Mastering Mannitol

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QUESTIONS

1. Which of the following pharmacologic interventions is a hyperosmolar therapy helpful in the management of increased intracranial pressure (ICP)?

- **A.** Maintaining adequate sedation
- **B.** Pentobarbital infusion
- **C.** Neosynephrine infusion
- **D.** 3% saline infusion

2. Mannitol given for the treatment of head injuries because:

- **A.** It is an osmotic diuretic that will decrease intracranial pressure (ICP) by decreasing intracellular volume.
- **B.** It is an osmotic diuretic that will decrease ICP by increasing intracellular volume.
- **C.** It is an osmotic diuretic that will increase cerebral perfusion pressure (CPP) by decreasing intracellular volume and increasing vascular volume.
- **D.** It is an osmotic diuretic that will increase CPP by increasing mean arterial pressure (MAP).

3. Your patient is a young child with blunt head trauma and signs of increasing intracranial pressure. The electronic medical record (EMR) system is on "downtime," and an order for mannitol, 0.5-g/kg bolus, via intraosseous (IO) needle has been ordered. The child weighs 40 kg, and the mannitol bottle is labeled as 25%, 12.5-g/50-mL bottle (250 mg/mL). How many mL of mannitol would this child receive?

- **A.** 20 g
- **B.** 160 mL
- **C.** 0.5 g
- **D.** 80 mL

4. For the child with blunt head trauma and increased intracranial pressure (in the previous question), the ED nurse finds no vials of mannitol available. However, a bag of 20% mannitol (100 g/500 mL) is available. At this concentration, what volume (mL) of mannitol would this child receive?

- **A.** 20 g
- **B.** 100 mL
- **C.** 0.5 g
- **D.** 50 mL

5. Prior to initiating an IV infusion of mannitol, the ED nurse finds numerous visible crystals in the bag. The nurse should:

- **A.** Immediately discard the still-sealed bag of mannitol into a biohazard container.
- **B.** Immediately return the bag of mannitol to the manufacturer for their evaluation.
- **C.** Immediately see if there is another bag of mannitol available without visible crystals, and place the crystallized bag in the blanket warmer.
- **D.** Immediately administer the dose from the currently available bag as the crystals are not of clinical concern.

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These online review questions offer emergency nurses an opportunity to test their knowledge about their practice.

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1. Correct answer: D

The question specifically mentions "hyperosmolar therapy," and, of the answers, the only one that involves a hyperosmolar therapy is 3% (hypertonic) saline. Sedation and "sedation to the extreme" (ie, pentobarbital coma) can be used to decrease ICP but are not hyperosmolar therapies. Neosynephrine is a vasopressor that helps increase the body pressure but does nothing to decrease the ICP. Normal saline is 0.9%, whereas hypertonic saline (much more concentrated saline) can be 3%, 5%, or 7.5%. Think about how mannitol works and the body's response in efforts to dilute the "big, clunky molecule." Hypertonic saline works in a similar way. The body doesn't like having really concentrated things floating around the bloodstream (it likes everything to be balanced or equal), so the fluids shift from the tissues (ie, brain) into the bloodstream to dilute the blood. When all that extra fluid hits the kidneys, the patients pee, pee, and then pee some more.

2. Correct answer: C

Furosemide is a loop diuretic, which means it works in the kidney and says "pee." Mannitol works in a different way; it is an osmotic diuretic (a "big, clunky molecule"). The bloodstream doesn't like having "big, clunky molecules" floating around it, so it shifts fluid from the tissues (ie, brain) into the bloodstream to dilute the "big, clunky molecules." In other words, it shifts "edema fluid" from the brain cells into the vascular space. When all of this extra fluid hits the kidneys, they recognize that there's way too much fluid in the bloodstream, and it's time to pee, pee, and pee some more. Having more fluid in the toilet than you do in your swollen brain is the rationale for mannitol use in head injuries.

3. Correct answer: D

This question not only asks you to calculate the appropriate mannitol dose in grams but then to take it 1 step further and calculate the actual amount in milliliters to be administered. First, what is the RIGHT dose for the child? 0.5g for every kg = 0.5g x 40 kg = 20 g. Second, knowing the right dose, calculate the correct dose (volume in mL). Yes, it's basic algebra coming back from freshman year to haunt us yet again!

- The child weighs 40 kg, so the correct dose is 20 g.
- The concentration is 12.5 g/50 mL, so divide both numbers by 50 and you get 0.25 g/mL.
- Multiply the dose (20 g) by the concentration (0.25 g/mL) to get the correct dose amount of 80 mL.

4. Correct answer: B

Okay, same formula, but different concentration! But our child still needs 20 g of mannitol (we found that out in the last question).

- 100 g/500 mL = 0.20 g/mL.
- The child weighs 40 kg and needs 20 g.
- At 0.20 g/mL concentration, the volume for 20 g is 100 mL

This question not only asks you to calculate the appropriate mannitol dose in grams but also to take it 1 step further and calculate the actual volume (in milliliters) to be administered. The grams of medication to be administered to the child are the same whether the medication comes from a bottle or a bag. However, it is crucial to note that there are different concentrations between the vial and the bag, and therefore the milliliters to be administered to the child are different.

5. Correct answer: C

Crystals in your IV solution are never a good thing! Unfortunately, crystal formation in mannitol bottles and bags is a very common situation, especially when the solutions above 15% concentration are stored at low temperatures. Several methods to rewarm mannitol and allow the crystals to return to solution are described in the literature. In an emergency setting, probably the easiest option is to see if there is another bag or bottle without visible crystals immediately available. If this is not the case, then the bag or bottle may be placed in a dry-heat cabinet—that is, a blanket warmer—until the solution temperature has increased to the point that the crystals have returned to a liquid state. After the mannitol has returned to room temperature, it can then be administered to the patient. When administering greater than 20% mannitol either as an IV bolus or a continuous IV infusion, a filter needle or filter IV tubing should be used, as not all mannitol crystals are visible to the naked eye! Option A may sound inviting because of the specificity of the answer, but that amount of information (and the safety implication) is intended only as a distraction. Returning the bag to the manufacturer does not address the need to care for the patient. Finally, as mentioned above, crystals in an IV solution are never a good thing.

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