Filtration in IV Therapy for Infants

Reference

34. Wilkie A et al, NZ Hospital Pharmacists’ Association 1998.
Particles are present in IV therapy in large numbers

Particles of glass, rubber, metal, plastic, crystalloidal material, fibres and other material are routinely present in IV infusions. These arise from the drugs and fluids, infusion equipment, manipulations and drug incompatibilities. Levels as high as half a million particles per litre of infusate have been reported, for patients receiving intensive IV therapy. The largest contribution appears to come from small volume additive drugs.

Particles have pathological effects

Since the 1950’s reports of particles in the lungs of children at post mortem examination have been published. Earliest reports were of granulomata containing cotton fibres in 5-10% of children who had received IV therapy, with a relationship between the number of granulomata and the amount of fluid infused. More recently, glass particles have been seen in the lungs of neonates and a case report described fatal bowel necrosis in a neonate due to plastic material from a syringe; histological examination of the small bowel showed infection and thrombus in the mesenteric arteries containing irregular fragments of polypropylene.

It has been proposed, based on post mortem results and animal studies, that the presence of particles in the pulmonary circulation induces thrombosis, capillary endothelial damage, granulomata and foreign body giant cell formation. It has been suggested that these effects on the lung microvasculature, coupled with impairment of the clearance system, may accelerate the course of respiratory distress syndrome and multiple organ failure.

In addition to potentially serious systemic effects, particles have been shown to have an important role in the pathogenesis of infusion-related thrombophlebitis and loss of venous access. In adults, the incidence of phlebitis is reduced by half by the use of 0.2µm filters to remove particles from the infusion, and a study in neonates showed a significant improvement in cannula site life in neonates in whom 0.2µm filtration was used.

It is possible to protect infants against the effects of particulate contamination

Particles can be removed from IV infusions using appropriate filters. 0.2µm filters are suitable for use with infusion fluids and drugs in solution. Lipid emulsions can be filtered using 1.2µm filters.

Air can be a clinical problem in IV therapy

Air can gain access to IV systems by degassing as fluids are warmed to room temperature, by disconnection or incomplete priming, or due to a vented line running dry. There is a risk that air embolism can develop, particularly on central venous lines, with potentially serious clinical implications, especially when the foramen ovale or ductus arteriosus are still patent.

It is possible to protect infants against air embolism from the infusion system

Air can be effectively prevented from entering the catheter by attaching a suitable filter to the catheter hub. Effective air eliminating filters enable venting of entrained air to the atmosphere, preventing the system from becoming air-locked.

Microbial contamination can gain access to IV systems

Multiple manipulations increase the risk of inadvertent microbial contamination. All patients on IV therapy are at risk of this, but there have been several reports in recent years of outbreaks affecting babies and children.

Summary

- Particles are present in IV therapy in large numbers.
- Particles have pathological effects.
- It is possible to protect infants against the effects of particulate contamination.
- Air can be a clinical problem in IV therapy.
- Microbial contamination can gain access to IV systems.
- It is possible to protect infants against inadvertent microbial contamination from the infusion system.
- Endotoxin can be released by bacteria trapped within an IV filter.

Table 1: Retention of endotoxin by IV filter membranes

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The safe extended use of filters and sets has enabled cost savings to be made in neonatal care units.

Intravenous medications for infants, including neonates, can be effectively filtered.

Cost effective delivery of medications at flow rates and doses used for infants, including neonates can be achieved with small volume endotoxin-retentive 96 hour IV filters.

Several filter membranes have been tested for endotoxin retention.

Effective endotoxin retention is possible with an appropriate filter membrane.

IV filters that retain endotoxin completely can be used for longer than 24 hours, reducing the number of filter and IV set changes and the number of catheter hub manipulations.

- A recent study has shown a significant reduction in septic and thrombotic complications in neonates with the use of an endotoxin retentive IV filter.

Most of these organisms are Gram-negative bacteria which are capable of surviving and replicating in simple solutions.

Endotoxin is a component of the outer layers of Gram-negative bacteria. It is released in large amounts during cell lysis and has potentially lethal clinical effects. Bacteria trapped within an IV filter can release clinically significant amounts of endotoxin after 24 hours, so conventional filters require daily change.

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