PG21BP Guideline on safe practices for central venous access device insertion, maintenance, and removal Background Paper 2026

Short title: Central venous access device (CVAD) mechanical safety BP

1. Reasons for document development

Central venous access devices (CVADs) are a form of venous access that is required to deliver medications, fluids and parenteral nutrition, to facilitate haemodialysis, and to augment haemodynamic monitoring. The insertion, maintenance and removal of CVADs are all associated with potential adverse events that can cause morbidity and mortality.[1 2]

For major procedures, anaesthetists place CVADs electively or emergently. Additionally, anaesthetists may be requested to place CVADs on behalf of other craft groups.

The safety of CVAD insertion has improved with the introduction of new evidence and associated practice change in three key areas: the widespread use of dynamic (real-time) ultrasound to facilitate placement of lines [1, 3-5]; bundles of care designed to minimise the incidence of CLABSI [6, 7] including the use of ultrasound [8]; and education and accreditation pathways packages including the use of simulation.[9]

Unfortunately, despite efforts to improve complications associated with CVADs, large contemporary studies, audits, and critical incident reports (including WebAIRS) demonstrate that CVAD management is associated with ongoing morbidity and mortality.[10] A 2022 prospective multicentre cohort study suggested a rate of mechanical complications of 7.7% of which 0.4% were major complications, and in a 2024 systematic review 3% of CVAD insertions were associated with major complications.[1, 2, 11] In Australia and New Zealand, a WebAIRS report on this topic in 2026 yielded 163 episodes of complications associated with CVADs of which 69% were determined to be preventable. This report noted 29 cases of arterial injury, 10 cases where the tip of a catheter was incorrectly positioned, 12 incidents involving guidewires and 8 episodes of pneumothorax. Ultrasound was used in 19 of the cases of arterial injury.

The literature suggests there are practice changes that could be incorporated into the bundle of care surrounding CVAD insertion, maintenance and removal, that will decrease mechanical complications. Noting that the primary role of the anaesthetist is insertion and maintenance during anaesthesia, and that the majority of major complications were associated with placement and verification, this was the focus of this professional document.

2. Scope of this document

This professional document describes strategies to minimise mechanical complications associated with the insertion, maintenance and removal of CVADs. It is directed to anaesthetists, as CVAD insertion and maintenance is considered a core skill.[12] The recommendations of PG21 may be considered where CVAD insertion is undertaken by practitioners elsewhere such as in emergency and critical care medicine.

Radiologists have access to sophisticated real-time imaging, a thorough understanding of radiological anatomy, and the opportunity to use contrast media to confirm correct placement of CVA devices. Hence the use of confirmatory techniques such as manometry, blood gases etc. are not necessarily applicable to their practice. This may also apply in other areas where advanced radiological imaging techniques or direct exposure are used (eg vascular and cardiac surgery, and cardiology).

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It is recognised that placement of CVADs in paediatric patients, especially neonates, requires specialised knowledge and skills. Scope of paediatric clinical practice for anaesthesia provider is outlined in PG29 and the principles outlined in this document (PG21) should also apply.

Prevention of infectious complications are considered in *PG28 Infection prevention and control.* [13]

Recognition of the risk of allergic complications related to chlorhexidine use or impregnation of CVADs are covered in *PG69 Hypersensitivity reactions*.

3. Process of development

The document development followed the process outlined by ANZCA professional document *CP24 Policy for the development and review of professional documents.* Relevant literature and resources were identified using:

1. A literature review conducted through the ANZCA library on Medline from 2010 onwards using the search strategy detailed in Appendix 1. The abstracts were reviewed by two members of the DDG and full-text was accessed for those considered relevant.
2. Further relevant references were obtained from the citations in reviewed articles.
3. Additional references were contributed by members of the DDG during the review process.
4. Web-based guidelines published by relevant organisations were also considered.

The DDG members met virtually on three occasions, with ongoing document review and discussion conducted using a collaborative platform (Microsoft SharePoint).

