Can the subclavian vein predict risks of hypotension under anaesthesia?

- General anaesthesia allows surgeons to perform long and painful procedures.
- During anaesthesia, patient blood pressure is continuously monitored to ensure it doesn't drop below normal levels (hypotension).
- Hypotension can cause damage to the heart, kidneys, and brain.
- There are few tools to accurately predict hypotension and these are difficult to use.
- Professor Anitha Nileshwar at the University of Manipal, India, has investigated the value of measuring the diameter of a vein under the collar bone in predicting hypotension during anaesthesia.

General anaesthesia is a controlled sleep-like state that keeps patients unconscious and pain-free during surgical procedures. This state of unconsciousness is achieved and sustained with the use of special medicines called anaesthetics. During the procedure, the doctor in charge, the anaesthetist, monitors the heart rate, blood pressure, breathing, and other vital signs to make sure they are steady and that the patient remains safely asleep.

However, as with any medical intervention, general anaesthesia can have side effects. One of the most common side effect is low blood pressure (hypotension). Blood pressure can drop during anaesthesia for various reasons, often in response to the anaesthetics themselves, but sometimes because of the patient's extensive fluid or blood loss before surgery (hypovolaemic shock). More rarely, hypotension is caused by sepsis (generalised infection) or an allergic reaction to the medicines. Extended or very low blood pressure can affect the oxygen supply to the vital organs such as the brain, kidneys, and heart and damage them, which in some cases can even lead to death.

Can we predict hypotension?

The severe risks involved make monitoring the patient's blood pressure before, during, and after general anaesthesia a very critical task. Predicting which patients are more likely to develop hypotension can help clinicians be more vigilant and act in a timely way to prevent adverse events. To assess the patients before their induction to general anaesthesia, anaesthetists take their history and perform a physical examination which can reveal signs of dehydration such as dizziness, increased heart rate, and low baseline blood pressure. Sometimes, especially for complex cases or unwell patients, more sophisticated methods (such as echocardiography) must be used prior to anaesthesia. Echocardiography is an ultrasound scan of the heart to measure the volume of its chambers as an estimate of the total volume of the circulating blood in the body.

Besides the patient's basic assessment process, there are also dynamic methods to identify issues with the blood pressure during the general anaesthesia, such as measuring the pulse pressure, the heart stroke volume, and the blood flow inside the big vessels near the heart. These measurements are very accurate and helpful, but are also invasive and not without their side effects.

What about the veins?

Veins are the blood vessels through which the blood returns from the tissues to the heart. If the volume of the circulating blood is low or unevenly distributed as happens when a patient has a low blood pressure, the veins can be empty and appear more collapsed than normally. Previous studies have established that measuring the minimum and maximum diameters of the body's large veins such as the inferior vena cava (IVC), the vein that returns the blood from the torso and lower body to the heart, can reliably predict whether the patient's low blood pressure will rise after giving them intravenous fluids (fluid responsiveness). The changes of the diameter of IVC with breathing or after raising patient's legs can also provide important information that can help predict hypotension early. Some researchers decided to include smaller vein diameters, such as the subclavian vein (a major vein that runs under

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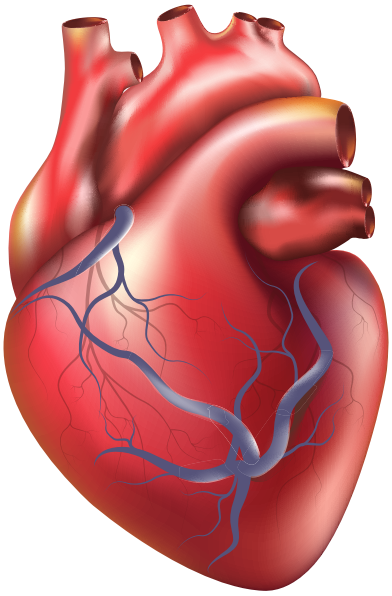
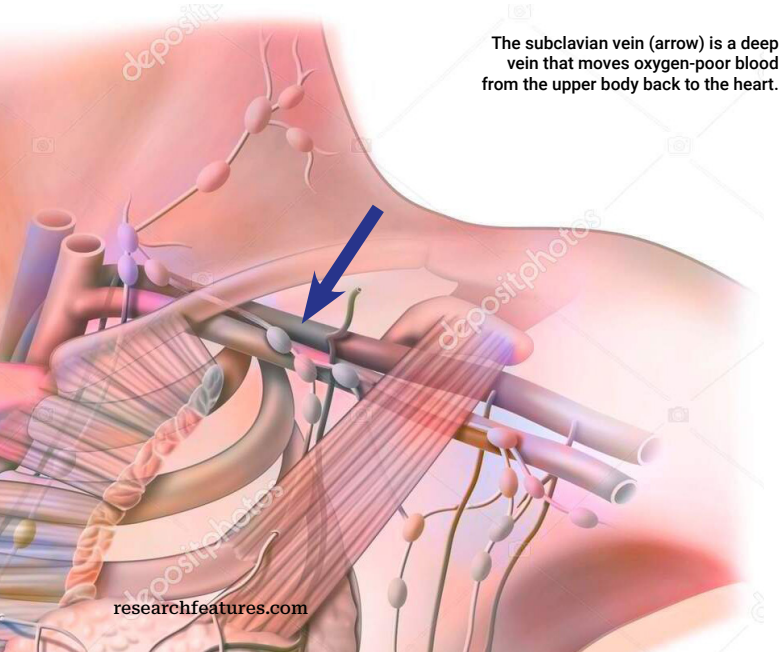
BLOOD PRESSURE RANGES

