A 79-year-old woman was admitted to our center for atypical angina pectoris with chest pains worse at coughing. Her medical history revealed a dorsal stabilization of 3 lumbar vertebral bodies, 5 months ago. Laboratories showed moderate elevation of high-sensitive troponin T. Therefore, a coronary angiography was performed and ruled out significant coronary artery stenoses. However, fluoroscopy showed a toothpick-shaped structure of \( \approx 9 \text{ cm} \) reaching from the superior vena cava down to the diaphragmatic base of the right ventricle (RV; Figure [A] and [B]). Chest x-ray and 3-dimensional echocardiography confirmed the presence of a toothpick-like structure within the RV, along with a small pericardial effusion (Figure [C–E]; see Movie IA and IB in the Data Supplement). In-depth investigation of the patient’s medical record revealed usage of bone cement (polymethylmethacrylate [PMMA]) during the orthopedic procedure 5 months ago. A computed tomographic scan was performed, and 3-dimensional reconstruction showed multiple pulmonary emboli of identical Hounsfield units in addition to the structure in the RV (Figure [F] and [G]). Considering the patient’s medical history, we hypothesized the visualized structures being PMMA fragments accidently penetrating into the paravertebral venous system causing consecutive cardiopulmonary embolism after the orthopedic procedure. For retrieval, open heart surgery was declined by the patient.

Because the patient rapidly became more symptomatic in terms of dyspnea and complaints of worsening chest pains, a fully percutaneous catheter-based approach for retrieval was pursued. Inferior vena cava access seemed inappropriate because of the upward orientation of the structure and its presumably fragile composition. Therefore, a transjugular 18F sheath and an Amplatz lasso (Goose neck snare kit 35 mm/6F; Figure [J]) were used to mobilize the foreign body into the sheath for removal. During the procedure, 2 small fragments split off but could successfully be removed by the same technique (Figure [H–K]; see Movie II and III in the Data Supplement). The retrieved structures had solid cement-like structure with a minimal internal lumen (Figure [K]). The patient recovered quickly and was discharged on day 3 after the intervention.

Discussion

Bone cement fragment penetration into the paravertebral venous system and consecutive pulmonary embolism are described as complications of orthopedic procedures involving PMMA administration and may occur in \( \approx 23\% \) of cases in some reports.\(^1,2\) Given the frequently asymptomatic nature of small pulmonary emboli, total incidence might even be underestimated. Often, these small foreign bodies of 1 to 5 mm (Figure [G]) are not hemodynamically relevant. Without any clinical or functional implications such as worsening of New York Heart Association class or RV functional impairment, these small pulmonary emboli, therefore, do not require any specific treatment.\(^1,2\) Several reports on complicated large cardiopulmonary PMMA embolism after percutaneous kyphoplasty that required open heart surgery for foreign body removal and RV repair have been published.\(^3,4\) In a recent study, percutaneous catheter-based retrieval was deemed futile, given the presumably nonpliable PMMA nature of the fragment.\(^4\) Moreover, RV perforation was present with indication for open heart surgical repair.\(^1\) However, in this present case, open heart surgery was declined by the patient and RV perforation absent. Therefore, after careful risk–benefit assessment, a fully percutaneous catheter-based retrieval of the bone cement fragment with a lasso catheter was performed successful.

Although frequent clinically asymptomatic tiny pulmonary emboli do not require specific therapy, retrieval of large bone cement fragments should be considered in (1) symptomatic patients presenting with dyspnea, chest pains, or arrhythmia; (2) in case of large cohesive pieces in the RV with the risk of perforation and subsequent cardiac tamponade, tricuspid valve damage, or major embolism of large pulmonary arteries resulting in pulmonary hypertension and right heart failure; and (3) in case of perforation with pericardial effusion and cardiac tamponade. If perforation is present or the tricuspid valve seems to be damaged, open heart surgery should be first choice therapy as it allows for RV repair and, if necessary, repair/replacement of the tricuspid valve. However, here we show that in toto percutaneous catheter-based removal of RV PMMA fragments is safe and feasible in the absence of RV perforation, especially if adjunctive imaging modalities such as 3-dimensional echocardiography are available for proper fragment localization and catheter guidance for retrieval.

Of note, percutaneous catheter-based RV foreign body retrieval implies crossing the tricuspid valve and may, therefore, cause substantial iatrogenic trauma to the valve when passing it, resulting in significant regurgitation or stenosis
in the long term. Therefore, caution has to be implied by the interventionalist during the retrieval procedure, and adjunctive imaging modalities such as 3-dimensional transthoracic echocardiogram/transesophageal echocardiogram should be implied for optimal visualization and guiding during the procedure to optimize procedural outcome and minimize possible side effects.

Reports on rare life-threatening cardiopulmonary complications after orthopedic procedures involving PMMA administration raise the question if better ways to prevent ongoing systemic embolization during orthopedic procedures are routinely warranted, despite the high frequency of clinically asymptomatic emboli that do not require specific therapy. Patients presenting with dyspnea, chest pains, or arrhythmia after an orthopedic procedure require detailed cardiopulmonary checkup to not miss rare but possibly life-threatening complications.

Disclosures
None.

References

Key Words: embolism ■ intervention ■ right ventricular involvement

Figure. A and B, X-ray examination in RAO ap 0° and LAO 90° showing a small, 9-cm spear stuck in the right ventricular wall (arrows). C and D, Echocardiography confirmed the presence of a structure (red arrow) reaching from the superior vena cava into the right ventricle.
Figure (Continued). E, Lumbar x-ray showed dorsal stabilization with small effusion of bone cement into paravertebral veins (black arrows) and large cement fragment in right ventricle (red arrow). F and G, Performed computed tomographic scan and 3-dimensional reconstruction showed a toothpick-like structure in the right ventricular wall (red arrow) and multiple small pulmonary emboli (black arrows) in the left lower lung lobe.
Figure (Continued). H and I, TEE-guided catching of large cement fragment with a snare catheter (arrow) via transjugular approach; removal of a small fragment that split off during the catching procedure. J and K, Bone cement fragments and snare catheter after successful fishing, and bone cement reflects a cast specimen of the paravertebral vein; toothpick with internal lumen (arrow).
Percutaneous Transjugular Removal of an Intracardial Bone Cement Fragment After Dorsal Stabilization

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Supplemental Material
**Supplemental Figure.** X-ray in pa-view shows dorsal stabilization with bone cement and a “toothpick” like structure in the right ventricular wall
Video Legends

Video 1A and B. Video files show both 2D- and 3D-transesophageal sequences detecting a large structure reaching from the superior vena cava into the right ventricular wall.

Video 2. Video file shows TEE-guided catching of the larger cement fragment with a snare catheter

Video 3. Video file shows TEE-guided catching of the smaller cement fragment with a snare catheter