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Totally Implantable Venous Access Port Insertion in a Regional Australian Centre: A Comparison of Open Venous Cutdown With the Seldinger Technique

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Abstract

Background: Totally implantable venous access ports (TIVAPs) can be inserted via open venous cutdown or the Seldinger technique. Comparative evidence for safety and efficacy remains mixed, and Australian regional data are limited.

Methods: A retrospective observational study of all adult patients undergoing TIVAP or port-a-cath insertion at Goulburn Valley Health, a regional Australian general surgery unit, between January 2019 and December 2024 was conducted. Procedural and postoperative outcomes were compared between open cutdown and Seldinger techniques using Fisher's exact tests, with unadjusted odds ratios (ORs) and 95% confidence intervals (CIs). Because the use of open cutdown changed over time, sensitivity analyses adjusted for calendar year using Firth's penalised logistic regression and were restricted to procedures performed during 2023-2024.

Results: A total of 127 insertion episodes were included: 42 (33.1%) open cutdown and 85 (66.9%) Seldinger. Use of open cutdown increased over the study period, accounting for 59.4% of procedures during 2023-2024 compared with 1.7% during 2019-2022. First-attempt success (88.1% vs 82.4%; OR 1.58, 95% CI 0.50-6.00), technique conversion (9.5% vs 7.1%), and access-site conversion (4.8% vs 10.6%) did not differ significantly between the cutdown and Seldinger groups, and all procedures were ultimately successful. The initial access vein was cephalic for 97.6% of open cutdown attempts and subclavian for 90.6% of Seldinger attempts. All periprocedural complications (four bleeding events, four arterial punctures, and one pneumothorax) occurred in the Seldinger group. Unplanned removal within one year was less frequent with open cutdown (0% vs 14.1%; p = 0.008), but this association was not statistically significant after adjustment for calendar year (OR 0.11, 95% CI 0.00-1.14; p = 0.067) or restriction to 2023-2024 (p = 0.063). Unplanned revision (2.4% vs 12.9%; OR 0.17, 95% CI 0.00-1.22) was numerically less frequent with open cutdown but did not reach statistical significance.

Conclusion: Open cutdown and Seldinger insertion both achieved high procedural success in this regional cohort, with periprocedural complications occurring exclusively in the Seldinger group. The lower rate of unplanned removal following open cutdown did not remain statistically significant after accounting for the concentration of open cutdown in the later study period. Because technique determined vein selection and was closely associated with calendar period, the independent effect of insertion technique cannot be determined from these data. Larger, prospective, multicentre data are needed to confirm these findings.

Categories: General Surgery, Oncology, Cardiac/Thoracic/Vascular Surgery
Keywords: central venous access, cephalic vein cutdown, portacath, rural surgery, seldinger's technique, totally implantable venous access port

Introduction

Totally implantable venous access ports (TIVAPs) provide long-term venous access for patients requiring intravenous chemotherapy, parenteral nutrition, or repeated blood sampling. Their use is particularly important in patients requiring prolonged or repeated intravenous treatment. TIVAPs are generally preferred over other long-term central venous devices because their design reduces infectious complications relative to externalised catheters [1].

TIVAPs can be inserted by open venous cutdown, most commonly via the cephalic vein, or by percutaneous cannulation using the Seldinger technique, typically via the subclavian or internal jugular vein [1]. Comparative evidence regarding these approaches remains mixed. A Cochrane systematic review of nine randomised or quasi-randomised trials involving 1253 participants found a higher primary implantation success rate with the Seldinger technique but no significant difference in overall peri- or postoperative

complication rates. However, among studies using subclavian access, catheter-related complications were more frequent with the Seldinger technique than with venous cutdown [2]. A single-centre randomised trial similarly reported an overall success rate of 97.4%, with comparable perioperative complication rates of approximately 5% between approaches, although complications were more frequent when conversion between techniques was required [3]. In contrast, a literature review covering a 27-year period and including 11,430 TIVAPs implanted in 11,381 patients reported a higher rate of early complications, including pneumothorax, haemothorax, and arterial puncture, following percutaneous insertion compared with surgical cutdown (4.5% versus 0.9%) [4]. A subsequent meta-analysis of six randomised trials involving 1,831 patients found a significantly lower risk of pneumothorax with open cutdown but a higher rate of primary technique failure, with no significant differences in other morbidity outcomes [5]. Complication rates with the Seldinger technique also depend on how venous puncture is performed. Real-time ultrasound guidance reduces arterial puncture and improves cannulation success compared with anatomical landmark techniques [6-8] and is recommended by international guidelines for central venous access [9-10]. In a randomised trial of port insertion, ultrasound-guided subclavian access had the lowest failure rate, with early complication rates similar to those of cephalic cutdown [11].

