Closed System Arterial Lines in the Pediatric Intensive Care Unit

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BACKGROUND

The standard practice of closed-system arterial lines is increasingly being implemented in Pediatric Intensive Care Units (PICUs) to increase the safety of patients and the quality of blood samples. Such systems are, therefore, very essential in minimizing blood loss, eliminating risk of infection, and thus preventing what is commonly called iatrogenic anemia, which is more predominant in pediatric patients who are critically ill (Edwards Lifesciences, 2021). Closed system arterial lines are a closed fluid-to-fluid connection minimizing contact with blood-borne pathogens and multiple line adjustments, which could cause contamination and other related complications (Lippincott Procedures, 2024). Traditionally, open blood sampling techniques have been known to present certain dangers, such as air embolism, improper sample collection, and elevated incidences of infections. It is for this reason, in contemporary PICU settings, closed systems have been favored.

Adopting Closed Blood Sampling (CBS) as part of Patient Blood Management (PBM) as standard procedure in the Pediatric Intensive Care Unit (PICU) may help achieve positive patient outcome while providing cost-effective care. CBS is demonstrated to more effectively conserve blood, improve patient outcomes and reduce costs when compared with conventional blood sampling procedures.

PURPOSE

This aims to apply evidence-based practice recommendations for arterial lines regarding closed versus open systems use and to justify transitioning to their use in the PICU at UMC.

METHODS

- This project used systematic review methods. It analyzed 63 studies on blood loss.

- Meta-analysis assessed the impact of interventions

- Statistical techniques compared blood conservation effectiveness.

- Reviewing current practice on arterial line monitoring and blood sampling.
- Comparing the process of collection of closed blood sampling system versus and open system.
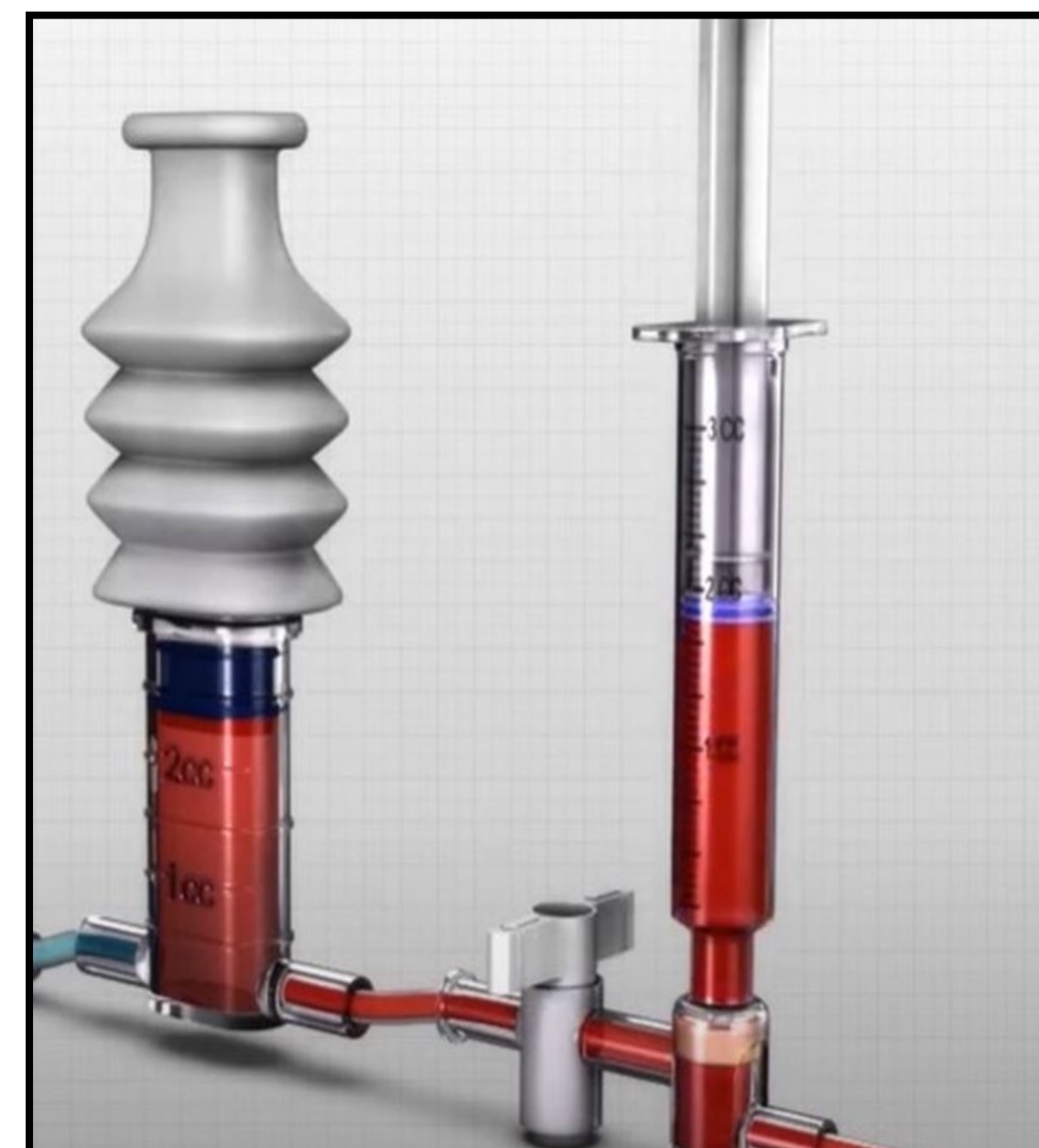
1. Locate the blood conservation reservoir and blood sampling port on the arterial pressure monitoring system's tubing and turn and close the distal shut off valve (perpendicular to tubing).

