Series Editor: Bernard Karnath, MD

Inspection of Neck Veins

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The bedside examination of neck veins can provide valuable diagnostic information about a patient's cardiopulmonary status. An inspection of the neck veins involves an evaluation of their physical appearance, an analysis of the venous pulse, and an estimation of central venous pressure (CVP). The right internal jugular vein is typically the best neck vein to inspect in most patients.

Jugular venous contours and the presence of jugular venous distention can provide information about underlying cardiopulmonary diseases. For example, the finding of jugular venous distention is highly sensitive and specific in the assessment of left heart pressures in patients with congestive heart failure.[1] Moreover, an estimation of CVP, which reflects cardiac function, can be made by way of a determination of jugular venous pressure[2]; an estimation of CVP and an analysis of the jugular venous pulse provide information mainly about physiologic events in the right atrium and right ventricle of a patient's heart.

This article briefly reviews anatomic considerations relevant to the jugular veins and discusses characteristics of the jugular venous pulse, jugular venous pressure, and CVP. It also describes methods of examining the pulse of the jugular veins and techniques for estimating CVP, as well as ways in which abnormal findings may be interpreted.

INSPECTION OF NECK VEINS

Jugular Venous Pulse
Best observed in right internal jugular vein
Accentuated by shining a flashlight obliquely across the neck
May be necessary to adjust the angle of the patient's trunk so that the jugular venous pulse is brought into view

Central Venous Pressure
Often estimated from jugular venous pressure
Sternal angle used as external reference point by a common measurement method
Phlebostatic axis of the midaxillary line used for direct measurement by a more reliable method

ANATOMIC CONSIDERATIONS

The internal jugular veins are located deep beneath the sternocleidomastoid muscle, lateral to the carotid arteries (**Figure 1**); they are not visible in many patients, except in those with conditions causing elevated venous pressure. The pulsations of the veins, however, are transmitted through the skin.

The external jugular veins are lateral to the internal jugular veins and are superficial (Figure 1). They lie over the sternocleidomastoid muscle. They too are easily identifiable in patients with elevated venous pressure. Some clinicians recommend not using the external jugular veins for detailed examinations[3]; however, others have gained some useful information by examining the vessels.[4,5]

JUGULAR VENOUS PULSE

General Characteristics

In a tracing of the normal jugular venous pulse, 2 positive waves (the *a* wave and the *v* wave) and 2 negative waves (the *x* wave and the *y* wave) are usually observable (**Figure 2**). The *a* wave is produced by right atrial contraction. The *v* wave is produced by passive right atrial filling late in systole or by ballooning of the tricuspid valve during right ventricular contraction.

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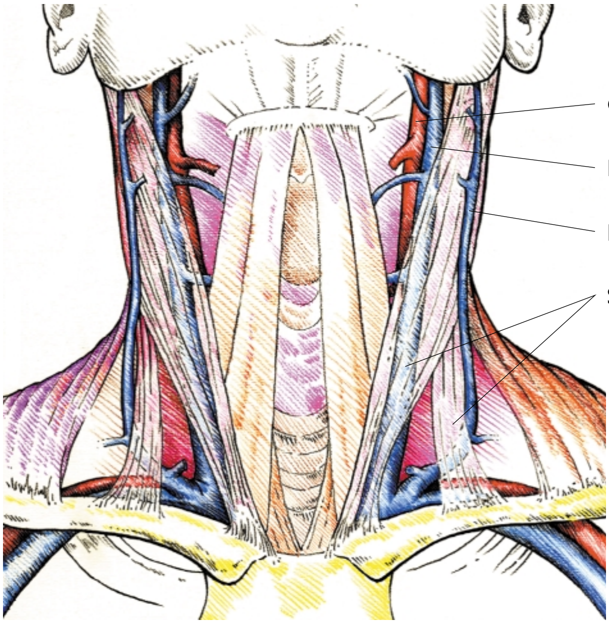

Figure 1. Anatomic location of the internal and external jugular veins. The internal jugular veins are located beneath the sternocleidomastoid muscle, lateral to the carotid arteries. The external jugular veins lie over the sternocleidomastoid muscle and are lateral to the internal jugular veins. Redrawn by DM Russell with permission from Ewy GA. Evaluation of neck veins. Hosp Pract (Off Ed) 1987; 22:73.