Australian data directly comparing open cutdown and the Seldinger technique are limited. The closest existing comparator, a three-year retrospective study across two peripheral Brisbane hospitals, compared TIVAD insertion outcomes between general surgeons and radiologists rather than between techniques specifically and found that pneumothorax occurred following central venous cannulation but not following open cephalic cutdown [12]. To our knowledge, no Australian regional study has specifically compared open venous cutdown and Seldinger techniques within a single general surgical unit over time. This study describes changes in the use of these techniques over a six-year period at a regional Australian centre and compares their procedural success, perioperative complications, and postoperative outcomes.

Materials And Methods

Study design and setting

A retrospective observational study was conducted of patients undergoing totally implantable venous access port (TIVAP) insertion at Goulburn Valley Health, a regional Australian general surgery unit. Consecutive TIVAP insertion episodes in adults between 1 January 2019 and 31 December 2024 were identified from institutional operative records. Each insertion episode was analysed as a separate observation, as outcomes related to individual procedures and devices. Repeat insertion episodes from the same patient were included; the analyses did not account for within-patient correlation.

Variables, data collection, and outcomes

Patient, procedural, and outcome data were obtained retrospectively from medical records, including operative reports and anaesthetic records, using a standardised data collection form.

Demographic variables included age and sex. Clinical variables included indication for port insertion, malignancy type, previous port, peripherally inserted central catheter (PICC) or central venous catheter (CVC) insertion, history of upper limb or neck deep venous thrombosis, and anticoagulant use. Procedural variables included insertion technique, laterality, vein selected, use of ultrasound guidance, number of insertion attempts, conversion of insertion technique, and conversion of access site. Insertion technique was classified according to the initially attempted approach: open venous cutdown or Seldinger. All procedural and postoperative outcomes were compared according to this initial technique, including when the procedure was completed using another technique. First-attempt success required successful insertion on the first attempt using the initial technique; any subsequent attempt, including conversion to another technique, was classified as a first-attempt failure. Guidewire assistance through the surgically exposed vein to guide passage of the catheter was considered an adjunct to open cutdown rather than conversion to percutaneous Seldinger insertion. Its use during the same initial venous-access attempt did not, in itself, constitute first-attempt failure. Technique conversion denotes a change from the initially attempted technique to the alternative technique.

Procedural outcomes included successful port insertion and immediate periprocedural complications, including bleeding, inadvertent arterial puncture, and pneumothorax. Postoperative outcomes included return to theatre within 30 days, port dysfunction within one year, port malposition, port infection within 30 days, port-associated thrombosis within one year, catheter fracture within one year, unplanned revision within one year, unplanned removal within one year, and 30-day mortality. Unplanned revision was defined as an unanticipated operative or interventional procedure required to restore or replace the port because of dysfunction, malposition, or another device-related complication. Unplanned removal within one year was defined as removal of the port within one year of insertion and before completion of the intended treatment because of a port- or procedure-related complication. One-year outcomes were ascertained from available hospital medical records, including oncology notes and emergency department presentations. Events managed entirely outside the hospital may not have been captured.

Statistical analysis

Continuous variables are presented as medians with interquartile ranges (IQRs) and were compared between insertion techniques using the Wilcoxon rank-sum test, with the Hodges-Lehmann estimator used to derive the median difference and its 95% confidence interval (CI). Categorical variables are presented as frequencies and percentages and were compared between insertion techniques using two-sided Fisher's exact tests, selected a priori because of small expected cell counts for several outcomes. For variables with more than two categories, a single overall Fisher's exact test was performed across all categories; where relevant, an individual category was additionally compared against all remaining categories combined. Odds ratios (ORs) comparing open cutdown with Seldinger insertion were calculated as the conditional maximum-likelihood estimate from Fisher's exact test, with exact 95% CIs. Where no events occurred in the open cutdown group, this yields an OR of 0.00 with a finite upper confidence limit; ORs were not estimated when no events occurred in either group. A two-sided p-value <0.05 was considered statistically significant. P-values were not adjusted for multiple comparisons.

Because open cutdown was used almost exclusively during the final two years of the study period, insertion technique and calendar time were closely associated. A sensitivity analysis was therefore performed for each technique-outcome comparison using (i) Firth's penalised logistic regression adjusting for calendar year as a continuous covariate and (ii) restriction to procedures performed during 2023-2024, the only period in which both techniques were used in substantial numbers. Firth's method was used in preference to conventional logistic regression because several outcomes showed complete or quasi-complete separation by technique, with no events in one group. Adjustment for additional covariates was not undertaken because of the small number of outcome events. The association between intraoperative ultrasound guidance and outcomes was examined as a secondary analysis in the whole cohort and within the Seldinger group. Statistical analyses were performed using R version 4.6.1 (R Foundation for Statistical Computing, Vienna, Austria).

