

Interventional radiology placement of totally implantable venous access devices in oncology practice

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In November 1929, Werner Forssmann, a German surgical resident, attempted the first documented central venous catheter with a 35 cm-long catheter via his left antecubital vein.¹ Although revolutionary for his time, this innovation encountered significant opposition, and he was expelled from his training programme for this unauthorised experimentation. Despite the initial censure, his idea garnered interest across the Atlantic in the US, where Andre Counard and Dickinson Richards, in the 1940s, refined his technique and used it for cardiovascular research. In 1956, Forsmann, Counard and Richards were awarded the Nobel Prize in Physiology for their work on central venous access.² Since then, a wide variety of central venous access options have emerged. However, totally implanted venous access device (TIVAD) is unique in that it has no exposed catheter parts. This reduces the risk of catheter-related infection, increases the longevity of the access and makes it low maintenance.³ Infuse-A-Port was the first described TIVAD, reported by Niederhuber et al.² in 1982. Since then, they have been colloquially called “ports”, among other names such as port-a-cath and chemoport. Among the scientifically appropriate descriptors, TIVAD, subcutaneous venous access device (SVAD) and totally implanted venous access port (TIVAP) are frequently used in medical literature. These devices have a reservoir or chamber implanted subcutaneously. A catheter connected to this reservoir is pulled through a subcutaneous tunnel and inserted into a large vein, with its tip usually placed in a central vein. The reservoir has a self-sealing silicone diaphragm that is punctured percutaneously with a non-coring needle to gain venous access. Traditionally, TIVADs were inserted by surgeons in operating theatres; however, with the transition to imaging-guided insertion, these devices are now implanted by interventional radiologists in most high-volume centres. Interventional radiology (IR) guided placement of TIVADs has been reported to be cheaper, faster and safer with higher placement success and more accurate positioning.⁴

With advances in healthcare, the incidence of treatable oncological conditions is increasing, along with the corresponding requirement for safe, reliable, long-term vascular access options. TIVADs have revolutionised modern oncologic care, providing a reliable and minimally invasive means for long-term venous access. Being entirely subcutaneous, they are aesthetically appealing and minimally interfere with the patient's quality of life (e.g. they can swim or shower normally, unlike patients with externally hanging catheter parts). A recent *Lancet* report of a randomised controlled trial by Moss et al.—comparing Hickman-type tunnellled catheters, peripherally inserted central catheters, and TIVADs for systemic anticancer treatment—found the ports to be more effective and safer than the others.⁵ Most published studies on larger cohorts of patients with TIVADs are from Western centres with limited Asiatic data in medical literature. In this issue of the *Annals*, the paper by Tashi et al.⁶ has special relevance. This retrospective study from Singapore, with a large sample size of 1180 oncological patients, offers a robust dataset to analyse the safety, efficacy and complications associated with the IR placement of TIVADs. The authors report a 100% technical success rate, with most TIVADs placed in the right internal jugular vein. The mean dwell duration was 342 days, with 2.1% removed due to infection, 0.6% due to malfunction, 0.6% due to port extrusion and 0.1% at the patient's request. The procedural safety is reinforced by the low rates of major complications, such as device extrusion (0.6%), venous thrombosis (0.25%), port inversion (0.1%) and catheter-related bloodstream infections (0.25%), which are comparable to international benchmarks.

Traditionally, the reservoir of the TIVADs is sutured to the underlying pectoral fascia through the dedicated slots for anchoring sutures provided by the manufacturer. These sutures are meant to reduce the likelihood of port inversion or migration.