4. Discussion

4.1 Planning

Appropriate planning before CVAD insertion is essential, including the choice of insertion site and choice of CVAD. This is especially the case for 'referred' insertions (eg from a renal unit) where a particular catheter type and site of insertion may be required.

4.2 Evidence for training and competence (See also 6.0 Training and assessment of competence)

It is likely that appropriate training and credentialing would decrease the incidence of arterial puncture and mechanical complications associated with needle malposition, although there is currently no high-level evidence to support this claim. A 2021 trial demonstrated that trainees who had undergone simulation training were non-inferior to more experienced traditionally trained colleagues.[14] The key principles of an education program have been outlined by Soffler et al.[15] A Japanese program [9] that introduced simulation-based training claimed a mechanical complication rate of 1.2% which decreased from 2.2% prior to the training program and was lower than the 2.3% mechanical complication rate claimed in a comparable meta-analysis.[1]

The use of ultrasound for CVAD placement by experienced operators has been found to decrease the incidence of CLABSI, whereas no difference was found with inexperienced operators, suggesting benefits may be achieved with training.[8]

Anaesthesia departments should have formal training programs describing the safe insertion of CVADs, these programs should outline a bundle of care that minimises CLABSI and minimises mechanical complications of insertion. This would ideally include focused ultrasound skills for confirmation of safe intravenous wire placement. Training programs could progress from didactic learning to simulated practice, to supervised practice and assessment of competency.

4.3 Procedural components

An appropriate procedural area must be used for CVAD insertion. In situations where a guide wire might contact the heart, a cardiac protected electrical environment is important (AS/NZS 3003). The ability to monitor a patient is critical not only because patients having CVADs inserted are prone to arrhythmia but also because they may be sedated during the procedure. If sedation is utilised, the principles of *PG09 Procedural sedation* should be followed. Wherever possible the CVAD insertion should occur on a trolley, bed or procedural table that can be placed in the Trendelenburg (head down) position. An ultrasound machine and the equipment to use the machine within a sterile field should be available, noting that emergency situations may require adapting to specific circumstances.

4.4 Central venous access

4.4.1 Ultrasound (US)

An understanding of surface anatomy is an important component of CVAD insertion, however complete reliance on surface anatomy has been replaced with the use of ultrasound.[16] The use of dynamic ultrasound has been demonstrated to decrease the incidence of arterial puncture by a factor of 5, it is also associated with increased success rate, less bleeding and a lower incidence of pneumothorax [1] and may be associated with lower rates of CLABSI. [17 8] The careful use of dynamic US during IJV cannulation may prevent the vessel being transfixed and potential damage to underlying vessels of the thyrocervical trunk. Its use alone has not eliminated the risk of arterial dilation and cannulation. [18]

Ultrasound has distinct roles throughout the insertion of a CVAD.

- Whilst assessing the patient and making decisions about line placement, a systematic assessment of relevant venous anatomy such as Rapid Central Vein Assessment (RACEVA) can be performed. [19] If a specific vessel for CVAD insertion is required, a pre-scan may be performed to assess vessel suitability before the sterile field is established, particularly if the patient has challenging anatomy, the site has previously been used for cannulation or in complex circumstances such as ECMO cannulation.
- Evidence suggests that use of US to facilitate needle / cannula insertion is safer than practicing a landmark approach. Further using real-time or dynamic US is a safer option than using US to assess the vessel before inserting the needle without US guidance which has been described as an indirect US technique. [3, 5]
- US may also play a role in assessing that a guidewire has an appropriate venous course before a dilator is passed and a CVAD placed (see 4.5.2).

Each of the modes of US use requires a distinct skill set. Assessment of wire position has been termed 'focussed' as it is an advanced skill with critical consequences where incorrect image interpretation can lead to significant morbidity and mortality. In this regard it has parallels to other POCUS techniques where image interpretation and subsequent diagnoses can have specific clinical consequences. It would be reasonable to treat training for this application in the same way as other POCUS techniques as described in *PG47 Diagnostic POCUS*.