Ethics

The study was approved by the Goulburn Valley Health Human Research Ethics Committee (HREC; reference QA/120915/GVH-2025-499431[v3]) on September 9, 2025. The requirement for individual informed consent was waived because of the retrospective study design and use of routinely collected clinical data.

Results

A total of 127 TIVAP insertion episodes were included, involving 117 unique patients. Of these, 10 underwent more than one insertion. Of the 127 insertion episodes, 42 (33.1%) initially used open venous cutdown, and 85 (66.9%) initially used the Seldinger technique. The distribution of insertion techniques changed over the study period (Figure *1*). Between 2019 and 2022, 57 of 58 insertion episodes (98.3%) initially used the Seldinger technique. During 2023-2024, open cutdown accounted for 41 of 69 insertions (59.4%), including 29 of 39 insertions (74.4%) performed in 2024.

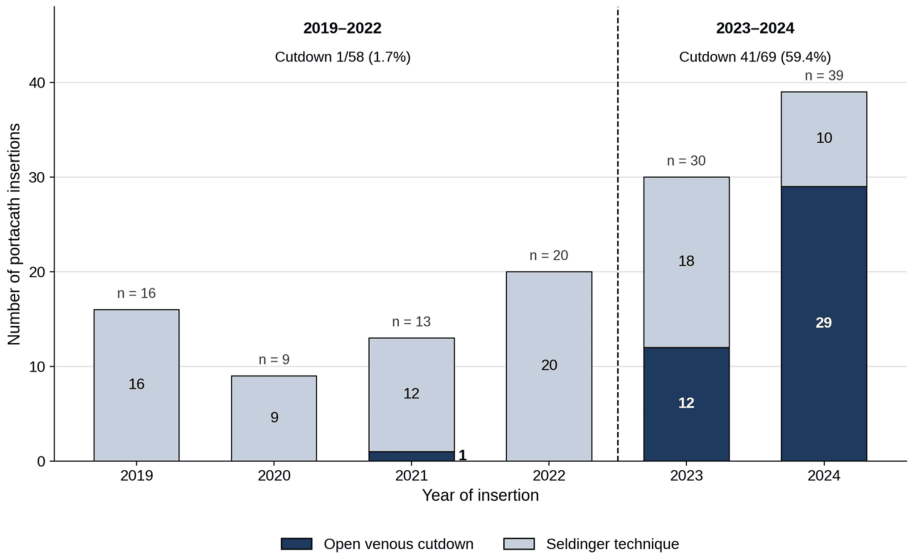


FIGURE 1: Annual TIVAP insertions according to initially attempted technique. Open venous cutdown accounted for 1 of 58 insertions (1.7%) performed between 2019 and 2022, compared with 41 of 69 insertions (59.4%) performed during 2023–2024.

TIVAP: totally implantable venous access port.

The median age was 60 years (IQR 53-70) in the open cutdown group and 63 years (IQR 53-73) in the Seldinger group (median difference −2.0 years, 95% CI −6.0 to 3.0; p = 0.453). There were no statistically significant differences between groups in sex, indication, previous central venous access, insertion laterality, or intraoperative ultrasound use (Table *1*). Known neck or upper-limb deep-vein thrombosis (14.3% vs 3.5%; OR 4.50, 95% CI 0.90-29.32; p = 0.058) and anticoagulant use (21.4% vs 9.4%; OR 2.60, 95% CI 0.81-8.51; p = 0.094) were more frequent in the open cutdown group, although neither difference reached statistical significance. Intraoperative ultrasound guidance was used in 7 of 127 procedures (5.5%), all of which were Seldinger insertions.

