MANNITOL CRYSTALLOGENESIS

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ABSTRACT

Mannitol is an osmotic agent that increases osmotic pressure in the glomerular filtrate, reducing tubular absorption of water producing diuresis as well as functioning as an oxygen free radical scavenger. Crystals can often be observed in the crystals had been dissolved, a drop of the solution was placed on a microscope slide at a magnification of 20x to determine if crystals were present. The remaining mannitol solution was poured through filter paper, the filter was dried and the residue (crystals) was weighed. During the next phase of the study the mannitol bottles from the manufacturer that appeared to have no crystals in them were centrifuged at five minutes at fifteen hundred revolutions per minute and then for another five minutes at two thousand revolutions per minute. A drop of this solution was placed on a microscope slide for analysis. A benchmark analysis was performed in the second part of the study in order to precipitate crystals in a cardiopulmonary bypass circuit. Physiological conditions such as temperature, various amounts of mannitol, sodium bicarbonate levels, and lactated ringers versus normal saline were employed. A cardiopulmonary bypass circuit with an arterial filter was set up for all trials. A flow of 4.5 L/min with a temperature of 28°C was maintained for fifteen minutes during all trials. A prebypass filter was placed post oxygenator and post arterial filter. A drop of the solution from the prebypass filter was placed on a microscope slide to determine if mannitol crystals could be seen. Six different trials were performed with different configurations of the prebypass filter being placed post oxygenator and post arterial filter with various physiological conditions. The last component of the second part of the study encompassed centrifuging the solution post arterial filter for ten minutes at two thousand revolutions per minute. This was executed after Plasmalyte with 25g of mannitol had recirculated for fifteen minutes at 28°C. A drop of the centrifuged solution was placed on a microscope slide for inspection. The third part of the study determined if crystals formed in prime when a circuit sat for 24 and 72 hours with prime drugs. A circuit was set up and primed with one liter of Plasmalyte, 25g of mannitol, 10,000 IU of heparin, and 50mEq of sodium bicarbonate. A prebypass filter was placed post arterial filter. The placed circuit recirculated for fifteen minutes at a flow of 4.5 L/min at ambient room temperature (20°C). After the circuit sat for the specified time, the prebypass filter was removed and was allowed to soak in water after the specified time frame. A drop of the solution was placed on a microscope slide for observation.

Methods

The first part of the study determined how many minutes it took mannitol crystals to dissolve when placed in a water bath at 51°C +/- 1°C. Once the crystals had been dissolved, a drop of the solution was placed on a microscope slide at a magnification of 20x to determine if crystals were present. The remaining mannitol solution was poured through filter paper, the filter was dried and the residue (crystals) was weighed.

Results

The results showed that the mean number of minutes for crystals to dissolve was 88.2 after being placed in the water bath. Crystals could be microscopically observed in the solution after being dissolved in the water bath at 51°C.

The mean weight of the crystals was 0.040 grams after 12.5 grams of mannitol containing crystals had been dissolved in the water bath and poured through the filter paper. A mannitol bottle from the manufacturer with no visible crystals was centrifuged at five minutes at 1500 revolutions per minute and then another five minutes at 2000 revolutions per minute. The centrifuged tube appeared to have no visible crystals, however when a drop of the solution taken from the bottom of the tube was placed on a microscope slide, crystals could be observed. After the six trials with various physiological conditions employed such as temperature change, pH change, and different concentrations of mannitol, a crystal post arterial filter could be observed.

The circuit had recirculated for fifteen minutes at 28°C with 25 grams of mannitol and Plasmalyte (7.4 pH). The primed circuits were left at ambient room temperature (20°C) for 24 and 72 hours. Once the prebypass filter was removed it was allowed to soak in water. A drop of this solution was placed on a microscope slide for observation. Crystals were not seen post arterial filter after a primed pump containing priming drugs sat for 24 and 72 hours.

Conclusion

The study revealed that crystals could be observed post-arterial filter when both Plasmalyte (7.4 pH) and saline (5.0 pH) were used with 25 grams of mannitol, a temperature of 28°C, and a flow of 4.5 L/min with a recirculation time of 15 minutes. Microcrystals were present after the crystals were dissolved in a water bath at 51°C even though they appeared to have dissolved with the “naked” eye. Microcrystals were also present in a “clear” (no visible crystals) bottle of mannitol from the manufacturer. The study further suggested that crystals were not present in the CBP circuit when a primed pump sat for 24 and 72 hours with prime drugs.

References


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Objectives

- To determine the physiological conditions in which mannitol crystals can be dissolved and precipitated based upon the above graph.
- To establish if mannitol crystals are formed in prime.
- To evaluate the prevalence of microcrystals in mannitol.
- To determine if mannitol crystals are seen in the bypass circuit before or after the oxygenator and arterial filter.
- To establish if mannitol crystals form in a bypass circuit when a pump sits overnight and for 72 hours with prime drugs.