4.4.2 Needle v cannula

A central vein can be accessed with a needle (Seldinger technique) or a cannula (modified Seldinger technique). It is recognised that the choice of access technique remains a point of personal preference for a proceduralist. Having accessed the vein, it is important that critical check steps (see 4.5) occur from a position of stability. If a needle is used for the critical checks, it is conceivable that movement of the needle to an extra-venous position could occur following assessment. A benefit of using a cannula is that manometry, waveform analysis or blood-gas sampling can be performed directly through the cannula. If a needle is used to access a vein, to before performing these checks, it is suggested that the wire is used to exchange the needle for a cannula. Not all CVAD insertion kits contain a cannula, if a cannula is added to the set up, it must be of an appropriate length and have an internal diameter sufficient to accommodate the wire.

There is some evidence that when placing subclavian CVAD there may be a higher success rate with the Seldinger technique,[20] but these findings are probably not transferrable to other insertion sites.

4.4.3 Avoiding venous air embolism

Venous air embolism (VAE) can occur during insertion, maintenance and removal of CVADs. Anaesthetists may be asked to advise on CVAD removal in some circumstances eg PACU. A coroner's report in Victoria has highlighted the danger of air embolism associated with CVAD removal.

To avoid VAE, practitioners must take steps to ensure there is not a pressure gradient from the atmosphere through an open channel to the venous circulation. This might occur during placement if a patient's breathing was obstructed due to sedation, and there was an open needle placed in a central vein. During removal, the venous pressure can be maintained by using head-down positioning and asking the patient to hold their breath in inspiration. Leaving uncovered (open) needles, cannulae, needles or CVADs in the vein must be avoided.

4.4.4 Guidewire management

A significant complication associated with a guidewire is that it is retained and potentially embolises. This is a rare complication, with significant consequences. This relates to the absence of a formal 'count' during CVAD placement, as would be performed in surgery. Noting the removal and disposal of any guidewire(s) with the assistant should be part of routine practice. If a dual puncture technique is undertaken (eg CVC + Sheath) or second kit opened the wires should be formally counted off the set up.

4.4.5 Number of attempts

As for many procedures, seeking assistance from an experienced colleague in difficult or challenging circumstances is considered good professional practice. When overseeing trainees, clinical judgement is required regarding when to 'take over'. If a trainee performs an arterial puncture, then subsequent attempts should be undertaken by a consultant.

Studies have recommended no more than three attempts by a single proceduralist and an increased risk of mechanical complications with multiple attempts.[11, 21] It seems reasonable to suggest that after three attempts, where support is available, a proceduralist should seek assistance or reconsider their approach or necessity of the line.

4.4.6 Documentation

A specific CVAD insertion form can be used to facilitate correct practice and to document steps taken to ensure asepsis and procedural safety. A form can take the role of a checklist, describing components of a bundle of care, ensuring wire removal, describing the steps taken to ensure line position and safe use (eg [22]). The same form can be regularly used to assess the insertion site and need for the line, to ensure it is removed promptly when no longer required.

4.5 Confirmation of needle / cannula / wire placement before dilatation: "A critical check"

Arterial puncture was seen in 16.2 out of 1000 CVAD, with progression to arterial dilatation in 2.8 out of 1000 catheters in a contemporary systemic review and meta-analysis.[1] The same meta-analysis noted that in cases where ultrasound was used, the rate of arterial puncture and pneumothorax was decreased by a factor of a least 5 times. The American Society of Anesthesiologists "Practice Guidelines for Central Venous Access 2020" recommend that real time (dynamic) ultrasound is utilised for vessel localisation and needle guidance.[23]

Using US, even well-trained proceduralists will have an incidence of arterial puncture. To avoid the progression from arterial puncture to arterial dilatation, confirmatory tests can be used to ensure venous placement.

Traditionally the colour of blood and assessment of pulsatility have been utilised to differentiate between arterial and venous placement, but **these tests are unreliable** especially in critically unwell patients.