Characteristic	Open cutdown (n = 42)	Seldinger (n = 85)	P-value
Patient characteristics			
Age, years, median (IQR)	60 (53-70)	63 (53-73)	0.453[a]
Sex			0.569
Male	20 (47.6)	35 (41.2)	
Female	22 (52.4)	50 (58.8)	
Indication			0.065
Non-malignant	0 (0.0)	9 (10.6)	
Solid malignancy	41 (97.6)	73 (85.9)	
Haematological malignancy	1 (2.4)	3 (3.5)	
Solid tumour type[b]			0.96
Colorectal	19 (46.3)	31 (42.5)	
Breast	8 (19.5)	16 (21.9)	
Lung	4 (9.8)	8 (11.0)	
Hepatobiliary	4 (9.8)	8 (11.0)	

Upper gastrointestinal	2 (4.9)	4 (5.5)	
Gynaecological	1 (2.4)	4 (5.5)	
Skin	2 (4.9)	1 (1.4)	
Urological	1 (2.4)	1 (1.4)	
Previous port, PICC or CVC	20 (47.6)	31 (36.5)	0.252
Known neck or upper-limb DVT	6 (14.3)	3 (3.5)	0.058
On anticoagulation	9 (21.4)	8 (9.4)	0.094
Procedural characteristics			
Right-sided insertion	36 (85.7)	66 (77.6)	0.348
Ultrasound guidance	0 (0.0)	7 (8.2)	0.095
Vein accessed[c]			<0.001
Subclavian	0 (0.0)	77 (90.6)	
Cephalic	41 (97.6)	0 (0.0)	
Internal jugular	0 (0.0)	8 (9.4)	
Femoral	1 (2.4)	0 (0.0)	

TABLE 1: Baseline patient and procedural characteristics by insertion technique.

Values are n (%) unless otherwise stated. Percentages are of the technique group (open cutdown n = 42; Seldinger n = 85) unless otherwise stated. Technique is classified according to the initially attempted approach.

P-values are from two-sided Fisher's exact tests (Freeman–Halton extension for variables with more than two categories, giving one overall P value per variable), except for age.

[a] Wilcoxon rank-sum test; Hodges–Lehmann median difference (open cutdown minus Seldinger) −2.0 years (95% CI −6.0 to 3.0).

[b] Percentages are of patients with solid malignancy (open cutdown n = 41; Seldinger n = 73).

[c] Initial access vein is closely linked to the initially attempted technique (open cutdown: cephalic or femoral vein; Seldinger: subclavian or internal jugular vein).

CI, confidence interval; CVC, central venous catheter; DVT, deep vein thrombosis; IQR, interquartile range; PICC, peripherally inserted central catheter.

Overall, 118 procedures (92.9%) were performed for malignant indications, comprising 114 solid and four haematological malignancies. All nine procedures performed for non-malignant indications were Seldinger insertions (10.6% vs 0.0%; p = 0.029 compared with malignant indications combined), although the overall distribution of indications did not differ significantly between groups (p = 0.065). Colorectal cancer was the most common solid malignancy (50/114, 43.9%), followed by breast (24/114, 21.1%), lung (12/114, 10.5%), and hepatobiliary cancer (12/114, 10.5%), with no significant difference in solid tumour type between groups (p = 0.960) (Table *1*).

The initial access vein was closely linked to the initially attempted technique (p<0.001). The initial access vein was cephalic in 41 of 42 open cutdown attempts (97.6%) and femoral in the remaining attempt. It was subclavian in 77 of 85 Seldinger attempts (90.6%) and internal jugular in the remaining eight (9.4%).

First-attempt insertion was successful in 37 open cutdown procedures (88.1%) and 70 Seldinger procedures (82.4%; OR 1.58, 95% CI 0.50-6.00; p = 0.451). Conversion to the alternative technique was recorded after four initially attempted open cutdowns (9.5%) and six initially attempted Seldinger insertions (7.1%; OR 1.38, 95% CI 0.27-6.23; p = 0.729). Access-site conversion occurred in two (4.8%) and nine (10.6%) procedures, respectively (OR 0.42, 95% CI 0.04-2.19; p = 0.336). All 127 procedures ultimately resulted in successful TIVAP insertion. Guidewire assistance through the surgically exposed vein under fluoroscopic guidance was used to facilitate catheter advancement in 11 cephalic cutdown procedures.

Recorded periprocedural complications occurred exclusively in the Seldinger group, comprising four bleeding events, four inadvertent arterial punctures, and one pneumothorax; none of the individual

comparisons reached statistical significance (Table 2). Return to theatre within 30 days occurred after four episodes initially attempted by Seldinger insertion and none initially attempted by open cutdown (p = 0.301).

