ventilation requirement (AUC, 0.735), deep venous thrombosis (AUC, 0.660), cardiopulmonary arrest (AUC, 0.733), and septic shock (AUC, 0.796). A cumulative frequency table of mortality with ESS was used to partition patients into quartiles of ESS <5, ESS of 6 or 7, ESS of 8 or 9, and ESS >10. A Cochran-Armitage test showed linear trend towards increased 30-day mortality among the quartiles with increasing ESS ($P < .001$), with quartile 4 (ESS >10) having 76 times odds of increased 30-day mortality compared with reference quartile 1 (ESS <5) (Table).

Conclusions: ESS performance accurately predicts mortality for neAER procedures. Its use may be useful for preoperative risk stratification, and it has the potential to be utilized for national benchmarking after these endovascular procedures.

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Development And Initial Validation Of A Modern Hemodynamics Laboratory

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Objective: Modern technology has made it possible to study complex arterial stenoses, aneurysms, and other vascular pathology ex vivo using pulsatile perfusion pumps, three-dimensional (3D) printed arteries, flow and pressure transduces, ultrasound, and cadaveric vessels. We develop such a laboratory and initially validate it against in vivo and computational fluid dynamic results.

Methods: As shown in Fig 1, the flow loop is equipped with a pulsatile blood pump (Harvard Apparatus, model 1423 PBP), four pressure transducers (Deltran-DPT-100), a portable ultrasound system (Philips Ultrasound, CX50), a data acquisition system (National Instruments Corporation, Labview v19.0), five flowmeters (IFM Efector - SM6400), and elements of resistance and compliance. Specific arterial pathology is obtained by segmenting arteries from computed tomography angiography or duplex ultrasound. A 3D printer able to print with sonolucent material with various compliances is used to either print the arterial pathology for study or to print stenoses placed within cadaveric arteries. Flow and pressure measurements are live via LabVIEW and duplex ultrasonography.

Results: Both aortoiliac and aortorenal arterial systems anatomically extracted from patients' computed tomography angiography data have been studied. A typical example using an iliac stenosis is shown in Fig 2. The relative errors of the experimental vs invasive measurement at peak systole and end diastole are 0.6% to 2.7% (a) and 0.1% to 5.8% (b). The accuracy is equivalent to the computational results for the same patient cases.

Conclusions: The pulsatile flow loop provides a unique capability to noninvasively measure pressure and flow waveforms in 3D printed arteries or cadaveric arteries with 3D printed stenoses, from which the trans-stenotic pressure gradient can be calculated for medical insights. It can also be used to study wall shear stress in complex aneurysms and flow pattens related to atheroemboli in diseased carotid bifurcations.

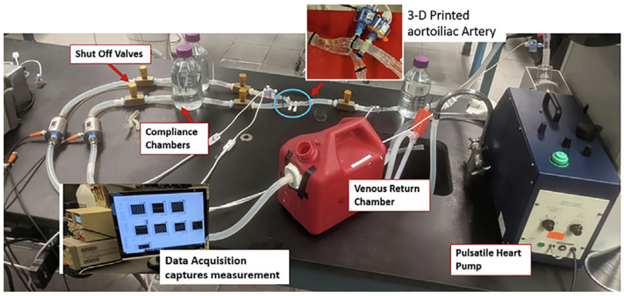

Fig 1. Flow loop.

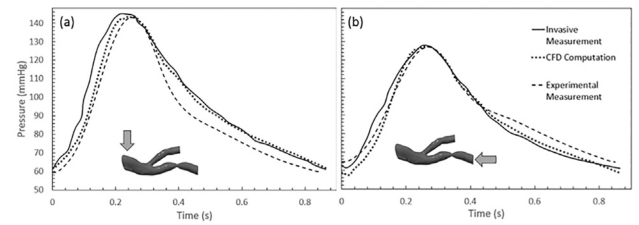

Fig 2. The pressure waveforms from invasive pressure measurements (*solid lines*), experimental measurements (*dashed lines*), and computational results (*dotted lines*) at the common iliac artery **(a)** and the external iliac artery **(b)** are compared.

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Extravascular Access Artery Closure Following Percutaneous Peripheral Intervention

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Objectives: Percutaneous closure of the access artery following endovascular intervention has become commonplace. In patients with peripheral vascular disease, however, control of a femoral puncture site is problematic as the access artery is frequently plaque-laden and stenotic. Ischemic complications in the access extremity are more common in these cases, particularly when using devices requiring the deployment of prosthetic material within the compromised arterial lumen. The purpose of this retrospective clinical study was to assess the efficacy of totally extravascular/bioresorbable closure of femoral artery puncture sites following percutaneous peripheral intervention (PPI).

Methods: Consecutive PPIs performed by three vascular surgeons in a single institution between the years 2015 and 2020 were studied. Demographic characteristics and 30-day morbidity were analyzed. Logistic regression modeling was used to assess predictors of procedural complications.

Results: A total of 522 consecutive percutaneous endovascular procedures were performed in 396 patients. Their mean age was 74 years; comorbidities were prevalent, including hypertension (91%) and diabetes (58%). The most common indications for angiography were chronic limb-threatening ischemia (67%) and lifestyle-limiting claudication (26%). All procedures were performed using femoral artery access in retrograde (93%) or antegrade (7%) fashion through sheaths of 5 Fr (17%), 6 Fr (27%), or 7 Fr (53%). Post-procedure control of the access site was achieved by manual compression (MC) (75%) or percutaneous extravascular/bioresorbable closure (PEC) (25%). PEC became the preferred method following United States Food and Drug Administration approval of the Vascade device (Haemonetics Corp, Boston) in 2019. Using logistic regression analysis, the occurrence of access complications was significantly lower with PEC compared with MC (24% vs 14%; $P = .012$). The most severe complication of acute arterial ischemia was observed in four extremities controlled with MC (1%) but none of the 129 extremities controlled with PEC.

Conclusions: Totally extravascular access artery closure following PPI is safe, effective, and reduces complications compared with MC. Acute arterial ischemia following percutaneous extravascular access artery closure was not observed in this series.

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