The appropriate method for minimising incorrect wire placement before dilatation was a point of discussion in the document development group. Discussion centred around the need for a minimum of two recommended confirmation methods versus ultrasound assessment of the wire alone being considered definitive (as possible). Practically the group concluded that one well performed test (Manometry / Waveform analysis / Focused US / Blood gas analysis / Fluoroscopy) should always be performed and that promoting this approach would likely help to decrease the rate of arterial injury. It was acknowledged by the group that using ultrasound to ensure the wire had a solely transvenous course, required advanced focused ultrasound skills, beyond those required for real-time cannulation. This skill set would not be held by every anaesthetist. Wherever possible a combination of recommended techniques should be used. As there are situations where US or manometry / waveform analysis are impractical, wherever possible anaesthetists should be familiar with all the recommended techniques of wire assessment.

4.5.1 Manometry / Waveform analysis

Measurement of the pressure in the vessel before dilatation has been suggested to identify inadvertent arterial puncture. Pressure can be measured with manometry or by transducing a waveform. In the largest study of this technique [24], manometry was utilised in over 9000 consecutive patients without any instances of dilatation. In 511 consecutive patients over a year, arterial puncture was noted in 5%, in 24 of these cases the puncture was recognised before manometry, but in 4 cases manometry prevented arterial dilatation. [24]

The 2020 American Association of Anaesthesiologists Guidelines, make the distinction between the Seldinger technique (utilising a needle) and the modified Seldinger technique (utilising a cannula). It is important to note that if pressure measurement or waveform analysis occurs through a needle, it can be inadvertently moved to an extra venous position following the assessment, whereas this will not occur with a cannula.

There does not appear to be any evidence to date to differentiate between the use of manometry (falling column) and waveform analysis to assess positioning, although the working group considered that a waveform indicating respiratory pressure variation for internal jugular or subclavian approaches is likely to indicate correct venous cannulation.

Although rare, the passage of the cannula could be trans-arterial (which has been identified with femoral placement) with the tip then in a vein – which is a reason for the use of additional ultrasound modalities.

4.5.2 Ultrasound modalities

Using the ultrasound for vein puncture is insufficient to ensure appropriate wire position. Likewise, simply seeing the wire in the internal jugular vein is insufficient as the wire may pass through the vein and into an artery more distally. Bowdle et al were able to visualise the wire in the brachiocephalic vein successfully in all but 2 of 200 consecutive patients.[25] They reasoned that if the guidewire could be visualised in the brachiocephalic vein it could not have entered the carotid or subclavian arteries. During this study simultaneous pressure measurement was also utilised. Ultrasound evidence of correct wire position may also be achieved if transoesophageal echocardiography is utilised to visualise the wire in the superior vena cava or right atrium.

During the insertion of a CVAD, the DDG defined three distinct modalities of ultrasound usage:

4.5.2.1 **Static** Ultrasound (pre-procedural) can be used to identify and assess the most appropriate vein for line insertion or to assess the appropriateness of a specified vein. As an example, the RaCeVA tool follows a series of 7 steps to systematically assess all possible venous options for catheter insertion.[19] This is distinct from dynamic ultrasound.[26]

4.5.2.2 **Dynamic** Ultrasound can be utilised during insertion of the needle or cannula into the chosen vein to follow the tip of the needle through the tissues into the vein. Its use during needle insertion shows increased first-pass success (internal jugular, subclavian, and femoral vein approaches) and reduction in complications (internal jugular and subclavian vein approaches). [3, 5, 27] The dynamic needle tip positioning technique in short-axis is often utilised once the vein is entered to advance it along the vessel lumen.[26, 28]