2. Open the valve or stopcock to the blood conservation reservoir.

3. Hold the reservoir upright and fill with the discard blood.

4. Turn off the one-way valve to the reservoir.

5. Attach a needleless cannula to the blood collection tube holder or syringe and swab proximal sample site.

6. Access the sampling port using the needleless cannula with the blood collection tube holder or syringe.

7. When sample obtained, grasp the needleless cannula with the blood collection tube holder or syringe and remove them as one device.

8. Turn the one-way valve to its original position, parallel to the tubing.

9. Open the valve to the discard blood and smoothly and evenly push down on the plunger of the reservoir until the flexures lock in place in the fully closed position and all blood is reinfused.

10. Transfer your sample to tubes using VAMP blood transfer unit needleless injection site.

RESULTS

The outcome highlighted that blood-conservatory devices helped to reduce blood loss among ICU patients by 25% (Whitehead et al., 2019). Closed-loop blood sampling systems were incredibly beneficial, as were blood conservation bundles (Keogh et al., 2023). Significant savings in daily blood loss (mean 15.5 mL/ patient vs. 32.7 mL/patient in traditional systems, $p < 0.001$) and transfusion requirements were also reported. There was also some indication that arterial line microbial colonization rates were lower with blood conservation systems than with the conventional method of 3-way stopcock catheterization (Oto et al., 2012). Nevertheless, the present sparse data on conservation devices permitted to decrease blood loss but failed to provide evidence about its influence on the following days' hemoglobin levels, transfusion requirements, or anemia risk (Whitehead et al., 2019; Raurell-Torredà et al., 2024). It is for these reasons that blood conservation strategies should be put in place in the ICUs to reduce blood loss while at the same time ensuring that none is compromised. Currently there are about 232 PICU's in the United States that use a closed blood sampling system.

CONCLUSIONS

- Closed system arterial lines promote blood conservation reducing ICU blood loss and subsequent iatrogenic anemia.
- Closed-loop systems cut transfusion rates effectively.
- Improved patient care and outcomes through reduced risk of infection.
- Implementation of a closed system arterial lines in the PICU

REFERENCES

References available by scanning the QR Code