CLINICAL IMAGE

Ultrasound-assisted catheter-directed thrombolysis for treatment of deteriorating intermediate-high-risk pulmonary embolism in early pregnancy

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A 31-year-old woman, 10 weeks pregnant (gravida 4, para 3), presented with sudden shortness of breath. Her past medical history was uneventful. Initial evaluation showed heart rate (HR) of 120 bpm, respiratory rate of 36 bpm with a need of 6 l of supplemental oxygen (nasal cannula) to maintain saturation above 94%, blood pressure (BP) of 128/70 mm Hg, and elevated troponin I (0.83 ng/ml; reference range [RR] <0.05 ng/ml) and N-terminal pro–B-type natriuretic peptide (NT-proBNP; 1082 pg/ml; RR <125 pg/ml). Imaging revealed extensive clots in both pulmonary arteries (PAs) and their branches and increased right ventricle (RV)-to-left ventricle (LV) diameter ratio (FIGURE 1A and 1B), but without deep vein thrombosis. Echocardiography demonstrated severe RV hypokinesis (tricuspid annular plane systolic excursion [TAPSE] of 14 mm) and increased RV/LV ratio of 1.3 (FIGURE 1C). Anticoagulation with intravenous unfractionated heparin (UFH) was started. Six hours later, the patient's condition deteriorated with an increase in tachycardia (up to 135 bpm), oxygen demand, overt hypotension requiring vasopressor support with dobutamine and norepinephrine, progression of RV failure (TAPSE dropped to 8 mm) (FIGURE 1D), with troponin I peaking at 1.3 ng/ml and NT-proBNP at 2478 pg/ml.

After extensive multidisciplinary discussion with increased concern about maternal and fetal bleeding with the use of systemic thrombolysis (ST), and a detailed explanation of the potential risks to the patient and the developing fetus, the institutional pulmonary embolism (PE) response team qualified the patient for catheter-directed, ultrasound-accelerated thrombolysis (USAT). She underwent the procedure with 2 EKOS devices (Boston Scientific, Marlborough,

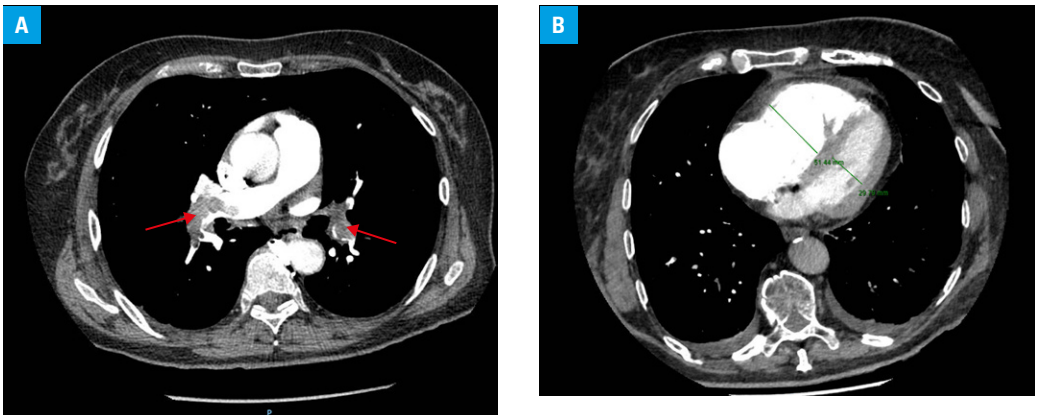

FIGURE 1 A–B – computed tomography pulmonary angiography showing bilateral proximal pulmonary embolism (arrows) (A) and right ventricular (RV) dysfunction with increased right ventricular-to-left ventricular diameter ratio (RV/LV, 51.4 mm/29.8 mm = 1.7) (B)