4.5.2.3 **Focused** Ultrasound describes the techniques that are used to assess whether a guidewire lies entirely within a vein, or particularly to rule out the passage of a wire into an artery before dilatation. This is a high-stakes process as misinterpretation of the ultrasound images could lead to arterial damage and serious morbidity and mortality, Higher level ultrasound skills are required, scanning in multiple views in short and long axis. The DDG felt there were several imaging approaches that might rule out arterial passage of the guidewire as outlined in PG21 which this background paper accompanies. Specific to IJV insertions, if the ultrasound probe is placed in the right supraclavicular fossa and the beam is tilted down caudally, the wire can be seen to pass from the IJV into the brachiocephalic vein, past the subclavian artery. If the wire is seen in the brachiocephalic vein past the subclavian vein, it is unlikely have anything other than a venous course.[25]

It is also possible to use transthoracic and transoesophageal echocardiography to assess the appearance of the wire in the right atrium. When using transoesophageal echocardiography a bicaval view should be obtained. A subcostal view can be used when using transthoracic echocardiography.

US has a role for the assessment of pneumothorax following line insertion. Given this may be a late complication and it is an uncommon occurrence, it probably only needs to occur if there is a clinical suspicion of this complication. Like all US techniques Lung US has a learning curve and should be undertaken by a trained practitioner.

4.5.3 Two other methods appropriate for the critical check are discussed. Arterial blood gas analysis and real-time fluoroscopy. Arterial blood gas analysis may need to be paired with a peripheral sample particularly in a critically ill patient. A specific skill set is required for fluoroscopy and to interpret intra-vascular wire position radiologically.

4.6 Securing and assessing the CVAD

4.6.1 Assessment of line position

There are reports of CVADs placed in the OR that are subsequently found to be intra-arterial in the ICU or on the ward. It is strongly recommended that CVADs are assessed as intravenous as soon as possible after placement. Assessment may be through pressure transduction, blood gas analysis or radiologically if available.

4.7 CVAD removal

4.7.1 Venous air embolism

Air embolism can occur during insertion, maintenance or removal of a central venous catheter. The mechanism is an open pathway from the atmosphere to the patient's venous system and a negative intra-thoracic pressure. During insertion the risk of venous air embolism can be decreased by maintaining positive venous pressure, avoiding negative intra-thoracic pressure and minimising the period where there is open venous access.

5. Management of complications

5.1 Arterial puncture

On consultation with vascular surgeons the advice was that arterial puncture from smaller cannulae (less than 6 French (16G or smaller (21G in paediatrics)) can usually be managed with prolonged local pressure. This advice applies predominantly to femoral access. The advice for internal carotid puncture (moderately compressible) and subclavian puncture (difficult to compress) is generally that 16G puncture or smaller can be managed conservatively. However, if the patient is to undergo cardiac surgery with full anticoagulation, then individual consideration and careful observation of the site should be undertaken.

In paediatrics, there is no clear published evidence for paediatric cut off in escalation of care with carotid/subclavian arterial punctures. In carotid catheterisation for interventional radiology/cardiology practice in 47 catheterisations in a sophisticated environment showed limited carotid thrombosis and stenosis for 3 or 4 Fr catheter but uncertainty for 5Fr catheters. [29] In paediatric anaesthesia practice, 21G needle or 22G cannula access is common for initial venepuncture as they are the smallest calibre needles that will allow threading 0.018" wire for Seldinger techniques.

5.2 Arterial dilation / Arterial placement of a CVAD

The advice received was that vascular surgeons have the broader competencies to assess whether conservative management (compression), interventional radiology or open intervention would be required. Likewise, advice on anticoagulation while awaiting device removal (especially for carotid or subclavian sites), should be individually considered.

If arterial dilation, or arterial placement of a CVAD occurs, the device should be left in place and a vascular surgeon should be consulted as soon as is practical.

6. Training and maintenance of competence

Central venous cannulation is one of the ANZCA clinical fundamentals and there is an expectation that trainees will complete a minimum of 40 procedures throughout their training. Anatomy relevant to central venous cannulation (ANZCA BTGS 1.72) and techniques of insertion are specified learning (BTGS 1.73). Knowledge surrounding ANZICS guidelines are specified in BTGS 2.2. Choice of access site is specified in ATGS 1.14. An advanced trainee should be able to place a central line in any of the common positions (ATGS 2.4) and should understand factors unique to paediatric patients (SSPA 1.66).

