Abstract:

Purpose: Infusate osmolarity, pH, and cytotoxicity were investigated as risk factors for midline catheter failure.

Methods: An experimental, randomized, controlled, blinded trial was conducted using an ovine model. Two 10-cm, 18-gauge single-lumen midline catheters were inserted into the cephalic veins of sheep. The animals were divided into 6 study arms and were administered solutions of vancomycin 4 mg/mL (a low-cytotoxicity infusate) or 10 mg/mL (a high-cytotoxicity infusate), doxycycline 1 mg/mL (an acidic infusate), or acyclovir 3.5 mg/mL (an alkaline infusate) and 0.9% sodium chloride injection; or 1 of 2 premixed Clinimix (amino acids in dextrose; Baxter International) products with respective osmolarities of 675 mOsm/L (a low-osmolarity infusate) and 930 mOsm/L (a mid-osmolarity infusate). Contralateral legs were infused with 0.9% sodium chloride injection for control purposes. Catheter failure was evaluated by assessment of adverse clinical symptoms (swelling, pain, leakage, and occlusion). A quantitative vessel injury score (VIS) was calculated by grading 4 histopathological features: inflammation, mural thrombus, necrosis, and perivascular reaction.

Results: Among 20 sheep included in the study, the overall catheter failure rate was 95% for test catheters (median time to failure, 7.5 days; range, 3-14 days), while 60% of the control catheters failed before or concurrently (median time to failure, 7 days; range, 4.5-14 days). Four of the 6 study arms (all but the Clinimix 675-mOsm/L and acyclovir 3.5-mg/mL arms) demonstrated an increase in mean VIS of ≥77% in test vs control legs (P ≤ 0.034). Both pain and swelling occurred at higher rates in test vs control legs: 65% vs 10% and 70% vs 50%, respectively. The mean difference in rates of occlusive pericatheter mural thrombus between the test and control arms was statistically significant for the vancomycin 10-mg/mL (P = 0.0476), Clinimix 930-mOsm/L (P = 0.0406), and doxycycline 1-mg/mL (P = 0.032) arms.

Conclusion: Administration of infusates of varied pH, osmolarity, and cytotoxicity via midline catheter resulted in severe vascular injury and premature catheter failure; therefore, the tested infusates should not be infused via midline catheters.

Reference: