Pseudoaneurysms of the transplanted kidney can be divided into two categories: those incident to the renal parenchyma (parenchymal pseudoaneurysms) and those involving the main renal artery or its artery at the anastomosis (extrarenal pseudoaneurysms (EPSAs)) [1, 2]. Parenchymal pseudoaneurysms are common and usually antegrade complications requiring surgery, but can be successfully treated with the use of pledged coils. Extrarenal pseudoaneurysms are rarer, usually arise from distal branches of the renal arteries, and may present without a clear etiology, and have been reported in the past to require transplant nephrectomy. Here we report the cases of four patients who were diagnosed angiographically with EPSAs, discuss the clinical scenarios and imaging findings that led to their diagnosis, and describe the treatment modalities and outcomes in the current cases.

CASE PRESENTATIONS
Case 1
A 33-year-old man received a kidney from a living-related donor. The initial transplantation was complicated by three episodes of intraperitoneal thrombosis of the transplanted renal artery requiring surgical thrombectomy with anastomotic revisions, as well as the development of a perigraft hematoma that required surgical evacuation. The patient had delayed graft function but eventually regained renal function. Two months post-transplant, the patient noted to have a rise in creatinine to 4.7 mg/dL, from a baseline of 3.2 to 4.4 mg/dL. The patient did not have fevers, chills, nausea, or vomiting, and his creatinine levels were hemodynamically stable. A renal ultrasound was performed which demonstrated an extrarenal renal pseudoaneurysm with pararenal renal waveforms (Figure 1A). Given the clinical presentation, it was decided to treat the pseudoaneurysm surgically by bypassing the area of narrowing (Figure 1B). During the procedure, it was complicated by renal injury with significant blood loss (550 mL), requiring multiple blood transfusions and ultimately lead to graft sacrifice. Intensification of surgical therapy then resulted in placement of a renal prosthesis and successful renal retransplantation (Figure 1C). It was then decided to treat the EPSAs surgically by bypassing them with a renal prosthesis. The patient was then placed back on dialysis and remained alive 3 years post-nephrectomy. The EPSAs are believed to have been caused by repetitive mechanical surgical manipulation from the revascularization of the anastomosis and graft renal artery that had become necessary secondary to the EPSAs.

Case 2
A 58-year-old man received a renal graft from a deceased donor. His postoperative course was complicated by multiple admissions for urinary tract infections of mixed flora which were treated with intravenous antibiotics. A month post-transplant, the patient presented with pain over his transplant site. The patient was found to have an anastomotic pseudoaneurysm on an angiogram performed for the diagnosis of transplant renal stenosis (Figure 2A). B: Conventional angiogram confirmed the suspicion for an EPSA. An angiogram was performed which demonstrated persistent narrowing of the branch renal arteries, which were successfully treated with drug-eluting stents (Figure 2B). Since then, the patient has maintained a functioning renal transplant without recurrence of the pseudoaneurysm in the last two years. In the setting of a transplant hemostasis and repetitive urinary tract infections, it is thought that this EPSA was mycotic in origin.

Figure 1: 33-year-old male, status post renal transplant, who developed an EPSA. A: Coronal reconstruction CT of the abdomen and pelvis demonstrates a large heterogeneous collection within the left renal fossa with a smaller hypodense collection in the region of the transplanted renal artery anastomosis. B: Conventional angiograms confirmed the suspicion for an EPSA.

INTRODUCTION
The Role of Endovascular Procedures in the Diagnosis and Management of Transplanted Kidney Extrarenal Pseudoaneurysms: A Case Series
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DISCUSSION
• EPSAs are rare complication encountered in < 1% of renal transplant recipients.
• Clinical and lab factors suggestive of EPSAs include rise in Cr, pain over transplant site, fever, hypotension. Other studies have found palpable pulsatile mass and lumbarobaseous pain to be associated [3-6].
• In 3 out of 4 cases, EPSA were not appreciated on ultrasound. This can be due to technical errors including depth of transplanted vascular scarring and obscuration by bowel gas, as well as low prevalence to warrant a search. Interestingly, in three cases, renal artery stenosis was expected most likely due to compression of the transplant renal artery secondary to compression by the expanding pseudoaneurysm, which suggests if new onset renal artery stenosis is observed, a careful search for a pseudoaneurysm should be considered. Angiography remains the gold standard for diagnosis as 2 out of 4 cases solely relied on conventional angiography for the diagnosis.

Figure 2: 49-year-old female, status post renal transplant, who developed on EPSA. A: Coronal reconstruction CT of the abdomen and pelvis demonstrates a large heterogeneous collection within the left renal fossa with a smaller hypodense collection in the region of the transplanted renal artery anastomosis. B: Conventional angiograms confirmed the suspicion for an EPSA.

CONCLUSIONS
In conclusion and based on our experience, clinical outcomes of EPSAs in the current era may have improved as half of the patients in our series were able to retain a functioning graft after the therapeutic intervention. An endovascular approach continues to play a central role in the diagnosis and management of clinically stable EPSAs. Discerning whether an EPSA is mycotic has important implications for the treatment of the aneurysm itself and the potential need for parenteral antibiotic therapy. In the clinically stable patient, at least a pre-interventional course of antibiotics may be prudent.

REFERENCES