In a 2013 review of education for central venous access [30], it is suggested that training to undertake central venous access pass through a number of stages, to impart cognitive knowledge and technical skills. First there should be a program of knowledge acquisition, this should be followed by simulated practice using models, before supervised practice. Rather than specify a number of procedures to be undertaken it may be more appropriate to assess trainees with a global rating scale during each supervised training attempt. This approach has been endorsed in the recent American Society of Echocardiography Guidelines. [26]

Individual institutions will have specific policies and procedures for CVAD insertion, whilst curriculum-based training provides fundamental skills. Familiarisation with institutional requirements will be required for anaesthetists and trainees in new working environments.

Anaesthesia occurs in a wide variety of practice settings and exposure to CVAD insertion will vary dramatically from anaesthetists in regular cardiac practice to those who may only place a CVAD once a year or less, possibly under emergency situations. There is no clear evidence or guidelines on the maintenance of clinical knowledge and technical skills. It is reasonable to expect that the risk associated with CVAD insertion will be lower with regular clinical practice. Institutions could consider providing the opportunity for anaesthetists to perform simulated or supervised insertions, particularly to reinforce the key skills around asepsis and minimising the risk of arterial dilatation and catheter placement.

7. High risk situations

It was acknowledged by the document development group that not all situations are elective, straightforward cannulations, or enable the use of **critical checks**. However, wherever possible steps must be taken to minimise the risk of misplacement of a CVAD because the consequences can be significant.

References

1. Teja B, Bosch NA, Diep C, Pereira TV, Mauricio P, Sklar MC, et al. Complication Rates of Central Venous Catheters: A Systematic Review and Meta-Analysis. JAMA internal medicine. 2024;184(5):474–82.
2. Ingefors S, Adrian M, Heckley G, Borgquist O, Kander T. Major immediate insertion-related complications after central venous catheterisation and associations with mortality, length of hospital stay, and costs: A prospective observational study. J Vasc Access. 2025;26(2):487–96.
3. Brass P, Hellmich M, Kolodziej L, Schick G, Smith AF. Ultrasound guidance versus anatomical landmarks for internal jugular vein catheterization. The Cochrane database of systematic reviews. 2015;1:CD006962.
4. Sobolev M, Shiloh AL, Di Biase L, Slovut DP. Ultrasound-guided cannulation of the femoral vein in electrophysiological procedures: a systematic review and meta-analysis. Europace. 2017;19(5):850–5.
5. Zawadka M, La Via L, Wong A, Olusanya O, Muscara L, Continella C, et al. Real-Time Ultrasound Guidance as Compared With Landmark Technique for Subclavian Central Venous Cannulation: A Systematic Review and Meta-Analysis With Trial Sequential Analysis. Crit Care Med. 2023;51(5):642–52.
6. Latif A, Halim MS, Pronovost PJ. Eliminating Infections in the ICU: CLABSI. Curr Infect Dis Rep. 2015;17(7):491.
7. Australian and New Zealand Intensive Care Society. Central Line Insertion and Maintenance Guideline Melbourne: ANZICS Safety and Quality Committee; 2012. Available from: https://www.anzics.org/wp-content/uploads/2018/08/ANZICS_Insertionmaintenance_guideline2012_04.pdf. Accessed: 7 Nov 2025
8. Boulet N, Pensier J, Occean BV, Peray PF, Mimoz O, Rickard CM, et al. Central venous catheter-related infections: a systematic review, meta-analysis, trial sequential analysis and meta-regression comparing ultrasound guidance and landmark technique for insertion. Crit Care. 2024;28(1):378.
9. Tokumine J, Yorozu T, Moriyama K, Suzuki T, Okada C. Outcome-based simulation training for ultrasound-guided central venous catheter placement: clinical impact on preventing mechanical complications. BMC medical education. 2025;25(1):131.
10. Davidson F, Reynolds H. Central venous access complications: An ongoing safety concern. ANZCA Bulletin. 2024(Winter):43–4.
11. Adrian M, Borgquist O, Kroger T, Linne E, Bentzer P, Spangfors M, et al. Mechanical complications after central venous catheterisation in the ultrasound-guided era: a prospective multicentre cohort study. Br J Anaesth. 2022;129(6):843–50.
12. Walsh EC, Fitzsimons MG. Preventing mechanical complications associated with central venous catheter placement. BJA Educ. 2023;23(6):229–37.
13. Cosme V, Massart N, Reizine F, Machut A, Vacheron CH, Savey A, et al. Central venous catheter-related infection: does insertion site still matter? A French multicentric cohort study. Intensive Care Med. 2024;50(11):1830–40.
14. Day J, Winchester ZB, Cairns CA, Goyal M, Kumar A, Bell J, et al. The Impact of a Comprehensive Simulation-Based Training and Certification Program on Resident Central Venous Catheter Complication Rates. Simulation in healthcare : journal of the Society for Simulation in Healthcare. 2021;16(2):92–7.
15. Soffler MI, Hayes MM, Smith CC. Central venous catheterization training: current perspectives on the role of simulation. Advances in medical education and practice. 2018;9:395–403.
16. Imai E, Kataoka Y, Watanabe J, Okano H, Namekawa M, Owada G, et al. Ultrasound-guided central venous catheterization around the neck: Systematic review and network meta-analysis. The American journal of emergency medicine. 2024;78:206–14.

