LECTURE

Jugular Contour Recognition by Naming and Timing Descents

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Abstract

Jugular wave recognition requires looking for descents rather than rises. The dominant normal descent is systolic and should be called the X prime (X') descent. The X' is a rapid collapse caused by the descent of the base of the right ventricle and can be easily recognized by noting that the collapse falls onto the second heart sound or is simultaneous with the radial pulse. The V wave and Y descent is expected to be easily visible only in the young. The C wave is never visible. It is difficult to learn jugular recognition from most textbooks mainly because they use the letter X for both the atrial relaxation descent and the descent of the base descent and also, they teach from artifactual pulse tracings and they recommend looking for waves rather than descents.

Key words: jugular, venous pulse, A wave, X descent, X prime, decent of the base

There are two reasons why jugular wave recognition is the most poorly understood of the physical examination signs in cardiology. Firstly, there is confusing non-standardized terminology used for both waves and descents. Secondly, jugular contours are full of both carotid artifacts and exaggerated amplitudes due to sensor characteristics.

Since the right atrial and jugular waves have the same etiologies and hemodynamics, we shall describe right atrial contours as the equivalent of jugular contours (Fig. 1). Shortly after the P wave of the VCG, right atrial contraction occurs and produces a rise in right atrial pressure. This rise is not named because rises in jugular pressures

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Fig. 1 Normal right atrial or jugular contours are similar. They consist of A, C, V and H waves and X, X’ and Y descents.

Fig. 2 This rise in right atrial pressure resulting from right atrial depolarization is not named.

are not named; only waves and descents are named (Fig. 2). When the atrium relaxes, the fall in pressure produces a descent which, when named, is called the X descent, and the waves preceding the X descent is the A wave (Fig. 3. However, the first confusing point of nomenclature is that many authors do not name this descent at all. However, the wave produced by the rise and fall in right atrial pressure is universally called the A wave.

After the P wave and atrial events comes the QRS which results in right ventricular contraction. The rise in right ventricular pressure pushes the tricuspid valve up into a closed position and, therefore, raises right atrial pressure slightly (Fig. 4). After
Fig. 3 The A wave contains the X descent.

Fig. 4 The slight rise in pressure due to tricuspid valve closure is not named.

Isovolumic contraction, the right ventricle ejects its blood by inward movement of its free wall and downward movement of the base. Since the septum moves away from the free wall of the right ventricle, and since the apex does not move upward significantly, they do not assist in ejecting blood from the right ventricle. Ejection of the right ventricular volume depends more heavily on the descent of the base than does the
Fig. 5 The four possible movements that could cause right ventricular ejection are indicated by the numbers 1, 2, 3, and 4. However, only movements 1 and 4 actually participate in ejection.

The right cardiac contraction weakens about one-half way through systole and the descent of the base effect decreases. Filling of the right atrium from the venae cavae now overcomes the fall in right atrial pressure due to the descent of the atrial floor and the caval blood entering the right atrium causes a rise in right atrial pressure be-
Fig. 6 Most authors use the letter "X" to name both the atrial relaxation descent and the fall in pressure due to the descent of the base. This confusing nomenclature can make it impossible to understand jugular contours.

Fig. 7 Right ventricular pressure weakens about half way through systole and allows right atrial pressure to build up.
When the right ventricular pressure falls below right atrial pressure, the tricuspid valve opens and the peak of the V wave occurs. Because the tricuspid valve is closed. The rise in pressure during systole is not named (Fig. 7). During right ventricular isovolumic relaxation, the right ventricular pressure falls rapidly to below right atrial pressure, at which time the tricuspid valve opens and the rise in right atrial pressure ends abruptly. As blood flows from the right ventricle into the right atrium, the right atrial pressure falls and makes a pressure fall known as the Y descent. The wave produced by the systolic atrial pressure rise followed by the Y descent is known universally as the V wave (Fig. 8). Surprisingly, not every cardiologist even names this descent. The Y descent occurs during early rapid expansion of the right ventricle in diastole and it is brief. It is followed by a mid- and late diastolic slow expansion phase, which produces a slowly rising pressure wave known as the H wave.