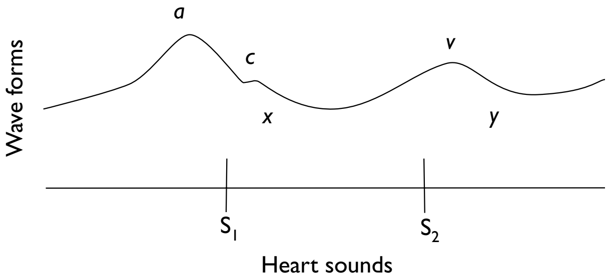

Figure 2. Waveforms of the jugular venous pulse.

The descending limb of the *x* wave (the *x* descent) and the descending limb of the *y* wave (the *y* descent) represent drops in pressure in the right atrium and right ventricle, respectively. The *a* wave is followed by the *x* descent; however, the *x* descent is sometimes preceded by another positive wave—the *c* wave, which is produced by tricuspid valve closure (Figure 2). The *v* wave follows the ascending limb of the *x* wave and is followed by the *y* descent.

Examination Techniques

Recommended steps in examining the jugular venous pulse are provided in **Table 1**. The jugular venous pulse is best observed in the right internal jugular vein with the patient's head turned away from the examiner. The jugular venous pulse can be accentuated by shining a flashlight obliquely across the neck. The angle of elevation of the head of the bed must be large enough for the highest point of pulsation of the jugular vein to be easily identified (usually 30 to 45 degrees). The jugular venous pulse is usually not visible when a patient sits in an upright position. When it is visible in a patient sitting in this position, it is a sign that venous pressure is elevated.

Occasionally, it may be difficult to differentiate venous and carotid arterial pulsations in the neck. In general, the venous pulse cannot be palpated because of its low pressure. If a pulse can be felt, it is likely that of the carotid artery. The jugular venous pulse waves should be timed by simultaneous palpation of the carotid arterial pulse; the *a* wave precedes the carotid arterial pulse, whereas the *v* wave closely follows the pulse. In general, the jugular venous pulse is seldom observed in healthy young patients, but it is often observed in elderly patients and in patients with diseases such as congestive heart failure.

Pulse Abnormalities

Large (or giant) *a* waves result from obstruction to active right ventricular filling during right atrial contraction. They occur in conditions such as pulmonary hypertension, pulmonic stenosis, and tricuspid stenosis (**Figure 3**).[6] Large *a* waves caused by right atrial contraction against a closed tricuspid valve or simultaneous contraction of the right atrium and right ventricle are termed cannon *a* waves; these waves occur in patients with atrioventricular dissociation (with complete heart block or ventricular tachycardia).[6] The *a* wave is absent in patients with atrial fibrillation. Large *v* waves result from tricuspid regurgitation (Figure 3).[6] An increased *x* descent can be observed in conditions that cause

Table 1. Recommended Steps in Examining the Jugular Venous Pulse

Adjust the angle of elevation of the head of the bed such that the right internal jugular venous pulse is brought into view.* The patient's head should be turned away from the examiner. It may be necessary to shine a flashlight obliquely across the neck.
Distinguish the jugular venous pulsations from the carotid arterial pulsations. The jugular venous pulsations are not palpable and vary with position.
Time the jugular venous pulse waves by simultaneous palpation of the carotid arterial pulse. The *a* wave precedes the carotid arterial pulse, whereas the *v* wave closely follows the pulse.

*The trunk of a patient is usually raised 30 to 45 degrees; however, the trunk of a patient with elevated venous pressure may need to be raised by as much as 90 degrees.

large *a* waves and also constrictive pericarditis. An increased *y* descent can be observed in conditions that cause large *v* waves and also constrictive pericarditis.