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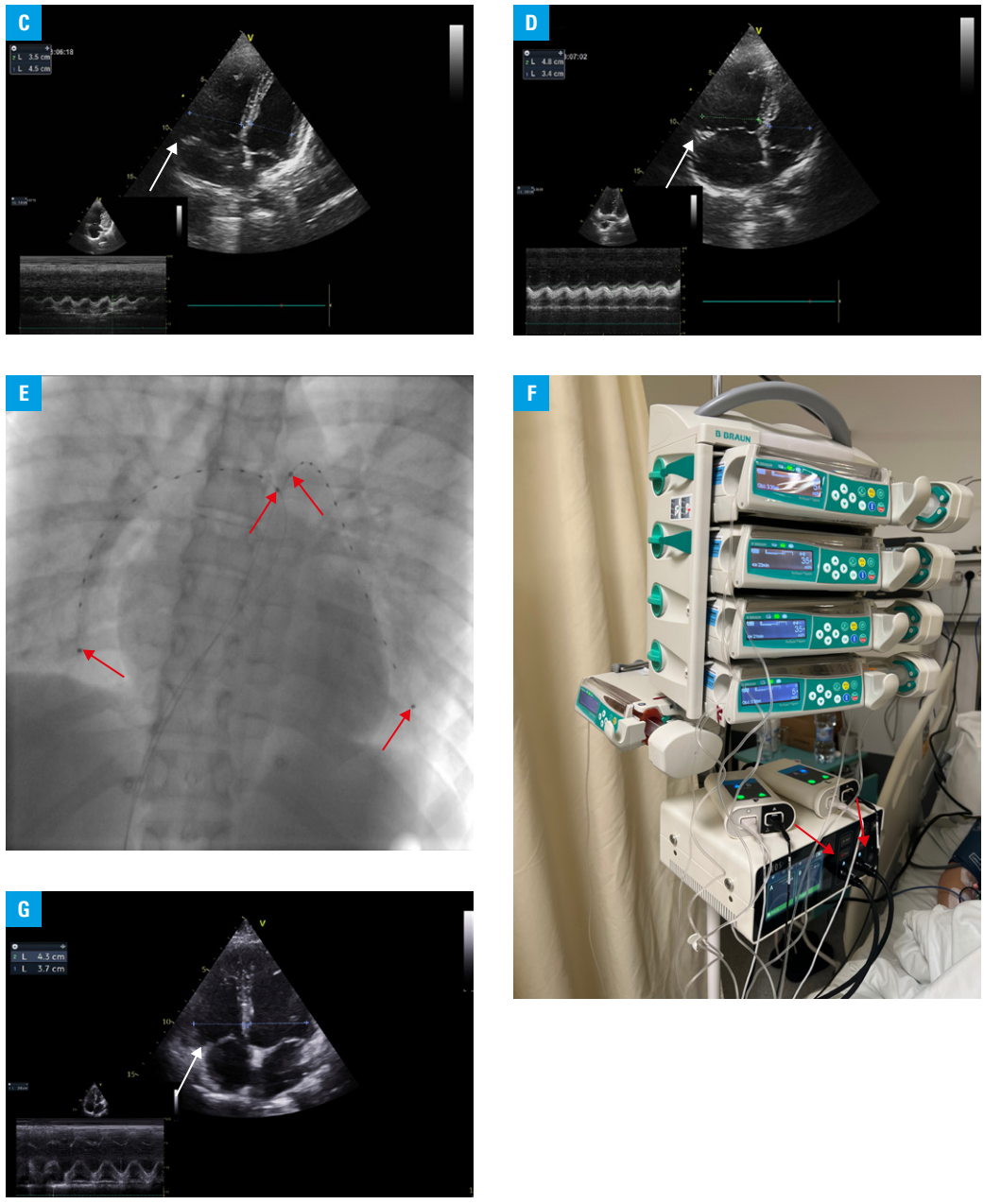

FIGURE 1 **C** – initial echocardiography (apical 4-chamber view [A4CH]) showing enlargement of the RV with increased RV/LV ratio (45 mm/35 mm = 1.3) and hypokinesis with decreased tricuspid annular plane systolic excursion (TAPSE, 14 mm), the arrow indicates TAPSE measurement in an M-mode tracing. **D** – echocardiography at the time of the patient's clinical deterioration (A4CH view) showing progression of RV failure with an increase of RV/LV ratio (48 mm/34 mm = 1.4), and a drop in TAPSE (8 mm), the arrow indicates TAPSE measurement in an M-mode tracing. **E–F** – fluoroscopy of catheter-directed, ultrasound-accelerated thrombolysis (EKOS catheters) placed bilaterally in the segmental arteries of the lower pulmonary lobes. Arrows indicate the segment of the infusion catheter with holes for deploying the thrombolytics (**E**) and EKOS equipment with the control unit with separate ports for simultaneous management of 2 EKOS catheters (arrows) connected with infusion pump lines for coolants and lytics (**F**). **G** – repeated echocardiogram (A4CH) 48 hours after the procedure showing improvement of the RV function with reduced RV/LV ratio (37 mm/43 mm = 0.86) and improvement in TAPSE (26 mm), the arrow indicates TAPSE measurement in an M-mode tracing.

Massachusetts, United States) placed bilaterally in the lower segmental arteries under fluoroscopic guidance, accessed via the right common femoral vein. The patient's pelvis was shielded using lead aprons. The initial PA pressures were 33/15/22 mm Hg, and the cardiac index (CI) was 2.2 l/m^2. An initial bolus of 1 mg of alteplase was injected through each catheter, followed by a continuous infusion of 1 mg/catheter/hour for 7 hours (FIGURE 1E and 1F) with continued UFH infusion. USAT was safely completed resulting in a significant hemodynamic improvement (CI, 3 l/m^2; HR, 95 bpm; BP, 117/75 mm Hg; saturation, 96% on room air). Catecholamines were discontinued a few hours after the procedure. Enoxaparin in a weight-adjusted dose was

initiated for long-term anticoagulation. Follow-up transvaginal ultrasound showed a viable intrauterine pregnancy. A consultant obstetrician recommended a routine prenatal workup. Echocardiography performed 48 hours after the procedure revealed complete normalization of RV size (RV/LV ratio, 0.86) and function (TAPSE, 26 mm) (FIGURE 1G); the biomarkers also normalized.

PE accounts for 10% of all maternal deaths and occurs with equal frequency in all trimesters.[1] Currently, there is limited evidence for management of life-threatening PE in pregnancy.[2] Guidelines list pregnancy as a relative contraindication to ST, due to a risk of critical maternal and fetal bleeding.[3] Here, we report a case of a pregnant woman with PE and cardiovascular collapse with an excellent response to USAT. USAT reduces the bleeding risk by applying lower doses of thrombolytics. Moreover, its combination with ultrasound energy unwinds fibrin strands and accelerates lytic dispersion deeper into the clots.[4,5]

ARTICLE INFORMATION

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