept flexed at the elbow and relaxed, with hands clasped loosely and resting against the abdomen.
- Remind participant that s/he will be standing upright for three minutes and to tell the technician when s/he is feeling unwell or tired.
- Bring the Mayo stand close to the participant and adjust it according to his/her height, slightly below heart level.
- Measure the heart rate after two minutes and 25 seconds have elapsed since standing.
- Position arm on the Mayo stand.
- Record heart rate and time.
- Hold the participant's arm over his/her head for five seconds.
- Measure the standing blood pressure.
- Record standing blood pressure.

### 3.10 Conclusion of Procedure

- Seat participant on the chair.
- Switch off the ECG.
- Remove the cuff and the ECG leads.
- Clean any remaining coupling material off the skin.
- Assist participant into examination garment.
- Escort participant to the next work station.
- Transcribe the supine blood pressure from the blood pressure form onto the ECHO Log Sheet.
- Close-out echocardiography examination procedures.

### 3.11 Participant Safety Measures for Orthostatic Blood Pressure Measurement

- Prior to assisting participant to standing position, notify the participant that when

s/he feels dizzy to lean backwards against the examination table and ask for assistance. This is the time of highest risk of orthostatic symptoms.

- To enhance participant safety the examiner remains close by the entire three minutes and observes participant's alertness to verify visually that s/he tolerates the upright position well.
- When there appear to be any symptoms of dizziness or fainting, or when in the judgment of the examiner the participant is unstable, seat the participant and obtain remaining measurements in the sitting position.
- When the participant continues to feel dizzy or is fainting, support participant under the arms and place him/her on the floor.
- Notify another staff person that assistance is required and immediately return to the participant.
- Elevate and support participant's feet in a 20 degree angle from the floor.
- Obtain a heart rate and blood pressure measurements.
- After the nurse-practitioner/physician assistant (or other qualified personnel) have attended to the participant's safety and comfort, log the incident on the study form. This will provide a record of the occurrence, and indicate the participant's position (standing/sitting) when the measurements were obtained.

#### 4           **References**

- (1) Davis BR, Langford HG, Blaurock MD, et al. The association of postural changes in systolic blood pressure and mortality in persons with hypertension: The Hypertension Detection and Followup Program Experience. Circulation 75:340-346, 1987.
- (2) Sparrow D, Toffler CP, Rosner B, Weiss ST. Postural changes in diastolic blood pressure and the risk of myocardial infarction: The Normative Aging Study. Circulation 70(4):533-537, 1984.
- (3) Sparrow D, Rosner B, Vokonas V, Weiss ST. Relation of blood pressure measured in several positions to the subsequent development of systemic hypertension: The Normative Aging Study. American Journal of Cardiology 57:218-221, 1986.