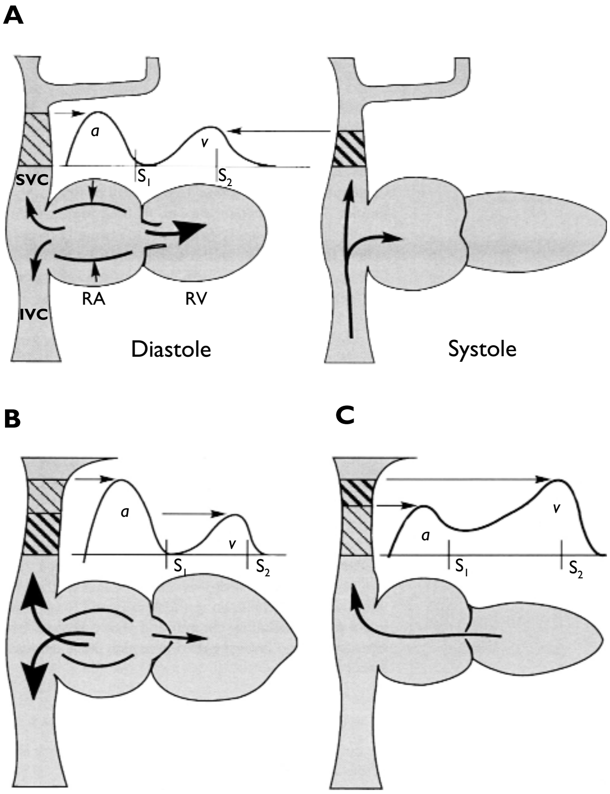

Figure 3. Schematic representation of heart structures, blood flow, and jugular venous pulse waveforms under normal (**A**) and abnormal conditions (**B** and **C**). (**B**) A giant *a* wave caused by tricuspid stenosis. (**C**) A large *v* wave caused by tricuspid regurgitation. IVC = inferior vena cava; RA = right atrium, RV = right ventricle; SVC = superior vena cava. (Illustration by S. Jones and W. Thornton)

JUGULAR AND CENTRAL VENOUS PRESSURE

General Characteristics

Jugular venous pressure reflects right ventricular filling pressure, and it remains the most reliable means of estimating CVP.[2] CVP is expressed in millimeters of mercury (mm Hg) or centimeters of water (cm H_2O).[4] (Note: 1.36 cm H_2O = 1.0 mm Hg.) In adults, normal CVP is typically in the range of 5 to 9 cm H_2O but can be as low as 2 cm H_2O.

Examination Techniques

The right internal jugular vein should be used to assess CVP because it is in direct line with the right atrium. The most common external reference point used to determine CVP is the sternal angle (of Louis) (**Figures 4A** and **5**).[4] The right atrium is approximately 5 cm below the sternal angle; this location allows the sternal angle to be used as a reference point for measuring the height of the blood column above the right atrium.

The CVP equals the vertical distance between an imaginary line running parallel to the floor and extending from a point 5 cm below the sternal angle and an imaginary line running parallel to the floor and extending from the highest point of pulsation of the jugular vein (Figure 4A). Therefore, in a patient resting in a supine position (usually at an angle of inclination of 30 to 45 degrees), a CVP measuring 9 cm H_2O relates to a jugular venous pressure extending 4 cm above the sternal angle (Figure 4A). In general, only a CVP of at least 7 cm H_2O can be observed by this method because of visual obstruction by the clavicle.[4]

Another and more reliable method of determining CVP, or even right atrial pressure, involves having the patient rest in a supine position on a bed elevated so that the highest point of pulsation of the right internal jugular vein can be observed. (The angle of inclination of the front of the bed is usually 30 to 45 degrees.) The examiner begins by placing the zero mark of a centimeter ruler in the midaxillary line in the area of the fourth intercostal space (**Figure 6**). The fourth intercostal space is in the upper axilla. The space is found by the extent to which the ruler can be moved forward in the midaxillary line (with the patient's arm relaxed and resting at his or her side) without displacement of normal tissue. This point of the midaxillary line, the intersection of the midanteroposterior level of the chest with the fourth

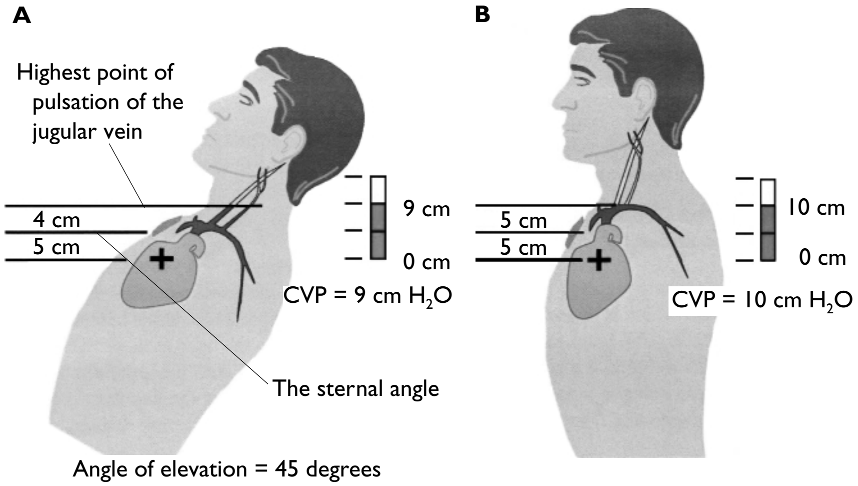

Figure 4. (**A**) Schematic representation of the measurement of central venous pressure (CVP) through use of the sternal angle in a patient resting in a supine position. (**B**) If the jugular venous pulse is visible in a patient sitting in an upright position, then the central venous pressure is at least 10 cm H_2O and need not be measured. (Illustration by S. Jones and W. Thornton)

Figure 5. Measurement of central venous pressure through use of the sternal angle.