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (Upper Number)	&/or	DIASTOLIC mm Hg (Lower Number)
HYPERTENSIVE CRISIS (CONSULT YOUR DOCTOR IMMEDIATELY)	HIGHER THAN 180	and/or	HIGHER THAN 120
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 - 139	or	80 - 89
ELEVATED	120 - 129	and	LESS THAN 80
NORMAL	LESS THAN 120	and	LESS THAN 80



Hypotension, or low blood pressure, can cause damage to a patient's liver, kidneys, or heart. Systolic blood pressure measures the pressure in the arteries when the heart beats. Diastolic blood pressure measures the pressure in the arteries when the heart rests between beats.

the collar bone), as potential hypotension prediction tools. Unfortunately, the results of such studies have so far been controversial, with some concluding that the subclavian vein's diameters are a sensitive predictor of hypotension, and others that it is not.



The subclavian vein (arrow) is a deep vein that moves oxygen-poor blood from the upper body back to the heart.

Measuring the diameter of the subclavian vein (SCV) instead of the IVC before and during general anaesthesia would be a helpful tool, especially because it is easier to access and also because most anaesthetists already have the relevant technical skills. This is why Professor Anitha Nileshwar at the University of Manipal, India, conducted a study to test whether the subclavian vein diameter measurements can accurately predict hypotension and fluid responsiveness during general anaesthesia.

Measuring the subclavian vein

The University of Manipal researchers included 80 patients in their study. Before the induction to anaesthesia, they measured the minimum and maximum diameters of the subclavian vein using ultrasound scan in three different states: spontaneous breathing, deep breathing, and with raised legs. After induction of the general anaesthesia, 51 out of the 80 patients (64%) developed hypotension (Group H), while 29 (36%) did not (Group NH).

The team did not find any significant differences in the baseline SCV diameters between the two groups in any of the three different states. Surprisingly, the group of patients that developed hypotension also had a higher initial mean blood pressure, which means that after the induction of the anaesthetic they demonstrated a bigger drop in their blood pressure compared to the Group NH. It's also worth noting that no link was found between the drop in the blood pressure and the subclavian vein collapsibility during normal breathing, deep breathing, or passive leg raising.

Not a reliable tool

Despite the limitations of their study, for example using the vague and subjective variable 'deep breathing', the researchers conclude that monitoring the diameter of the subclavian vein with and without raising the patient's legs cannot be used as a hypotension-prediction tool during general anaesthesia. A reason for this could be that the subclavian vein is potentially less collapsible than bigger veins, and therefore the smaller range of its diameter with breathing is practically undetectable.

> **The subclavian vein is potentially less collapsible than bigger veins and therefore the smaller range of its diameter during breathing is practically undetectable.**

Personal response

What inspired you to conduct this research on the predictive value of the subclavian vein diameter?

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Were you expecting the results you got from your study? Was there anything surprising about them?

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What is the importance of negative results in research and how can we encourage researchers to try and publish them with the same enthusiasm as the positive ones?

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Details

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Bio

Anitha Nileshwar is Professor and Head of Anaesthesiology at the University of Manipal with more than 30 years of experience. Her special interests include intensive care, respiratory care, difficult airway and teaching anaesthesia, resuscitation, trauma care and research. She headed and developed the Department of Respiratory Therapy, MCPH, Manipal for nine years. She has been chief editor of the *Indian Journal of Respiratory Care* since its inception in 2012.

Further reading

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