

# Central Line Insertion Review for Anesthesiologists: Review Article

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## Abstract

Central venous catheter (CVC) is an essential tool for monitoring hemodynamics and intravenous access in many healthcare settings and, by far, most in a dynamic environment such as the operating room. It's one of the most frequent invasive procedures performed by clinicians in their practice. The literature describes many different approaches that use anatomical landmarks. However, Practice guidelines published in 2020 by the American Society of Anesthesiologists recommend the confirmation of a guide wire and central line insertion in the vein by real-time ultrasound US. This recommendation has significant practical implications, as it can lead to a reduction in adverse events following the CVS insertion. A large multicentre cohort study done in 2022, after implying the use of ultrasound-guided, reviewed the rate of adverse events following the CVS insertion and identified a variety of reasons linked with higher complication rates. A recent randomized trial compared techniques used in central line was conducted on neonates coming to the operating room who had CVS catheter placement done by pediatric anesthesiologists concluded that the modified technique was superior in regards to time efficiency and safety. This article aims to review basic knowledge and recent relevant literature about the topic in order to provide anesthesiologists with a deeper understanding of it while performing the procedure.

**Keywords:** Central line insertion, central venous access, central venous catheter, Ultrasound-guided central line in the operating room, Internal jugular vein, central line techniques in neonate anesthesia.

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## INTRODUCTION

Central venous catheters (CVC) are essential for monitoring hemodynamics and intravenous access in many healthcare settings, including operating rooms, intensive care units, and emergency units [1]. Around three million CVC insertions are estimated annually in the United States [2]. The approximate number is 250,000 for the United Kingdom [3]. Data from a retrospective study conducted in the Scania Region alone in southern Sweden found that 6000–7000 CVCs are performed every year [4]. Therefore, CVC is one of the most used invasive procedures performed in practice at secondary hospitals [4].

### Indications:

- infusions that are unsuited for peripheral intravenous lines, such as vasopressors, total parenteral nutrition, chemotherapy, and further irritant medications to peripheral veins [5].
- Failure to secure venous access [5].
- In transmission to extracorporeal treatments, as in hemodialysis, continuous renal replacement therapy, and plasmapheresis [5].

- Hemodynamic monitoring, as well as central venous pressures [5].
- Therapeutics management, as in transvenous cardiac pacing, inferior vena cava filter insertion, thrombolytic treatment, and intravenous stenting [5].

Contraindications to inserting a CVS can be relative or absolute, and some contraindications may be site-specific.

### Absolute contraindications:

- Infection at the location of insertion that is active [5].
- Destruction and loss of anatomical marks at the site, such as implantable/indwelling hardware, as in hemodialysis lines and pacemaker leads [5].
- Injury to the vessel in interest to be inserted in as in trauma patients, whether proximally or distal to a specific insertion point [5].

**Tips for CVS Preparation:**

Make sure that the environment is clean and well-prepped to allow a sterile insertion of the CVS [6, 7].

- Confirm the availability of the ultrasound machine and the CVS standardized kit in the room [6, 7].
- Having an assistant to help you during placement to facilitate smooth procedure [6, 7].
- Review the checklist or the protocol used in your hospital for CVS placement [6, 7].

**Technique:**

This procedure is usually performed in sterile conditions in the operating room to decrease the risk of infection [6, 7].

There are two ways of insertion used to insert the central line. One is the Seldinger technique, which includes sliding the catheter into the needle, and the modified Seldinger technique is different in that the small catheter is advanced in the vein, similar in a way to placing a venous cannula, and then the guide wire is inserted into the catheter, choosing which style to use is usually depends on physician experience and preference; however ways and measures to ensure that guide wire is inserted in the venous lumen should be done to confirm prior to insertion of the dilator, these measures include but not limited to using ultrasound (US) guidance in real time to puncture the vessel and visualizing the wire in the lumen by US or TEE [6, 7].

**Choosing an Entry Point:**

Three locations are mostly used in practice for the insertion of CVS, specifically the internal jugular, common femoral, and subclavian veins; recognizing the framework of the associated anatomy and enclosing structures is key when inserting a CVC; the choice of where to insert a CVC is naturally built on clinical criteria and different physician skills and preferences, There is no clear evidence in the literature as to which site is superior to others in CVS insertion, with that being said, each anatomical location has its own risks and benefits[5]. Physicians are encouraged to choose a site that is more accessible, and that is not contaminated, Preferably an upper body for adults [7].

The most common preferred access site is usually the internal jugular vein (IJ) for many reasons: its easily accessible anatomy, predictable location, less risk of complication, and feasibility of using ultrasound guidance in real-time while performing the procedure [8].

The IJ is lying anterolateral in relation to the common carotid artery and is located in the superior part of the triangle shaped by the clavicle and the two heads of the sternocleidomastoid (SCM) muscle. The joining of the internal jugular and the subclavian vein forms the right brachiocephalic vein, which later on combines with the left brachiocephalic veins to form the superior vena

cava (SVC). If the anatomic landmarks method were chosen to identify the vein, this can be reached anteriorly, centrally, or posteriorly around the bifurcation of the SCM. On the whole, the central approach is most frequently preferred. until now, some have reasoned that the posterior position is safer, having more distance from critical structures such as the lung apex and the carotid artery and that the anterior position is more accessible, as it's easy to palpate the carotid artery and reference the needle direction aiming away from it. As there is still no evidence as to which landmark approach is the safest, many clinicians strongly believe that ultrasound guidance is superior in practice as it is easy to locate the vein in real-time and avoid injuring other nearby structures, most importantly in patients with anatomical variations[5,9,10].

**Mechanical complications:**

- Conduction abnormalities, such as ventricular or bundle branch blocks, are mostly caused by guidewire cross-ness in the atria or ventricles.
- Major Vessel injury
- Pulmonary perforation and possible pneumothorax.
- Bleeding –leading to a hematoma, which may threaten the airway patency.
- Tracheal damage.
- Air emboli while venous access or extraction of the line [11].

**Post-insertion complications:**

- Central line causing systemic infections – bacterial or fungal [12].
- Stenosis in the used vein.
- Thrombosis.
- Prolonged bleeding with multiple trials in a susceptible population, as in patients with coagulopathy [11, 13].

In a large multicentre cohort study done in 2022, the rate of adverse events following the CVS insertion after implying the use of ultrasound-guided was reviewed. The incidence of mechanical adverse events was 7.7%, of which 0.4% were major adverse events. Factors that were associated with higher risks were found to be: lower BMI of patients <20, operator performed by physicians with less experience, and increased number of attempts of skin punctures. Pneumothorax was specifically higher in patients who received subclavian vein CVS [14].

One randomized study conducted in 2018 and published in the British Journal of Anesthesia aimed to identify the superior technique for CVS placement with regard to ease of insertion and the incidence of adverse events in neonates coming to the operating room. CVS insertion was performed by expert pediatric anesthesiologists while patients were under general anesthesia. The study found that the modified technique was linked to a higher rate of successfully placing both

the line and the guide wire from the first time and fewer trials for guide wire sliding overall. A possible explanation could be the smaller lumen of IJ veins in this population that is easily collapsed with the negative aspiration of blood to guide the needle insertion on the Seldinger technique. A lower complication rate was also observed in the modified technique group [15].

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