Figure 6. Measurement of central venous pressure through use of the midaxillary line.

intercostal space, is called the phlebostatic axis. This axis is considered a true external reference point for the right atrium.[7] Placement of the zero mark of the ruler in this location, in effect, places it at the level of the mid–right atrium. The phlebostatic axis is considered the anatomic "zero point" for a measurement of CVP. That is, the height of the jugular venous pulse as measured vertically from this point can be considered a direct measure of the CVP.

The centimeter ruler is held at a perpendicular angle to the floor. The CVP, or right atrial pressure, is the vertical distance between the zero mark of the ruler (extending upward from the phlebostatic axis in the midaxillary line) and an imaginary line running parallel to the floor and extending from the highest point of pulsation of the right internal jugular vein (Figure 6). This method of measuring CVP, when compared with the method involving the sternal angle, is more reliable owing to smaller degrees of variation in measurements caused by the patient's posture.[8]

In patients with elevated CVP, it may be necessary to raise the patient's trunk more than 45 degrees for the pressure to be estimated. Clinicians, however, often underestimate the CVP in these patients.[4] Therefore, it is recommended that clinicians simply determine whether or not the CVP is elevated in all patients, without attempting to make a specific measurement.

As previously mentioned, the jugular venous pulse is normally not observable in the neck of a patient sitting in an upright position; a visible jugular venous pulse in a patient sitting upright represents a CVP of at least 10 cm H_2O (Figure 4B). Also, the CVP is abnormally high in a patient when the vertical distance between the highest point of pulsation of the internal or external jugular vein and the sternal angle is greater than 3 cm. Jugular venous pulsations may be visible to a height of 25 cm above the sternal angle, resulting in pulsations behind the angle of the jaw.

Elevated Venous Pressure

Elevated jugular venous pressure or CVP helps a clinician identify disorders of mainly the right atrium and right ventricle. However, elevated left-sided heart pressures are transmitted through the pulmonary circulation and right ventricle.[9] Thus, an analysis of jugular venous pressure and CVP can aid a clinician in identifying disorders of the left side of the heart as well. In general, elevated jugular venous pressure or CVP is a poor prognostic indicator for patients with congestive heart failure, indicating an increased risk for hospitalization and death.[2]

Clinical Signs Related to Jugular Venous Pressure

Kussmaul's sign. During inspiration, mean jugular venous pressure declines. However, in certain pathologic conditions the mean jugular venous pressure increases during inspiration: this clinical finding is known as Kussmaul's sign.[10] Kussmaul's sign can be explained by the inability of the heart to accommodate increased venous return caused by negative intrapleural pressure. Kussmaul's sign is seen in 33% of patients with constrictive pericarditis.[11] It can also be observed in restrictive cardiomyopathy, right ventricular infarction, and acute cor pulmonale.

Abdominojugular reflux sign. In patients with a normal CVP at rest who are suspected of having right ventricular failure, elicitation of the abdominojugular reflux sign may be useful. The sign is sometimes referred to as the hepatojugular reflux sign, but this is a less appropriate name because it is not necessary to apply pressure to the liver during elicitation. The sign is elicited by applying slow, steady abdominal pressure to the middle of the abdomen for 15 seconds.[5] A positive result on elicitation is defined by an increase in jugular venous pressure of more than 3 cm H_2O that is sustained for longer than 15 seconds. The abdominojugular reflux sign is not specific to any particular disorder. Its sensitivity and specificity in predicting tricuspid stenosis, constrictive pericarditis, right ventricular infarction, or pulmonary hypertension have not been studied.

CONCLUSION

The bedside examination of neck veins can provide diagnostic information relating to underlying cardiopulmonary diseases, including information about CVP and right ventricular hemodynamics. Despite the numerous technological advances in diagnostic procedures for cardiopulmonary disorders, the bedside physical examination remains the most widely accepted means for initial detection of these diseases. Furthermore, it is painless and harmless to the patient. **HP**

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