A comparative assessment of distal penetration between 40-micron microspheres and a novel liquid embolization agent.

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Introduction

The GPX® Embolic Device is a novel embolic agent designed for use in durable and pre-operative peripheral embolization procedures where there is intent for distal penetration. To accomplish this, the GPX Embolic Material is delivered into the body as a low-viscosity fluid material that follows vascular flow and that solidifies in response to physiological ionic strength, forming a gel-like, solid embolic (Figure 1). A first-in-human clinical trial was recently completed, showing positive outcomes in a wide variety of applications. Here, a pre-clinical animal study is presented that compared the extent of distal penetration of the GPX Embolic Device with 40-micron microspheres (Embozene®).

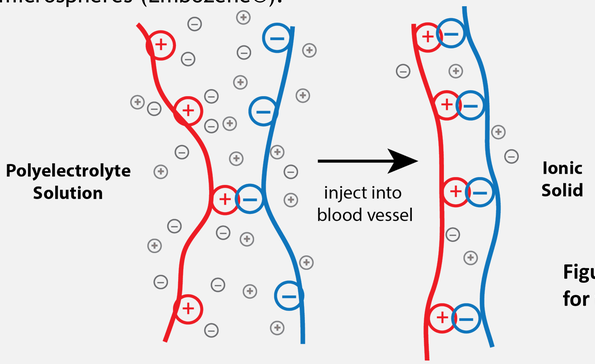


Figure 1: Solidification mechanism for the GPX Embolic Device

Materials & Methods

Bilateral renal artery embolizations were performed in domestic swine. Six embolizations were performed with the GPX Embolic Device, with Embozene microspheres (40 micron) used as the control device. Similarly sized vessels were chosen for each embolization, with sites selected after the 2nd or 3rd bifurcation of the renal artery. Each device was prepared consistent with its instructions for use prior to the embolization. The GPX Embolic Device was agitated by pushing the two opposing syringe plungers back and forth at least 25 times to resuspend the tantalum. Next, the syringes were disconnected and the syringe containing the embolic material was connected to the microcatheter. The microspheres were mixed into a slurry with a 50:50 mixture of Omnipaque 240 and saline utilizing a stopcock. Embolizations were then performed until stasis. Distal penetration of the embolization agents was evaluated using histopathology. To perform this analysis, the kidneys were split into 3 zones, within which, a minimum of 40 measurements were taken of the vessel diameters and the presence of embolic within the vessels of each of the zones visually confirmed. The study also measured untreated vessels for a comparison of vessel sizes without the effect of the embolization. The magnitude of occlusion of the arterial lumen of both the GPX material and Embozene beads was assessed based on the relative filling of the arterial lumen by the embolized material, and/or its proximate apposition to the arterial wall, and by the presence of residual red blood cells (RBCs) within the lumen of the treated artery.

Results

- All embolizations with both agents were considered a technical success, defined as being fully occluded <1 minute after delivery via angiography (Figure 2).
- The GPX Embolic Material was interpreted to exhibit effective and thorough embolization throughout the renal cortical vasculature, including the smallest arteries/arterioles of the distal cortex (≤20 µm vessel diameter) and the vascular glomerular tufts (Figure 3A).
- GPX completely filled vessels and there was little evidence of residual red blood cells (Figure 3B)
- Microspheres were also observed in the renal cortical vasculature, but not in vessels ≤20 µm.
- The microspheres tended to occlude vessels with residual red blood cells enmeshed in the material (Figure 3C).
- Regardless of vessel size/location (i.e., hilus or distal cortex), both devices were associated with generally complete occlusion of the treated arterial lumina, with filling of vessels interpreted as mildly enhanced with GPX compared to that observed with the microspheres (fewer interwoven red blood cells/more complete filling).

Figure 2: GPX Embolization

Initial angiogram

GPX delivery

Post-angiogram

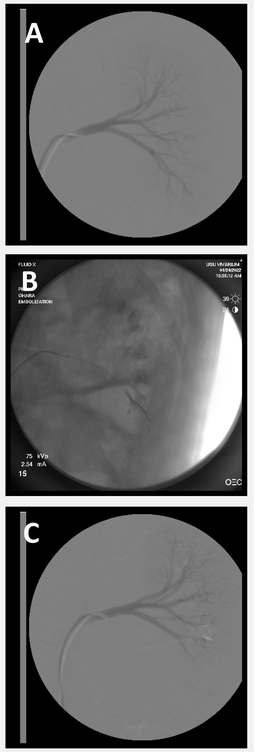
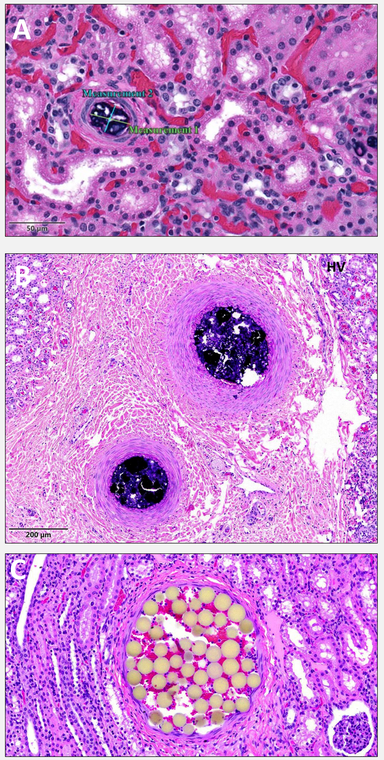


Figure 3: Histopathology

GPX occlusion of small arterioles

Vessel occlusion with GPX

Vessel occlusion with 40-micron microspheres



Conclusions

This study demonstrated the ability of the GPX Embolic Device to penetrate and occlude arterial vasculature ≤ 20µm in diameter, including the afferent arterioles of the glomerulus and within the glomerular vasculature. The 40µm microspheres used as the control device are the smallest commercially available microsphere embolization device and they did not penetrate into distal cortical arterial vasculature ≤ 20µm in this study. Microscopically, both devices provided good occlusion, but the GPX Embolic Device demonstrated a higher degree of filling within treated arteries (fewer intertwined RBCs). This study indicates that GPX is an embolization agent that may be well-suited for highly distal embolization applications.

The GPX Embolic Device is under development and does not have marketing clearance or approval in any market at this time. For investigational use (in New Zealand) only.
Doxorubicin-loaded GPX Embolic Device is under development and does not have marketing clearance or approval in any market at this time.