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IN-LINE FILTRATION REDUCES SEVERE COMPLICATIONS AND LENGTH OF STAY ON A PEDIATRIC INTENSIVE CARE UNIT:

A prospective, randomized, controlled

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BACKGROUND

Intravenous administration of fluids and drugs is an important part of patient care for the critically ill. Unfortunately, the contamination of infusion solutions by particles is a largely unknown and underestimated side effect of intravenous therapy which can lead to particle-induced mechanical blockage of vessels and the development of pulmonary foreign body granulomata[1, 2, 7, 8].

Contamination by particles may either be due to drug incompatibility reactions or their incomplete reconstitution during the preparation process, in addition to contamination with glass particles from opening glass ampoules, particles from rubber stoppers, or conglomerates of the parenteral nutrition components[3–5]. Particles have also been shown to be inherent to generic drug formulations[2].

In an intensive care setting, the particle load may rise up to one million infused particles per day, increasing with the complexity and quantity of the administered infusions[6, 7]. It is therefore important to optimize infusion therapy in order to minimize medication errors and particle load. In-line filtration has been shown to almost completely prevent the infusion of particles[4].

PURPOSE

The aim of this trial was to evaluate the impact of in-line filtration with respect to severe complications such as systemic inflammatory response syndrome (SIRS), sepsis, thrombosis, and organ failure in critically ill children.

METHODS

A single-centre, prospective, randomized controlled trial was conducted. A total of 807 children of less than 18 years of age were randomly assigned to either a control group (n = 406) or a filter group (n = 401), with the latter receiving in-line filtration.

The primary endpoint was a reduction in the rate of overall complications – SIRS, sepsis (defined according to the International Paediatric Sepsis Consensus Conference [9, 10]), organ failure, and thrombosis – whereas secondary objectives were a reduction in the length of stay on the intensive care unit and overall hospital stay.

The filter group received inline filtration throughout the period of infusion therapy, with eligible fluids administered via in-line filters. The appropriate filters –

- 1.2 µm pore size (Intrapur Lipid / Intrapur Neonat Lipid; B. Braun Corporation, Melsungen, Germany) for infusion of lipid-containing admixtures;
- 0.2 µm pore size positively charged filters (ELD96LLCE/NEO96E; Pall, Dreieich, Germany) for aqueous solutions

– were arranged in the lumen of each venous catheter. Filters were replaced after 24 hours (Intrapur Lipid / Intrapur Neonat Lipid) or 72 hours (ELD96LLCE/NEO96E) of regular use, or in cases of blockage.

RESULTS

Analysis showed that in-line filtration significantly decreases the overall complication rate for the filter group (figure 1; 40.9% versus 30.9%; p = 0.003). A significant difference (p = 0.003) between the control and filter groups was detected concerning the time to first occurrence of any complication per patient (Figure 2): the median event-free duration for the control group (7.0 ± 0.2 days) differed significantly from that for the filter group (10.0 ± 1.9 days).

The incidence of SIRS was significantly lowered from 30.3 % in the control group to 22.4 % in the filter group (p = 0.01).

Additionally the use of filters led to a significant reduction of the length of stay on the intensive care unit (3.89 days versus 2.98 days; p = 0.025), as well as to a reduction of the duration of mechanical ventilation (14.0 hours versus 11.0 hours; p = 0.028).

Although statistically not significant, overall hospital stay was reduced by one day in the filter group versus the control group (15.0 days versus 16.0 days; p = 0.19). Additionally, there was a statistical trend towards a lower mortality rate in the filter group (4.0%) versus the control group (6.7%; p = 0.09). When taking into account the relatively low incidence of mortality in a paediatric intensive care unit versus an adult group, this statistical trend is especially noteworthy.

In addition, there were reductions in the incidence of sepsis, ARDS, circulatory failure, thrombosis, acute liver and acute renal failure in the filter group, these differences did not reach statistical significance.

CONCLUSION

The results demonstrate the safety and efficacy of in-line filtration in preventing major complications in critically ill patients. The overall complication rate and the incidence of SIRS (systemic inflammatory response syndrome) were significantly reduced by using in-line IV filters. It is therefore conclusive that in-line filtration is a preventive strategy that can result in decreased morbidity of critically ill patients, reduced duration of mechanical ventilation and reduced length of stay on the intensive care unit.

Figure 1: Hazard ratios of primary endpoints for the treatment effect of in-line filtration. The incidences of overall complications and systemic inflammatory response syndrome (SIRS) were significantly reduced in the filter group. A trend towards a reduction in acute respiratory distress syndrome (ARDS) was evident for the filter group (p = 0.08). No significant differences were found for the incidence of sepsis, circulatory failure, acute renal failure, acute liver failure and thrombosis. Filled rhombi hazard ratios; horizontal lines 95 % confidence intervals

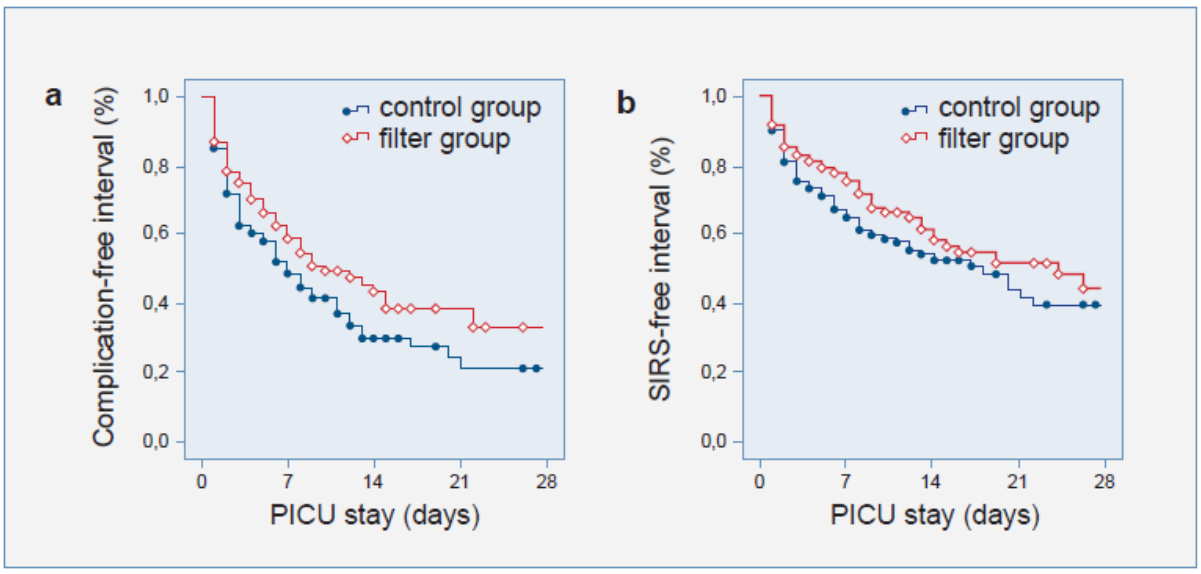

Figure 2: Kaplan-Meier analysis for complication-free interval (a) and SIRS-free interval (b) during a maximum stay on the pediatric intensive care unit (PICU) of 28 days; SIRS systemic inflammatory response syndrome; blue filled circle control group; red open rhombus filter group; circles and rhombi indicate censored patients

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