Recognition techniques and pulse tracing artifacts

Because it is easier to perceive and time large, rapid movements than small, slow movements, it is easier to decipher jugular descents or collapses because they are the largest, fastest jugular movements. Teaching physicians to look at the outward move-
ments has been another reason for difficulty in understanding jugular contours. Looking for rapid collapsing movements also helps the eye to distinguish jugulars from carotids because carotids produce more rapid outward then inward movements. The jugular X prime descent is the most rapid and largest amplitude jugular movement because it is due to the rapidly contracting right ventricle. Even the Y descent, although normally small in amplitude, is brisk due to the rapidly expanding right ventricle.

The C wave is too small to be visible to the eye. However, on a jugular pulse tracing taken with the sensor on the neck, the C wave is often artifactualy very large because the sensor cannot separate jugular from carotid movements if the latter are brisk or increased in amplitude (Fig. 9).

The C wave was originally thought to be entirely carotid artifact, hence the letter C for “carotid.” Teaching physicians from pulse tracings which often show large carotid artifacts is a further source of confusion. A skilled observer may, however, see a slight interruption of the systolic descent that actually separates the X from the X’.

The V wave and Y descent in adults are often too small to be seen by eye because the normal right atrium is a very compliant and distensible chamber. It accepts from the venae cavae without much increase in pressure. A pulse tracing of the jugular, however, may show a huge V wave because sensors are usually sensitive to rates of rise and will exaggerate any wave that is associated with a rapid rate of rise. Looking for the large V wave and Y descent shown in pulse tracings is another source of confusion for the learning physician.

In the normal adult neck you should look only for one major systolic descent, the
Fig. 10 On the left, a typical normal jugular pulse tracing is illustrated. On the right is the same pulse as seen by eye, i.e., only an $X + X'$ (but mainly an $X'$) is seen.

$X'$ descent (with small $\times$ attached), and perhaps a tiny diastolic descent which is the $Y$ (Fig. 10).

It should come as no surprise that jugular contours are difficult to understand when some of the widely used cardiology textbooks not only do not name atrial relaxation and do not name the descent of the base but do not even name the $Y$ descent. Instead, you will find the use of $X$ only for the trough that separates the $X'$ from the rise of the $V$ wave, and they reserve the letter $Y$ for the trough at the bottom of the $Y$ descent, i.e., without naming the descents at all!

**Timing of jugular descents**

The two best methods of recognizing jugular waves are to time the descent with either heart sounds or with the radial pulse. If you use auscultation to time the descents, the systolic descent or $X'$ will appear to fall onto the $S_2$ (See Fig. 10).

When timing the descents with the radial, it should be apparent that the $X'$ descent, since it is systolic, occurs simultaneously with the radial pulse. Because the carotid pulse occurs slightly earlier than the $X'$, it is usually easier to time the systolic descent with the radial pulse which is almost exactly synchronous with the systolic jugular descent.

If the patient is in sinus rhythm, then a dominant $X'$ descent means that an $A$ wave preceded it. If, on the other hand, the dominant descent occurred just after the $S_2$, you are seeing a dominant $c$ descent, and the preceding wave was a $V$ wave. If there is both an $X'$ and a $F$ descent, but the $X'$ is larger than the $Y$, you may describe it as a dominant $X'$ descent. This is the normal relationship. In most adults the $X'$ is not only the dominant descent, but the $Y$ descent is often absent altogether.
It is normal for the V wave and Y descent to be easier to see in a young person than in an adult because the circulation time is slightly faster in the young, and also because in children the right atrium is relatively small for the volume it receives.

Making jugular descent more visible

Jugular wave perception is easiest with the patient supine in order to achieve the maximum return of blood to the right atrium. If the chest is raised, jugular pulsations may disappear below the clavicles. If jugular movements are still too small to be timed easily, elevate the patient’s legs or have the patient take slightly deeper breaths than normal. You should first look for internal jugular movements because they communicate directly with the right atrium. However, occasionally only external jugular movements are visible.

In conclusion, if proper nomenclature is used, if patients rather than pulse tracings are used for instruction, and finally, if descents rather than waves are timed, then jugulars could be understood by all physicians and give them a fascinating and rich source of clinical information. When you have learned to recognized jugular contours, you can then take advantage of the literature that teaches the diagnoses that can be made from recognizing abnormal jugular contours. You may wish to refer to Bedside Cardiology, Little Brown and Company, for a study of abnormal jugular waves.