Infusing TPN in babies too rapidly poses risk of severe harm and death

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PATIENT SAFETY
Working together

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Background

A Patient Safety Alert was issued on the 27 September warning of the risk of severe harm and death from infusing total parenteral nutrition (TPN, also known as PN) too rapidly in babies. Three incidents reported through the StEIS (Strategic Executive Information System) and a further report sent directly to the patient safety team by a clinician, rapidly highlighted the potentially under-recognised risk of contributory factors for inadvertent TPN overdose.

An analysis of incident reports (**FIGURE 1**) relating to TPN and sent to the National Reporting and Learning System (NRLS) by the patient safety team at NHS Improvement highlighted the scale of the issue as well as the contributory factors that were likely to be under-appreciated, prompting the issuing of the warning alert.

The alert

TPN is a method of providing nutrition directly into the bloodstream to those unable to absorb nutrients from the food they eat.

TPN is used in all age groups but in babies its use is often part of a temporary planned programme of nutrition to supplement milk feeds in those too immature to suckle or too sick to receive milk feeds as a result of intestinal conditions. TPN consists of both aqueous and lipid components, which are infused separately into the baby via specific administration sets and infusion pumps (**FIGURE 2**).

The rate at which TPN is administered to a baby is crucial: if infused too fast there is a risk of fluid overload, potentially leading to coagulopathy, liver damage and impaired pulmonary function as a result of fat overload syndrome. In a recent three and a half year period, ten incidents were identified where infusion of the aqueous and/or lipid component of TPN at the incorrect rate resulted in severe harm to babies through pulmonary collapse, intraventricular haemorrhage or organ damage, and where intensive intervention and treatment were needed. Most of these incidents involved too rapid a rate of infusion. Review of samples of 'low harm' and 'no harm' reports (including 'near misses') in the same period suggested around 700 similar incidents were reported.

Three main types of error were identified:

1. The administration set primed with lipid was threaded through the infusion pump intended for the aqueous component and vice versa. Lipids were therefore infused at the rate intended for the aqueous solution and the aqueous solution at the rate for the lipids. A key factor underlying this error appeared to be near identical protective outer covers on the two infusion bags as the contents for both need to be protected from ultraviolet light. A sample report reads:
   "Noted at 23.00 that lipid bag was empty. Pump rate had been set the opposite way round so lipids were running at 17.3mL/hour and aqueous at 2.5mL/hour."
2. The incorrect infusion rate was entered into the administration pump.
3. Miscalculation of volumes when fluid or pump-related changes were made.

While a double-checking system at the cot side plays a vital role in reducing the risk of administration error, it cannot be relied upon in isolation. The use of visually distinct light covers, different syringe pumps and administration sets for the two

The NRLS was searched on 7 August 2017 for incidents reported as occurring between 1 January 2014 and 30 June 2017 (NRLS reference number 3942; incident category lvl1 equal to medication; keywords = Vamin, TPN, lipid, parenteral nutrition, PN bag, PN feed, PN line).

Filters identifying neonatal incidents and babies aged less than one year were applied and all identified incidents for which the reported degree of harm was moderate, severe or death were reviewed.

A sample of 150 out of 2,599 incidents from the 'neonatal dataset' where the degree of harm is 'no' or 'low harm' were reviewed. Of the 150 incidents reviewed, 32 were relevant, which suggests around 550 incidents would have been found if the whole sample of 2,599 incidents had been reviewed.

A sample of 150 out of 1,082 incidents from the 'young babies dataset' where the degree of harm is 'no' or 'low harm' were reviewed. Of the 150 incidents reviewed, 22 were relevant, which suggests around 160 incidents would have been found if the whole sample of 1,082 incidents had been reviewed.

The StEIS was searched on 5 September 2017 for serious incidents reported between 20 May 2015 and 30 June 2017 containing the keywords Vamin, TPN, lipid, parenteral nutrition, PN bag, PN feed and PN line.

FIGURE 1 Methodology and technical notes.

components; use of safety software within administration pumps; training and competency assessments; double checking by pharmacists as part of an additional measure while on rounds, and regular checks of fluid volumes infused may all have a role in reducing the risk of similar incidents.

Actions

The alert is targeted at all organisations providing NHS-funded care to neonates and children (especially those under 30kg) and where TPN is administered.

The actions were required to commence immediately and be completed no later than 8 November 2017. These actions included the need to:

1. identify if TPN is used in your neonatal and paediatric departments
2. bring the alert to the attention of all those with a leadership role in the prescribing and administration of TPN in neonatal and paediatric settings
3. consider if immediate action is needed locally, and ensure that an action plan is underway to reduce the risk of harm to babies through TPN administration
4. communicate the key messages in this alert, and your organisation's plan for managing those risks, to all relevant staff.

If there are any resources or examples of work developed in relation to this alert that you think would be useful to others, please share them by emailing patientsafety.enquiries@nhs.net

Through the voluntary reporting of incidents relating to TPN administration, together we have been able to raise awareness of the potential for severe harm.

FIGURE 2 Administration of total parenteral nutrition.

Patient safety incidents can be reported to the NRLS through local reporting systems within hospitals. Alternatively if you are aware of a new or under-recognised issue that you believe should be acted on, please email patientsafety.enquiries@nhs.net.

A patient-reporting eForm is also available and the content is reviewed alongside all other NRLS data, should patients or the public wish to report directly.

Join us to help improve patient safety

British Association of Perinatal Medicine

In collaboration with BAPM, *Infant* journal is keen to help improve patient safety and raise awareness of issues affecting neonatal patients, their families and staff by devoting a specific section to patient safety in each edition of the journal. Anyone can submit an article so if you have ideas for highlighting safety aspects to improve care, please do let us know.

- Have you implemented an initiative locally which has demonstrable benefits for improving safety?
- Are you developing a new initiative which might benefit from a wider application?
- Do you have experience in any human factors-related improvement that you'd be able to share?

If you would like to submit a patient safety article to *Infant*, please email lisa@infantjournal.co.uk

If you have any incidents for national learning, please contact BAPM by emailing bapm@rcpch.ac.uk