NCMD

National Child Mortality Database

Knowledge, understanding and learning to improve young lives

Critical central venous line complications in neonates

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HQIP

Healthcare Quality Improvement Partnership

We thank all Child Death Overview Panels (CDOPs) who submitted data for the purposes of this report and all child death review professionals for submitting data and providing additional information when asked.

Background

The use of central venous catheters (CVCs) is an essential part of neonatal care for prolonged delivery of intravenous fluids and medication. The use of these catheters is associated with a number of complications. Extravasation into a body cavity is a recognised, rare, potentially fatal complication.

Initial concerns over adverse outcomes with fine-bore central venous lines led to the publication of Department of Health recommendations in 2001 that catheter tips should be "sited out with the cardiac chambers". However further work identified that identification of line tip, especially in the smallest infants, and lines was difficult (Odd et al[1]), and that even lines outside the heart may have significant complications. [2] [3] (Jogender Kumar et al (2018) and Manasi Garg et al (2017)

While novel techniques to identify their positioning have been proposed [4], variation in practice is still high. [5] (Arunoday & Zipitis (2017).

In 2015, BAPM published a framework for practice for central line insertion in neonates, with a further update in 2018 (Use of Central Venous Catheters in Neonates (Revised 2018) | British Association of Perinatal Medicine (bapm.org)). They recommended 'all central catheter tips should be positioned outside the cardiac silhouette'. This guidance does not relate to surgically placed central lines.

The NHS Long Term Plan identifies starting well as one of its key areas of work. This includes the commitment to halve the number of child deaths. Child Death Overview Panels (CDOPs) have identified issues around line insertion as a modifiable factor in relation to child death. This briefing summarises the major points for clinicians.

NCMD Data:

Across a 52 month period (April 2019 to August 2023 inclusive) NCMD identified 11 deaths of babies where long line or umbilical venous catheter (UVC) insertion was felt to be a contributory factor in their deaths. There were additionally 2 further deaths occurring prior to NCMD surveillance beginning in April 2019. Out of the total of 13, 12 babies were born at a preterm gestation (less than 37 weeks) and 11 were born at or before 28 weeks gestation. 12 infants were aged under 28 days at the time of death. 11 were extravasations from a UVC and 2 were from a percutaneous long line. 3/13 deaths

[1] Odd et al (2004)
[2] Jogender Kumar et al (2018)
[3] Manasi Garg et al (2017)
[4] Nagsen Telang at al (2017)
[5] Arunoday & Zipitis (2017)

recorded evidence of pericardial tamponade; 2 from a percutaneous Long Line insertion and 1 from a UVC extravasation.

Separately, between January 2019 and December 2022 the National Reporting and Learning system (NLRS) reported 41 incidents related to UVCs or long lines in infants under 3 months. 11/41 related to pericardial effusion/ tamponade.

BAPM Guidance:

In 2015, BAPM published a framework for practice for central line insertion in neonates with a further update in 2018 (Use of Central Venous Catheters in Neonates (Revised 2018) | British Association of Perinatal Medicine (bapm.org)

The findings of the Working Group recommend that:

- All central catheters should allow aspiration of blood in their final position, and this aspiration should be documented. Where aspiration is not possible, operators should be aware that this may indicate a malpositioned catheter.
- Any clinical deterioration of a baby in whom a central venous catheter is present should raise the question of catheter-related complications, particularly infection, extravasation and tamponade.
- All central catheter tips should be positioned outside the cardiac silhouette. An umbilical venous catheter (UVC) tip should ideally be sited at T8-T9 (assuming this lies outside the cardiac silhouette). A UVC tip sited at or below T10 carries a significantly higher risk of extravasation. It may be necessary to use these catheters in the short term, but they should be replaced at the earliest opportunity.

Summary

NCMD data shows malposition of a central venous line has contributed to 13 infant deaths. The majority of these are in premature babies and occur before 28 days of life. 11 related to extravasation from a UVC and 2 to a percutaneous long line. 3 deaths occurred in the context of pericardial tamponade.

In the absence of further research, the recommendations set out by BAPM (above) and the Department of Health recommendations should be followed. In particular:

- Clinicians should remain vigilant regarding the risks of extravasation (especially from UVCs) and pericardial tamponade in any infant under their care.
- Until further investigation is undertaken concerning the ideal positioning of the catheter tip, all central venous lines inserted specifically for parenteral nutrition in this age group should be sited outside of the cardiac chambers.

- UVC catheters with their tips at, or below, T10 should be replaced at the earliest opportunity.
- Routine assessment of line position should be by plain X-ray. If this is inadequate to identify the tip of the line advice should be sought from an experienced radiologist with regard to other imaging techniques (e.g. radio-opaque contrast medium and Ultrasound). If there is suspicion that the line is in the atrium it should be repositioned.

Further evidence that may be useful would include:

- Further research around the best way to identify and monitor the tip position of central lines.
- Establishment of a National Audit, mandatory reporting, or confidential inquiry, to identify the incidence and nature of long line and UVC complications.
- Further work to identify the optimal time for a UVC to be replaced with other venous access given the different risk profiles apparent between UVC's and percutaneous long lines.

The National Child Mortality Database (NCMD) Programme is commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP). HQIP is led by a consortium of the Academy of Medical Royal Colleges and the Royal College of Nursing. Its aim is to promote quality improvement in patient outcomes and to increase the impact that clinical audit, outcome review programmes and registries have on healthcare quality in England and Wales. HQIP holds the contract to commission, manage and develop the National Clinical Audit and Patient Outcomes Programme (NCAPOP), comprising around 40 projects covering care provided to people with a wide range of medical, surgical and mental health conditions. The programme is funded by NHS England, the Welsh Government and, with some individual projects, other devolved administrations and crown dependencies (www.hqip.org.uk/national-programmes).

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