Outcome	Open cutdown (n = 42)	Seldinger (n = 85)	OR (95% CI)	P value
Technical outcomes				
First-attempt successful insertion	37 (88.1)	70 (82.4)	1.58 (0.50-6.00)	0.451
Technique conversion	4 (9.5)	6 (7.1)	1.38 (0.27-6.23)	0.729
Access-site conversion	2 (4.8)	9 (10.6)	0.42 (0.04-2.19)	0.336
Periprocedural complications				
Bleeding	0 (0.0)	4 (4.7)	0.00 (0.00-3.06)	0.301
Arterial puncture	0 (0.0)	4 (4.7)	0.00 (0.00-3.06)	0.301
Pneumothorax	0 (0.0)	1 (1.2)	0.00 (0.00-78.83)	1
Postoperative and device-related outcomes				
Return to theatre ≤30 days	0 (0.0)	4 (4.7)	0.00 (0.00-3.06)	0.301
Port dysfunction ≤1 year	3 (7.1)	11 (12.9)	0.52 (0.09-2.13)	0.385
Port malposition	0 (0.0)	8 (9.4)	0.00 (0.00-1.14)	0.052
Port infection ≤30 days	0 (0.0)	1 (1.2)	0.00 (0.00-78.83)	1
Port-associated thrombosis ≤1 year	0 (0.0)	2 (2.4)	0.00 (0.00-10.81)	1
Catheter fracture ≤1 year	0 (0.0)	1 (1.2)	0.00 (0.00-78.83)	1
Revision, removal and mortality				
Unplanned revision ≤1 year	1 (2.4)	11 (12.9)	0.17 (0.00-1.22)	0.102
Unplanned removal ≤1 year	0 (0.0)	12 (14.1)	0.00 (0.00-0.67)	0.008
30-day mortality	0 (0.0)	0 (0.0)	NE	—

TABLE 2: Procedural outcomes and complications by insertion technique.

Values are n (%) of the technique group. OR, odds ratio for episodes initially attempted by open cutdown relative to those initially attempted by Seldinger insertion, calculated as the conditional maximum-likelihood estimate from Fisher's exact test with exact 95% confidence interval (CI). An OR below 1 indicates lower odds of the listed event with open cutdown; for first-attempt successful insertion, an OR above 1 favours open cutdown. Where no events occurred in the open cutdown group, the estimate is 0.00 and only the upper confidence limit is informative.

P values are two-sided Fisher's exact tests. Estimates are unadjusted; estimates accounting for calendar period are presented in Table 3. Comparisons with few or no events are underpowered and do not demonstrate equivalence.

NE, not estimable (no events in either group).

Port dysfunction within one year occurred among three initially attempted open cutdown procedures (7.1%) and 11 Seldinger procedures (12.9%; OR 0.52, 95% CI 0.09-2.13; p = 0.385). Port malposition occurred among eight initially attempted Seldinger procedures (9.4%) and no open cutdown procedures (OR 0.00, 95% CI 0.00-1.14; p = 0.052). Port infection within 30 days (n = 1), port-associated thrombosis within one year (n = 2), and catheter fracture within one year (n = 1) occurred only in the initially attempted Seldinger group, with no significant differences between groups. Unplanned revision within one year occurred among one initially attempted open cutdown procedure (2.4%) and 11 Seldinger procedures (12.9%; OR 0.17, 95% CI 0.00-1.22; p = 0.102). Unplanned removal within one year occurred among 12 initially attempted Seldinger procedures (14.1%) and no open cutdown procedures (OR 0.00, 95% CI 0.00-0.67; p = 0.008). No deaths within 30 days were recorded in either group.

Because open cutdown use was concentrated in 2023-2024, each technique-outcome comparison was re-examined after adjustment for calendar year and after restriction to the 2023-2024 period (Table 3). After adjustment for calendar year, the association between open cutdown and unplanned removal was no longer

statistically significant (OR 0.11, 95% CI 0.00-1.14; p = 0.067). During 2023-2024, unplanned removal occurred following three of 28 Seldinger procedures (10.7%) and none of 41 open cutdown procedures (OR 0.00, 95% CI 0.00-1.60; p = 0.063). The borderline difference in port malposition was similarly attenuated (year-adjusted OR 0.32, 95% CI 0.00-4.83; p = 0.446), with one malposition during 2023-2024, following Seldinger insertion (p = 0.406). No technique-outcome comparison was statistically significant under either approach.