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Tashi et al.⁶ reported a trend of decreasing usage (from 63.3% in 2019 to 27.8% in 2021) of these anchoring sutures in their practice. Their rationale for skipping this step is the unproven benefit of such sutures and the perceived reduction in procedure time. Interestingly, the single instance of flipping of the port reported in this study happened in a patient without such anchoring sutures. In a series of 534 ports placed without anchoring sutures, McNulty et al.⁷ argued against the need for anchoring sutures, claiming their port flipping rate of 0.2% is comparable with other published series where the ports were anchored. However, they did not have any internal comparison in their series nor insights into specific patient characteristics or technical details from other series where ports flipped despite having anchoring sutures. Intuitively, port rotation can occur despite anchoring sutures when using absorbable sutures, loose stitching or fixation to the subcutaneous tissue instead of the pectoral fascia. Given the low probability of a properly placed port within a snug subcutaneous pocket flipping, the sample size may have to be extremely large to prove or disprove a statistically significant difference between the techniques. While one could argue on this subject ad nauseam, in our practice, we do not hesitate to spend a few additional minutes placing anchoring sutures, as they could prevent an avoidable complication.

In TIVAD implantation, the emphasis is on meticulous periprocedural asepsis, and antibiotic prophylaxis is not usually recommended.⁸ In a randomised, double-blind, placebo-controlled trial of 404 patients with well-matched preoperative variables and comorbidities, there was no significant difference in surgical site infection rates. A meta-analysis of 2154 patients, specifically enquiring about the role of antibiotic prophylaxis with TIVAD insertion, did not find any significant effect on infection rates. It concluded by reminding the medical community of the hazards of unnecessary antibiotic administration, including a higher risk of allergic reactions, the development of multidrug-resistant organisms, and additional costs to the healthcare system.¹⁰ Although Tashi et al. reported the routine use of prophylactic antibiotics in their institution, they discussed the debatable nature of this practice.

Overall, this real-world data successfully demonstrate that the radiological placement of TIVADs is a safe, effective and reliable modality for long-term venous access in oncology patients.

Sharing such positive and educational experiences can potentially benefit oncology patients in Asia at large by promoting the wider adoption of TIVADs in this region. The detailed technical and contextual nuances provided in this paper could also serve as a benchmark for future reference and research.

Declaration

A/Prof (Dr) Anil has undertaken proctoring assignments as well as organised workshops for Becton Dickinson, which manufactures TIVADs. Financial remuneration towards these activities was paid to the employer.

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REFERENCES

1. Forssmann, W. Die Sondierung des Rechten Herzens. *Klin Wochenschr* 1929;8:2085.
2. Niederhuber JE, Ensminger W, Gyves JW, et al. Totally implanted venous and arterial access system to replace external catheters in cancer treatment. *Surgery* 1982;92:706-12.
3. Groeger JS, Lucas AB, Thaler HT, et al. Infectious morbidity associated with long-term use of venous access devices in patients with cancer. *Ann Intern Med* 1993;119:1168-74.
4. Walser EM. Venous access ports: indications, implantation technique, follow-up, and complications. *Cardiovasc Intervent Radiol* 2012;35:751-64.
5. Moss JG, Wu Q, Bodenham AR, et al. Central venous access devices for the delivery of systemic anticancer therapy (CAVA): a randomised controlled trial. *Lancet* 2021; 398:403-15.
6. Tashi S, Tan AB, Chua JME, et al. Radiologic placement of totally implantable venous access devices: Outcomes and complications from a large oncology cohort. *Ann Acad Med Singap* 2025;54:27-35.
7. McNulty NJ, Perrich KD, Silas AM, et al. Implantable subcutaneous venous access devices: is port fixation necessary? A review of 534 cases. *Cardiovasc Intervent Radiol*;33:751-5.
8. Sugawara S, Sone M, Sakamoto N, et al. Guidelines for Central Venous Port Placement and Management (Abridged Translation of the Japanese Version). *Interv Radiol (Higashimatsuyama)* 2023;8:105-17.
9. Karanlik H, Kurul S, Saip P, et al. The role of antibiotic prophylaxis in totally implantable venous access device placement: results of a single-center prospective randomized trial. *Am J Surg* 2011;202:10-5.
10. Johnson E, Babb J, Sridhar D. Routine antibiotic prophylaxis for totally implantable venous access device placement: meta-analysis of 2,154 patients. *J Vasc Interv Radiol* 2016; 27:339-43.