17. Young MP, Yuo TH. Central venous catheters: overview of complications and prevention in adult: UpToDate; 2025. Available from: https://www.uptodate.com/contents/central-venous-catheters-overview-of-complications-and-prevention-in-adults/print. Accessed: 07 Nov 2025
18. Hart PW, Beddoes P, Burtle D, Bradshaw ML. Arterial trauma due to central venous catheter insertion: an analysis of incidents reported to the National Reporting and Learning System for England and Wales 2013-2023. Anaesthesia. 2025;80(6):673–83.
19. Spencer TR, Pittiruti M. Rapid Central Vein Assessment (RaCeVA): A systematic, standardized approach for ultrasound assessment before central venous catheterization. J Vasc Access. 2019;20(3):239–49.
20. Kim Y, Yu J, Kim Y, Lee W. Retained guidewire penetrating through the aorta into the thorax: an unusual cause of recurrent bilateral pneumothorax. Eur J Cardiothorac Surg. 2016;49(1):e33–5.
21. Calvache J-A, Rodriguez M-V, Trochez A, Klimek M, Stolker R-J, Lesaffre E. Incidence of Mechanical Complications of Central Venous Catheterization Using Landmark Technique: Do Not Try More Than 3 Times. Journal of intensive care medicine. 2016;31(6):397–402.
22. NSW Health. Central Venous Line Insertion Record NH606515 2010. Available from: https://www.swslhd.health.nsw.gov.au/Liverpool/CVAS%5Ccontent/pdf/MOH_SMR0900.200_CVAD_Insertion_Checklist.pdf. Accessed: 3 June 2026
23. American Society of Anesthesiologists. Practice Guidelines for Central Venous Access 2020: An Updated Report by the American Society of Anesthesiologists Task Force on Central Venous Access. Anesthesiology. 2020;132(1):8–43.
24. Ezaru CS, Mangione MP, Oravitz TM, Ibinson JW, Bjerke RJ. Eliminating arterial injury during central venous catheterization using manometry. Anesth Analg. 2009;109(1):130–4.
25. Bowdle A. Vascular complications of central venous catheter placement: evidence-based methods for prevention and treatment. J Cardiothorac Vasc Anesth. 2014;28(2):358–68.
26. Vegas A, Wells B, Braum P, Denault A, Miller Hance WC, Kaufman C, et al. Guidelines for Performing Ultrasound-Guided Vascular Cannulation: Recommendations of the American Society of Echocardiography. J Am Soc Echocardiogr. 2025;38(2):57–91.
27. Brass P, Hellmich M, Kolodziej L, Schick G, Smith AF. Ultrasound guidance versus anatomical landmarks for subclavian or femoral vein catheterization. The Cochrane database of systematic reviews. 2015;1:CD011447.
28. Kiberenge RK, Ueda K, Rosauer B. Ultrasound-Guided Dynamic Needle Tip Positioning Technique Versus Palpation Technique for Radial Arterial Cannulation in Adult Surgical Patients: A Randomized Controlled Trial. Anesth Analg. 2018;126(1):120–6.
29. Justino H, Petit CJ. Percutaneous Common Carotid Artery Access for Pediatric Interventional Cardiac Catheterization. Circ Cardiovasc Interv. 2016;9(4):e003003.
30. Moureau N, Lamperti M, Kelly LJ, Dawson R, Elbarbary M, van Boxtel AJH, et al. Evidence-based consensus on the insertion of central venous access devices: definition of minimal requirements for training. British journal of anaesthesia. 2013;110(3):347–56.

Membership of the 2025-2026 Document Development Group

Dr Ben Slater, Lead
Prof David A. Scott, Director of Professional Affairs (Policy)
Dr Maria Adrian
Dr Catherine Caldwell
Dr Fergus Davidson
Dr Andrew Deacon
Dr Anthony Hade
Dr Nathan Peters
Dr Peggy Yip

Expert advisors
Ms Tricia Kliedon (Nurse Practitioner in Paediatric Vascular Access)
Dr Mark Westcott (Vascular Surgeon)

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Appendix 1: Mechanical complications of central venous access

Literature Search Strategy (Medline):

#	Searches	Results
1	exp Catheterization, Central Venous/	17986
2	exp Central Venous Catheters/	4278
3	central venous access.ti,ab.	2558
4	central venous catheter*.ti,ab.	15606
5	central venous cannula*.ti,ab.	581
6	1 or 2 or 3 or 4 or 5	28202
7	femoral vein*.ti,ab.	8433
8	subclavian vein*.ti,ab.	4412
9	internal jugular vein*.ti,ab.	7638
10	temp* dialysis catheter*.ti,ab.	59
11	vascath.ti,ab.	14
12	catheter sheath*.ti,ab.	128
13	7 or 8 or 9 or 10 or 11 or 12	19479
14	mechanical complication*.ti,ab.	3219
15	exp Pneumothorax/	19032
16	exp Thromboembolism/	67956
17	exp Embolism/	68784
18	exp Embolism, Air/	6106
19	exp Arrhythmias, Cardiac/	251343
20	"faliure to place".ti,ab.	0
21	(place adj2 failure*).ti,ab.	145
22	placement.ti,ab.	175847
23	insertion.ti,ab.	189110
24	(wire adj2 retent*).ti,ab.	75
25	fragment*.ti,ab.	465476
26	vascular inju*.ti,ab.	16597
27	nerve* injur*.ti,ab.	31901
28	pneumothorax*.ti,ab.	27320
29	thromboembolism*.ti,ab.	52272
30	embolism*.ti,ab.	76584

31	arrhythmia*.ti,ab.	109933
32	15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31	1335576
33	6 and 14	444
34	limit 33 to yr="2010 -Current"	292
35	from 34 keep 1-2, 4, 6, 9, 13, 15-16...	86
36	6 and 32	10384
37	limit 36 to yr="2010 -Current"	6204
38	37 not 34	6002
39	limit 38 to "systematic review"	143
40	from 39 keep 1-2, 4, 6-7, 13, 42-43, 54...	24
41	13 and 14	140
42	limit 41 to yr="2010 -Current"	101
43	42 not 34	15
44	43 not 39	15
45	from 44 keep 5, 11	2
46	13 and 32	5646
47	limit 46 to yr="2010 -Current"	2937
48	47 not 34	2871
49	48 not 39	2855
50	49 not 44	2846
51	limit 50 to "systematic review"	11
52	35 or 40 or 45	112

Search date: 22 September 2025

Outcome: 112 Results