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Reducing Risks and Generating Economic Benefits

Did you know that IV filtration in an intensive care unit (ICU) could help to reduce risks and generate economic benefits?

Introduction

Intravenous administration of fluids and drugs is an important part of patient care for the critically ill. However, 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, 3, 4] In an intensive care setting, the particle burden may rise up to one million infused particles per day, increasing with the complexity and quantity of the administered infusions.[3, 5]

During the EAHM congress in Cascais, Portugal in September 2018, Dr. Michael Sasse, leading senior physician of the PICU at Hannover Medical School (MHH), showed that implementing standard operating procedures for infusion management and the use of in-line IV filters significantly lowers the occurrence of SIRS and the length of stay in the ICU by 23%. Based on these results, the MHH was able to increase the capacity in its ICU, which also had important economic effects.

Particulate Contamination: Why is it a Problem?

The contamination of infusion solutions by particles is a widely unknown and underestimated side effect of intravenous therapy.[1, 2] Particulate contamination is due to drug incompatibility reactions or their incomplete reconstitution during the preparation process.[6] Various studies have demonstrated the contamination of infusion solutions with glass particles from opening glass ampoules, particles from rubber stoppers or conglomerates of the parenteral nutrition components.[7,8] Particles have also been shown to be inherent to generic drug formulation.[2]

If these particles are not eliminated, they will enter the patient, with potentially severe consequences such as organ damage (lungs, kidneys, liver, bone marrow), particularly in organs that were damaged before. It is therefore important to optimise infusion therapy in order to minimise medication errors and particle load. In-line filtration has been shown to prevent the infusion of particles almost completely.

Clinical Trial Methods

The aim of the study published by Dr. Sasse and his team was to evaluate the impact of in-line filtration of particles with respect to severe complications such as systemic inflammatory response syndrome (SIRS), sepsis, thrombosis, and organ failure in critically ill patients.

A single-centre, prospective, randomised controlled trial was conducted. A total of 807 children under 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 in the intensive care unit and overall hospital stay.

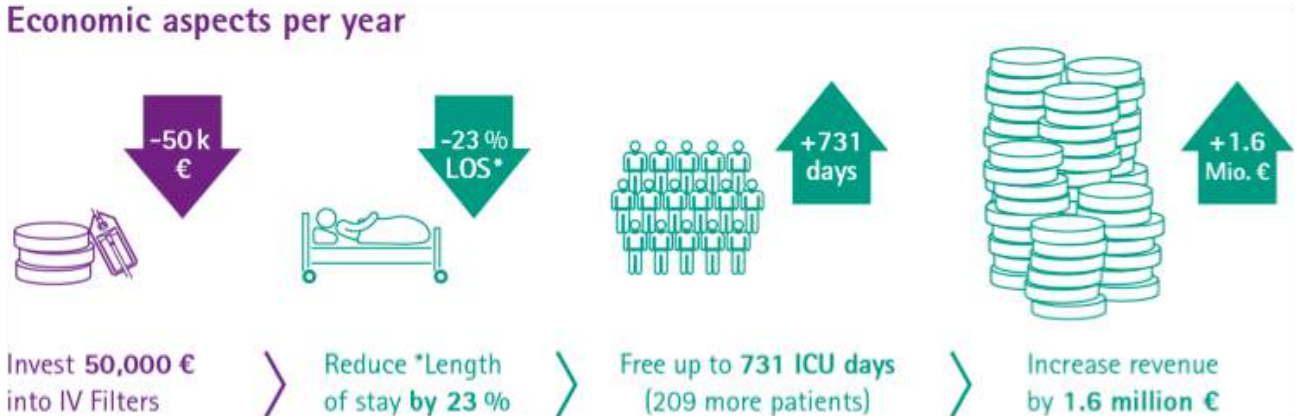
The filter group received in-line filtration throughout the period of infusion therapy, with eligible fluids administered via in-line IV filters. The appropriate IV filters –

- 1.2 µm pore size for infusion of lipid-containing admixtures;
- 0.2 µm pore size positively charged filters for aqueous solutions –

were arranged in the lumen of each venous catheter. IV filters for lipid containing infusions were replaced after 24 hours, IV filters for aqueous solutions were changed after 72 hours of regular use, or in cases of blockage.

Results of Clinical Trial

Analysis showed that in-line filtration significantly decreased the overall complication rate for the filter group (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: the median event-free duration for the control group (7.0 ± 0.2 days) differed significantly from that of 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 in the length of stay in the intensive care unit. The length of stay at ICU could be reduced by 23% (3.89 days versus 2.98 days; p=0.025).

"Because 12 to 18-year-olds are like adults when it comes to factors such as the capillary bed, we can safely assume that the effect must be the same in adults," comments the expert Dr. Michael Sasse.

Economic Impact of IV Filtration

Dr. Sasse can also prove that using filters make financial sense: the length of ICU stay can be decreased by an average of 21.75 hours per patient, representing a 23% drop. Almost an entire day can thus be saved – a substantial economic advantage.

Together with his team, Dr. Sasse evaluated ICU costs, which were found to be around 1,800 euros per patient per day, with an average refund of around 8,000 euros per ICU patient from the health insurers.

"The 23% shorter length of ICU stay that we found in our study translates to around 21.75 hours per patient. For 807 patients per year this would free up 731 ICU days per year, which means that we could treat 209 more patients per year." In turn, this also leads to an increase in revenue for the ICU of around 1.6 million euros per year. The additional costs for IV filters for 807 patients came to 50,000 euros per year, an amount that is somewhat dwarfed in respect to the improved outcome.

Other economic aspects should be considered as well: "Less severe complications result in fewer drugs such as antibiotics, reduction of organ replacement, medical staff workload and also a decrease in costs for diagnostic procedures. Being able to release patients sooner also increases the flexibility of ICU allocation and the capacity for surgeries."

For the ICU at Hannover Medical School, the results of the study also mean that no patients have to be turned away due to lack of capacity. Or to make it snappier: "shorter length of stay equals treat more patients equals save more lives," says the German intensive care specialist.

KRINKO, the German commission for hospital hygiene and infection prevention, which is part of the Robert-Koch-Institute and has a similar standing in Germany as the CDC or FDA, has taken on these study results. Since 2016, this body has recommended that in-line particle IV filters with pore size 0.2 µm should be used in infusion systems of intensive care patients to decrease the amount of SIRS and to eliminate air bubbles from infusion solutions (recommendation cat. II).

Conclusion

The conclusion of Dr. Sasse is clear: "Managed infusion therapy with in-line IV filters will increase patient health and significantly lower the length of stay at the ICU but also have a positive financial impact on the hospital and the national economy."

This article is based on a lecture by Dr. Michael Sasse, MHH, at the EAHM congress from 26-28.09.2018 in Cascais, Portugal. ■

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