

TPN and infections with *Bacillus cereus*: important lessons for neonatal staff

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The recent UK outbreak of *Bacillus cereus* infections associated with use of total parenteral nutrition (TPN) on neonatal units has again focused attention on the importance of strict quality assurance and good clinical governance procedures. At least 19 preterm infants became infected, with a further four possible cases, all occurring at the end of May and June 2014 in the south and east of England.¹ Three of these infants died and it is not yet possible to know if any others have died directly as a consequence of this infection, or have suffered any long-term effects.

While there are many benefits of TPN, equally there are many potential risks, such as infection. The purpose of this article is to update neonatal staff on the incident and highlight important aspects of practice to all staff involved in prescribing or administering TPN to neonates.

What is TPN?

TPN involves the administration of a combination of aqueous (water-soluble) and lipid-containing bags or syringes that contain amino acids (which are used to form protein), dextrose, lipid, minerals (eg calcium and phosphate), vitamins and other micronutrients (eg zinc) (FIGURE 1). Most large neonatal units will keep 'standard' bags of aqueous PN refrigerated for immediate commencement when a premature infant is first admitted. These bags contain amino acids and dextrose but do not contain vitamins because these are unstable and oxidise after a few days. Oxidation produces compounds (eg peroxides) that can damage tissues, although protecting the bags from light can reduce the amount of oxidation that occurs.

Standard bags of PN provided from the pharmacy have water-soluble vitamins added on the day of use that are stable for at least 48 hours. Fat-soluble vitamins (eg A, D and E) are added by the pharmacy just prior to use because these vitamins are also at risk of oxidation. The lipid syringes, or bags, contain an emulsion of lipid (eg 20%); lipid provides essential fatty acids and a concentrated amount of energy – more than twice as many calories per millilitre compared to dextrose.

What is *B. cereus* and how is it detected and treated?

B. cereus is a common bacterium that is widespread and can be found on household surfaces, in the soil and in many food products. It is Gram positive and forms spores and toxins. It is the bacterium responsible for 'fried rice syndrome' (when cooked rice



FIGURE 1 Administration of total parenteral nutrition.

is re-heated) and in adults usually causes self-limiting diarrhoea and vomiting. It is a rare, but well-recognised, cause of infection in neonates and in particular is associated with central venous lines or umbilical catheters. *B. cereus* will grow using standard blood culture techniques. Surface swabs are not helpful as most surfaces are likely to test positive for the presence of the bacterium.

There are choices for the specific antibiotic to be used; based on the recent outbreak vancomycin, along with the usual first or second line treatments as per local protocols, is recommended. Alternatives include aminoglycosides (eg gentamicin), ciprofloxacin and linezolid although the latter two, while commonly used, are unlicensed for use in neonates.² It is vital that potential sources of infection, such as central lines and umbilical catheters, are removed and that the tips are sent for culture. Provided there are no contraindications, most neonatologists would recommend a lumbar puncture to rule out meningitis.

Screening on neonatal units

Many units will already undertake periodic screening of high-risk infants and the environment – staff should discuss with their microbiologist if they are uncertain of local practice. There is no benefit in routine blood cultures in infants receiving TPN and there is no benefit in routine antibiotic prophylaxis as this will increase the risk of antibiotic-resistant organisms emerging on units and in infants themselves. The risk of person-to-person transmission is low and standard precautions with enhanced hand hygiene should already be considered ‘standard of care’ in every neonatal unit.

How did the outbreak occur?

Investigations are still ongoing, but it seems likely that a small number of batches of intravenous lipid became contaminated, possibly at the stage that the fat-soluble vitamins were added. This emphasises the importance of pharmacy quality assurance, and the need for very careful aseptic techniques when handling any TPN. All neonatal staff must be trained to connect intravenous solutions aseptically, ideally connecting to catheters solely used for the purpose of TPN. All catheters, especially central ones, must be inserted by trained staff using strict aseptic technique and

inspected regularly throughout the day for leakage or evidence of inflammation. Regular audit of practice is important, along with benchmarking, such as Matching Michigan (a patient safety programme, developed in the US, aimed at decreasing central line infections).³

Conclusions

There is a balance of risks and benefits associated with every healthcare intervention, including the use of TPN. This incident will remind all staff of the importance of training and careful governance procedures that allow us to maximise the benefits, while minimising potential harm.

References

1. **Public Health England.** *Bacillus cereus Infections: 1 July 2014* [Online]. Available from: www.gov.uk/government/news/bacillus-cereus-infections-1-july-2014 [Accessed 20 August 2014].
2. **Public Health England.** *Guidance for the Management of Cases of Bacillus cereus in View of the current Neonatal Outbreak in England, June 2014* [Online]. Available from: www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317141326559 [Accessed 20 August 2014].
3. **Patient Safety First.** *Matching Michigan: Reducing CVC Bloodstream Infections* [Online]. Available from: www.patientsafetyfirst.nhs.uk/Content.aspx?path=/interventions/matchingmichigan [Accessed 20 August 2014].

Learning lessons from clinical incidents

The purpose of BAPM’s ‘Learning from clinical incidents’ is to share lessons from a clinical event thereby helping to prevent similar incidents occurring elsewhere. The following brief summary of a recent incident can be seen in full on the BAPM website (www.bapm.org).

Accidental cutting of an inline suction catheter during shortening of an endotracheal tube

A Kimberly Clarke closed suction catheter was not fully retracted into the rinse chamber and the endotracheal tube was subsequently cut to reduce dead space. During this process the tip of the suction catheter was cut off. The tip was not radio-opaque and it was a further 10 days before this was noted on X-ray at which time the piece of suction tubing had migrated into the infant’s left main bronchus and required removal by bronchoscopy.

There have been reports of two similar incidents with the same device. The markings on the tip of the catheter are small and black making it difficult to visualise if the catheter tip is present within the endotracheal tube and not in the rinse chamber. Staff are advised to ensure the suction catheter is always fully retracted after suctioning and to always disconnect the endotracheal tube from the ventilator before cutting it.

Concerns have been raised with Kimberley Clarke; the company is providing further education on this matter.

Join us to help improve patient safety

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

