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Surgical planning with three-dimensional printing of a complex renal artery aneurysm

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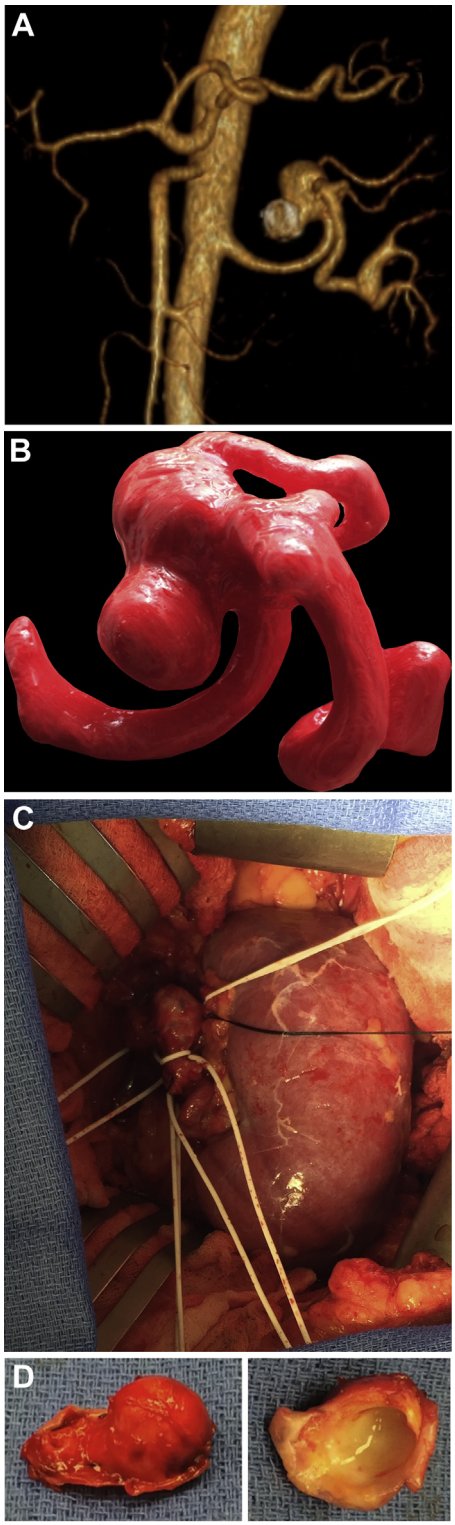
A 50-year-old woman with a solitary left kidney presented with a 1-year history of worsening left flank pain. A computed tomography angiography of her abdomen revealed a 2.8 cm left renal artery aneurysm that occurred at a distal branching point proximal to the renal hilum (*A*). Physical model generation, using a three-dimensional (3D) Printrbot (Lincoln, Calif), desktop printer and polylactic acid print filament, facilitated detailed inspection of the renal artery aneurysm morphology, dimensions, and location relative to afferent and efferent branches (*B*/Cover).

Intraoperatively, all known aneurysm-associated branches were expeditiously identified. Open aneurysmorrhaphy with patch angioplasty of the left renal artery was performed with a warm ischemia time of <14 minutes (*C*). Resected portions of the aneurysm were compared with the 3D printed model (*D*). Postoperatively the patient's renal function remained stable and she recovered well. The patient provided consent for her data to be submitted for publication.

Physical 3D anatomic models can provide significant benefit for preoperative surgical case planning when complex anatomy is involved. For example, 3D printing has recently been used to develop maxillofacial surgical implants, plan of complex tumor resections, and examine unique defects in congenital heart anatomy.[1] In vascular surgery, 3D printing is not yet widely adopted, although initial reports have demonstrated its utility in planning abdominal aortic aneurysm repairs[2] and anticipating abdominal aortic aneurysm neck anatomy.[3]

In the patient reported here, we further demonstrate the utility of 3D printing technologies in operative case planning and detailed anatomic assessments. We anticipate that as this technology becomes more widely available, it will be more widely adopted for vascular surgery operative case planning.



REFERENCES

1. Ventola CL. Medical applications for 3D printing: current and projected uses. Pharm Ther 2014;39:704.
2. Tam MD, Latham TR, Lewis M, Khanna K, Zaman A, Parker M, et al. A pilot study assessing the impact of 3-D printed models of aortic aneurysms on management decisions in EVAR planning. Vasc Endovasc Surg 2016;50:4-9.
3. Tam MD, Latham T, Brown JR, Jakeways M. Use of a 3D printed hollow aortic model to assist EVAR planning in a case with complex neck anatomy: potential of 3D printing to improve patient outcome. J Endovasc Ther 2014;21:760-2.

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