INTRODUCTION

- Patients managing their Type 1 Diabetes with an insulin pump are required to insert a new continuous subcutaneous insulin infusion (CSII) catheter every 2-3 days to minimize the risk for hyperglycemia, hypoglycemia, and DKA.
- The trauma of insertion and indwelling time may cause a local inflammatory response, leading to variable insulin delivery efficacy and loss of viable infusion sites.
- Understanding how the tissue responds to trauma and different catheter materials is clinically important.
- Tissue histology was used to evaluate the immune response surrounding commercial Teflon and stainless steel CSII catheters implanted in live swine for 7 days, 5 days, 3 days, 8 hours and 10 minutes.

METHODS

- CSII catheters with a 6 mm Teflon cannula (Inset) and 6 mm steel cannula (Contact-Detach) were implanted within the soft abdominal tissue of ambulatory swine for 7 days (n=8), 5 days (n=6), 3 days (n=4), 8 hours (n=4) and 10 minutes (n=6).
- Insulin Lispro (U-100) was continuously infused through the CSII catheters (5 µL/hr) using multiple insulin pumps.
- A 70 µL bolus of insulin Lispro (U-100) was infused through each CSII catheter the day of excision.
- Five minutes after each bolus, the CSII catheter and surrounding skin/subcutaneous tissue were excised and immediately frozen.
- Specimens were fixed using Formalin 10% and stained using H&E and Trichrome.
- Three investigators and a clinical pathologist blindly evaluated the tissue histology for degree of tissue inflammation, fibrin and collagen deposition, fat necrosis, and volume of debris field.

RESULTS

- Both Teflon and stainless steel CSII catheters produced significant inflammation that increased in size and density over time (See Figures 1 and 2).
- Tissue surrounding the Teflon and steel CSII catheters showed minimal damage and no inflammation at 0 and 8 hours.
- Both catheter materials elicited a more severe inflammatory response from 3 days to 7 days when compared to 0 and 8 hours.
- A difference in inflammatory response is observed between Teflon and stainless steel at 3, 5, and 7 days.
- Tissue damage and local inflammation was more extensive in specimens with stainless steel catheters compared to Teflon.

DISCUSSION

- CSII cannula insertion initiated an acute inflammatory response due to damaged cells, connective tissue, and extracellular matrix.
- A layer of inflammatory tissue formed around the cannula consisting of thrombus, neutrophils, macrophages, fibroblasts, and cellular debris.
- The layer of inflammatory tissue became thicker, denser, and more continuous over time in both Teflon and steel specimens.
- The layer of inflammatory tissue may function as a mechanical barrier slowing or inhibiting the movement of insulin into adjacent subcutaneous tissue containing capillary and lymph vessels.
- Although structurally stable, stainless steel catheters elicit a more severe tissue response surrounding the insertion site, which may interfere with insulin absorption and increase loss of viable sites.

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