Outcome	Year-adjusted, full cohort[a]		2023-2024 only[b]			
	OR (95% CI)	P value	Open cutdown (n = 41)	Seldinger (n = 28)	OR (95% CI)	P-value
Technical outcomes						
First-attempt successful insertion	2.35 (0.71-8.40)	0.163	36 (87.8)	21 (75.0)	2.37 (0.57-10.77)	0.205
Technique conversion	0.49 (0.11-2.11)	0.333	4 (9.8)	4 (14.3)	0.65 (0.11-3.86)	0.706
Access-site conversion	0.25 (0.04-1.15)	0.075	2 (4.9)	4 (14.3)	0.31 (0.03-2.38)	0.214
Periprocedural complications						
Bleeding	0.38 (0.00-7.75)	0.542	0 (0.0)	0 (0.0)	NE	—
Arterial puncture	0.38 (0.00-7.75)	0.542	0 (0.0)	0 (0.0)	NE	—
Pneumothorax	6.50 (0.01->1000)	0.544	0 (0.0)	0 (0.0)	NE	—
Postoperative and device-related outcomes						
Return to theatre ≤30 days	0.21 (0.00-3.17)	0.275	0 (0.0)	1 (3.6)	0.00 (0.00-26.63)	0.406
Port dysfunction ≤1 year	1.58 (0.29-8.79)	0.592	3 (7.3)	2 (7.1)	1.03 (0.11-13.08)	1
Port malposition	0.32 (0.00-4.83)	0.446	0 (0.0)	1 (3.6)	0.00 (0.00-26.63)	0.406
Port infection ≤30 days	0.45 (0.00-24.85)	0.67	0 (0.0)	0 (0.0)	NE	—
Port-associated thrombosis ≤1 year	0.27 (0.00-6.16)	0.414	0 (0.0)	1 (3.6)	0.00 (0.00-26.63)	0.406
Catheter fracture ≤1 year	0.28 (0.00-9.90)	0.466	0 (0.0)	1 (3.6)	0.00 (0.00-26.63)	0.406
Revision, removal and mortality						
Unplanned revision ≤1 year	0.43 (0.04-2.74)	0.383	1 (2.4)	2 (7.1)	0.33 (0.01-6.65)	0.562
Unplanned removal ≤1 year	0.11 (0.00-1.14)	0.067	0 (0.0)	3 (10.7)	0.00 (0.00-1.60)	0.063
30-day mortality	NE	—	0 (0.0)	0 (0.0)	NE	—

TABLE 3: Sensitivity analysis of the association between insertion technique and outcomes, accounting for calendar period.

OR, odds ratio for episodes initially attempted by open cutdown relative to those initially attempted by Seldinger insertion; CI, confidence interval. Unadjusted estimates for the full cohort (n = 127) are presented in Table 2.

[a] Firth's penalised logistic regression including insertion technique and calendar year (continuous). Upper confidence limits above 1000 are shown as >1000.

[b] Restricted to the 69 procedures performed during 2023–2024, the only period in which both techniques were used in substantial numbers. Values are n (%) of the technique group; ORs and P values are from two-sided Fisher's exact tests, as in Table 2.

NE, not estimable (no events in either group, or in the relevant analysis period).

Intraoperative ultrasound guidance was used in seven of 127 insertion episodes (5.5%), all within the Seldinger group. This represented seven of 85 Seldinger episodes (8.2%), with the remaining 78 episodes (91.8%) performed without ultrasound guidance. Within the Seldinger group, no outcome differed significantly between the seven ultrasound-guided and 78 non-guided procedures, including bleeding (1/7 vs

3/78; p = 0.296) and inadvertent arterial puncture (1/7 vs 3/78; p = 0.296), although the small number of ultrasound-guided procedures substantially limited this comparison. No open cutdown procedure was performed with ultrasound guidance, precluding comparison within that group.

Discussion

This study describes a marked change in TIVAP insertion practice at a regional Australian general surgery unit over a six-year period, with open venous cutdown increasing from 1.7% of insertions during 2019-2022 to 59.4% during 2023-2024 and 74.4% in 2024. Despite this change in practice, first-attempt success, technique conversion, and access-site conversion did not differ significantly between open cutdown and Seldinger insertion, and all 127 procedures ultimately resulted in successful TIVAP placement. All recorded periprocedural complications occurred following Seldinger insertion. Unplanned removal within one year was significantly less frequent following open cutdown in the unadjusted analysis, although this difference was no longer statistically significant after accounting for calendar period.

First-attempt success was high with both techniques in the present cohort (88.1% for open cutdown and 82.4% for Seldinger), with no significant difference between groups. Technique conversion occurred after 9.5% of initially attempted open cutdowns and 7.1% of initially attempted Seldinger insertions. Because outcomes were grouped by the initial technique, these conversions remained in their original technique groups. These findings nonetheless differ somewhat from the pooled randomised evidence. A meta-analysis of six randomised trials involving 1,831 patients found primary technique failure to be significantly more frequent with open cutdown than with closed cannulation (OR 2.36, 95% CI 1.05-5.32) [5]. Orci et al. (2014) similarly found a higher primary implantation failure rate with surgical cutdown, with no statistically significant difference in procedure duration [13]. Earlier observational data similarly demonstrated that open surgical placement may require conversion to a percutaneous approach, with Seiler et al. reporting successful primary surgical placement in 79.5% of 400 patients and a higher complication rate among patients requiring conversion [14]. In the present study, however, all procedures were ultimately successful, suggesting that both approaches can achieve high procedural success in contemporary regional surgical practice. The relatively small sample size and wide confidence intervals preclude conclusions regarding equivalence or superiority between techniques.

In 11 cephalic cutdown procedures, a guidewire was introduced through the surgically exposed vein under fluoroscopic guidance to facilitate catheter advancement. This remained an open cutdown approach, without the dilators or peel-away sheath used in the modified Seldinger technique described by Knebel et al. [15]. Although the techniques differ, their randomised trial found no statistically significant difference in primary implantation success between standard open insertion and the modified technique and supported the modified technique as a rescue option when standard open insertion failed. Guidewire assistance may similarly be a useful adjunct to open cutdown, although the small number of cases in our cohort precluded a meaningful separate evaluation of its outcomes.

The occurrence of all recorded early periprocedural complications in the Seldinger group is consistent with a systematic literature review reporting pleural and arterial injuries following percutaneous insertion [16]. Orci et al. (2014) reported pneumothorax exclusively following percutaneous puncture, although the pooled comparison did not demonstrate a statistically significant difference between approaches [13]. In a randomised comparison of three permanent central venous access systems involving 228 patients, Vandoni et al. reported 10 pneumothoraces (4.3%) [17]. The multicentre PORTAS-3 trial randomised 1,205 patients to a primary open strategy based on cephalic vein cutdown, with modified Seldinger assistance if required, or a primary closed strategy using subclavian vein puncture. The modified intention-to-treat analysis included 1,159 patients. Pneumothorax or haemothorax occurred significantly less frequently with the primary open strategy (OR 0.27, 95% CI 0.09-0.88), although operating time was shorter with the closed strategy [18]. These findings were subsequently supported by the meta-analysis of Klaiber et al. (2021), which demonstrated a significantly lower risk of pneumothorax with open cutdown (OR 0.31, 95% CI 0.12-0.78), although no significant differences were identified in other pooled morbidity outcomes [5]. An earlier literature review similarly reported higher rates of early complications, including pneumothorax, haemothorax, and arterial puncture, following percutaneous insertion compared with surgical cutdown [4].

These complications should be interpreted in light of how percutaneous access was performed. Ultrasound guidance was used in only seven of 85 Seldinger insertions (8.2%). The literature has shown that ultrasound guidance reduces arterial puncture and haematoma during subclavian cannulation [7-8], with larger reductions in complications demonstrated for internal jugular access [6], and is recommended in current guidelines [9-10]. The limited ultrasound use in our study could have contributed to the observed complications, but this cannot be established from the current data. An arterial puncture was also recorded in the ultrasound-guided subgroup, and the small number of guided procedures precluded a reliable assessment of its effect. Biffi et al. found no difference in early complications between ultrasound-guided subclavian access and cephalic cutdown [11], suggesting that the differences observed here may not apply where ultrasound-guided access is routine.

Australian data are limited but demonstrate a similar relationship between access route and procedural outcomes. Dastouri et al. (2022), in a retrospective study across two peripheral Brisbane hospitals, compared

TIVAP insertion performed by surgeons and radiologists and found that ultrasound-guided internal jugular insertion achieved the highest first-attempt success rate in both groups [12]. Pneumothorax occurred following central venous cannulation but was not observed following open cephalic cutdown. These findings highlight another important consideration in interpreting the present study: insertion technique and anatomical access were inseparable. Initial open cutdown was attempted almost exclusively via the cephalic vein (97.6%), whereas initial Seldinger insertion was attempted predominantly via the subclavian vein (90.6%), with the remainder via the internal jugular vein. Consequently, the observed differences cannot establish whether outcomes were attributable to insertion technique itself, the vein accessed, or a combination of both.

Late device-related outcomes demonstrated a similar pattern, but with considerable statistical uncertainty. Unplanned removal within one year occurred following 14.1% of Seldinger procedures and no open cutdown procedures (p=0.008), while unplanned revision (2.4% versus 12.9%; OR 0.17, 95% CI 0.00-1.22) and port malposition (0% versus 9.4%; p=0.052) were numerically less frequent following open cutdown. However, the association with unplanned removal was sensitive to the concentration of open cutdown in the later study period. After adjustment for calendar year, the OR was 0.11 (95% CI 0.00-1.14; p=0.067), and among procedures performed during 2023-2024, when both techniques were in routine use, unplanned removal occurred following three of 28 Seldinger procedures (10.7%) and none of 41 open cutdown procedures (p=0.063). The point estimate therefore continued to favour open cutdown, but the confidence intervals included no difference, and the restricted analysis was based on only three events. These data cannot distinguish a genuine effect of technique from confounding by calendar period or limited statistical power, and these findings should therefore be regarded as hypothesis-generating rather than evidence of a difference between techniques.

The increasing use of open cutdown during the latter part of the study period is noteworthy. As a retrospective study, however, the reasons underlying this change cannot be reliably determined from the available data. Changes in operator practice, procedural experience, patient selection, or other local factors may have contributed. There was some evidence that patient selection differed between techniques: all procedures for non-malignant indications were performed using the Seldinger technique, whereas known neck or upper-limb deep-vein thrombosis and anticoagulant use were more frequent in the open cutdown group, although these differences did not reach statistical significance. More importantly, the change in practice is relevant when interpreting the outcome comparisons because insertion technique and calendar period were closely associated. Although adjustment for calendar year and restriction to 2023-2024 partly addressed this, temporal changes in patient characteristics, procedural practice, or other aspects of perioperative care may still have influenced outcomes independently of insertion technique.

Several limitations should be acknowledged. First, this was a retrospective, single-centre study with a relatively small sample size. The low absolute number of adverse events limited statistical power and precluded meaningful multivariable adjustment for potential confounders beyond calendar year. Second, insertion technique was inseparable from anatomical access, with initial open cutdown attempted almost exclusively via the cephalic vein and initial Seldinger insertion via the subclavian or internal jugular vein. The independent effects of insertion technique and access vein therefore cannot be separated in this cohort. Third, the marked change in technique distribution over time introduces potential temporal confounding. Although sensitivity analyses adjusting for calendar year and restricted to 2023-2024 were undertaken, residual confounding from changes in operator experience, patient selection, or perioperative practice cannot be excluded. Fourth, outcomes were analysed according to the initially attempted technique, so complications and later device outcomes after conversion remained attributed to the initial approach. The effect of the technique ultimately used cannot be separated from that of the initial strategy in these converted cases. In addition, each insertion episode was analysed as an independent observation, without accounting for patients who underwent more than one insertion. The statistical analyses did not account for within-patient clustering; confidence intervals and p-values should therefore be interpreted cautiously. Data were obtained retrospectively from medical records and were therefore dependent on the completeness and accuracy of clinical documentation. Late outcomes were assessed within one year of insertion; events managed entirely outside the hospital may have been missed. Finally, the single-centre regional setting may limit generalisability to centres with different patient populations, operator experience, procedural practices, or access to interventional radiology.

Despite these limitations, this study provides contemporary Australian regional data comparing open venous cutdown and Seldinger TIVAP insertion within a single general surgical unit over six years. Both techniques achieved high overall procedural success. Periprocedural complications occurred exclusively among initially attempted Seldinger procedures in this cohort, while unplanned removal within one year was less frequent following open cutdown, although this difference did not remain statistically significant after accounting for calendar period. Given the inseparable relationship between insertion technique and anatomical access, and the close association between technique and calendar period, these findings should not be interpreted as demonstrating superiority of one technique over the other. Rather, they support open venous cutdown as an effective option for TIVAP insertion and highlight the need for larger multicentre studies capable of accounting for anatomical access, temporal changes in practice, operator factors, and contemporary use of ultrasound-guided percutaneous techniques.

Conclusions

Open cutdown and Seldinger insertion both achieved high procedural success in this regional cohort. However, insertion technique was closely associated with anatomical access and calendar period, and ultrasound guidance was infrequently used in the Seldinger group. Periprocedural complications occurred exclusively among initially attempted Seldinger procedures, and unplanned removal within one year was less frequent following open cutdown in the unadjusted analysis, although this difference was not statistically significant after accounting for calendar period. As insertion technique largely determines vein choice and uptake of open cutdown was concentrated in the later study period, larger studies accounting for anatomical access and temporal changes in practice are required to determine whether these differences are attributable to insertion technique itself.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Cambo Keng, Xin Yi Goai, Wan Amir Wan Hassan, Frans Pretorius

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Goulburn Valley Health Human Research Ethics Committee issued approval QA/120915/GVH-2025-499431[v3] dated September 9, 2025. The requirement for individual informed consent was waived because of the retrospective study design and use of routinely collected clinical data. The study met the requirements of the National Statement on Ethical Conduct in Human Research (NHMRC, 2023) and the Australian Code for the Responsible Conduct of Research (NHMRC, 2018); it is consistent with Ethical Considerations in Quality Assurance and Evaluation Activities (NHMRC, 2014). **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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