inal symptoms and normal ultrasound ruled out abdominal traumatic lesions. Chest x-ray follow-up showed radiologic findings that were suggestive of extraparenchymatous lesion, either pleural or extrapleural. Thorax computed tomography (CT) was ordered to assess for loculated pleural hemothorax versus extrapleural location, because plain x-rays cannot differentiate between these locations. Contrast-enhanced CT images (Figure 1) revealed a large collection of increased attenuation, which contained the chest tube, separated from the enhanced, partially collapsed left lower lobe by a fat attenuation stripe. The large outer high-density collection was interpreted as an extrapleural hematoma, which was separated from the lower lobe atelectasis by the parietal pleura and extrapleural fat. The patient underwent an open thoracotomy, and a large extrapleural hematoma was found and removed.

The extrapleural fat sign² refers to the fat layer outside the pleura in the chest wall between the parietal pleura and the endothoracic fascia. Recognition of this finding on CT scan is useful to determine the extrapleural location of a lesion, as it is outlined by a fat ribbon that represents the extrapleural fat medially displaced.³ In our case, the extrapleural fat sign was useful in distinguishing an extrapleural hematoma from the initially diagnosed pleural hemothorax. Extrapleural hematomas are rare and known to occur as a result of blunt trauma or placement of medical devices. When the hematoma is traumatic, it can be associated with rib fracture, hemothorax, lung contusion, or pneumothorax.⁴ A formal or minithoracotomy is the recommended procedure in cases of large hematomas or unstable patients.⁵ This sign has also been described secondary to thoracic wall tumor and edema.

Plain x-ray semiology suggests the extraparenchymatous location of the lesion. It is the recognition of medially displaced extrapleural fat on CT that helps to establish a differential diagnosis on the basis of an extrapleural lesion.

Elena Alventosa Fernández, MD^a
Luisa Elena Rodríguez Delgado, MD^a
Diagnostic Imaging Department^a
Hospital Universitario Nuestra Señora de
Candelaria
Santa Cruz de Tenerife, Spain

Emilio Martín Díaz, MD^b
Thoracic Surgery Department^b
Hospital Universitario Nuestra Señora de
Candelaria
Santa Cruz de Tenerife, Spain

References

1. Kabiri EH, Arsalane A, Zidane A, Aoini F. Extrapleural hematoma as a complication of spontaneous pneumothorax. *J Thorac Cardiovasc Surg.* 2006;132:423-4.
2. Hammerman AM, Susman N, Strzembosz A, Kaiser LR. The extrapleural fat sign: CT characteristics. *J Comput Assist Tomogr.* 1990;14:345-7.
3. Aquino SL, Chiles C, Oaks T. Displaced extrapleural fat as revealed by CT scanning: evidence of extrapleural hematoma. *AJR Am J Roentgenol.* 1997;169:687-9.
4. Goh BK, Koong HN. Massive traumatic extrapleural hematoma mimicking hemothorax: a potential pitfall of penetrating chest trauma. *J Trauma.* 2006;61:995-7.
5. Poyraz AS, Kilic D, Gultekin B, Ozulku M, Hatipglu A. Extrapleural hematoma: when is surgery indicated? *Monaldi Arch Chest Dis.* 2005;63:166-9.

doi:10.1016/j.jtcvs.2007.07.064

Cutting secondary chordae and placing dual taut stitches between the anterior mitral fibrous annulus and the heads of each papillary muscle to treat ischemic mitral regurgitation without deteriorating left ventricular function

To the Editor:

Langer and associates¹ are to be congratulated for their novel work in repositioning the posterior papillary muscle (PPM) using Teflon-pledged 4-0 polytetrafluoroethylene (PTFE) suture (in their term, "STRING") sewn up to the midseptal fibrous annulus to treat ischemic mitral regurgitation (IMR) by shortening the

distance between the PPM head and the mitral annulus, thus reducing the tenting height and enhancing the coaptation zone. We investigated the effects of cutting secondary chordae of the anterior leaflet and putting dual stitches with different tensions between the middle portion of the anterior mitral annulus and the head of both papillary muscles in a canine failing heart model (Figure 1).² Although Langer and colleagues reported that the STRING procedure clinically treated IMR better than an undersized annuloplasty ring alone in 12 patients, several concerns should be raised in its clinical application according to the findings from our animal study.

First, Langer and colleagues¹ did not perform chordal cutting, which has been shown to be effective in eliminating the anterior leaflet bend, reducing tenting height, and decreasing the extent of mitral regurgitation without prolapse.³ This simple technique can be performed easily and concomitantly with the STRING procedure.

Second, Langer and colleagues¹ did not put PTFE stitches on the head of the anterior papillary muscle. To decrease tenting height, Langer and associates pulled only the PPM head toward the midseptal fibrous annulus because papillary muscle displacement is usually found in PPM and not in the anterior papillary muscle.¹ However, tenting is usually observed in both the medial and lateral sides of the anterior leaflet in patients with IMR,⁴ which may necessitate the creation of new tension in both the anterior papillary muscle and the PPM to reduce tenting of the entire anterior leaflet.

Third, the appropriate tension of newly constructed PTFE should be defined. Langer and associates¹ pulled STRING with intraoperative echocardiographic guidance to the extent that residual mitral regurgitation significantly improved from the state with undersized mitral annuloplasty and no tension on STRING. IMR is a ventricular disease rather than a valvular disease. IMR is the

Figure 1. Schematic presentation of the combination of chordal cutting and chordal reconstruction with dual PTFE stitches between the anterior mitral fibrous annulus and the heads of each papillary muscle. IMR, Ischemic mitral regurgitation; PTFE, polytetrafluoroethylene.

consequence of papillary muscle displacement because of the dilated left ventricle (LV), not the cause. Mitral regurgitation itself should be treated with undersized mitral annuloplasty plus chordal cutting, and STRING is placed for preventing future LV remodeling, as Langer and associates mentioned. Pulling STRING to their extent means that it might distort the diseased LV geometry. In our study,² the condition under which artificial chordae between each papillary muscle head and mitral fibrous annulus were released was defined as “redundant,” the chordal tension of 15 g weight was defined as “taut,” and the tension of further chordal shortening of 2 mm was defined as “tight.” The remarkable findings were that stroke volume and cardiac output in the “taut” and “tight” states improved compared with the “redundant” state. However, the preload recruitable stroke work of the “taut” state significantly improved from the “redundant” state and deteriorated in the “tight” state.

The “taut” state achieved the best hemodynamics. In the clinical setting, we also achieved a favorable outcome with taut tension of the reconstructed artificial chordae in mitral valve replacement.⁵

The treatment of IMR is a balancing act. The leaflet must be secure with the newly created geometry and the tight PTFE stitch, as Langer and associates insisted; however, the LV may not be. In our opinion, cutting secondary chordae and pulling dual PTFE stitches with taut tension can treat IMR without deteriorating LV function.

Masashi Komeda, MD, PhD

Takeshi Shimamoto, MD

Department of Cardiovascular Surgery
Kyoto University Graduate School of Medicine
Kyoto, Japan

References

1. Langer F, Schafers HJ. RING plus STRING: papillary muscle repositioning as an adjunctive repair technique for ischemic mitral regurgitation. *J Thorac Cardiovasc Surg.* 2007;133:247-9.

2. Fukuoka M, Nonaka M, Masuyama S, Shimamoto T, Tambara K, Yoshida H, et al. Chordal “translocation” for functional mitral regurgitation with severe valve tenting an effort to preserve left ventricular structure and function. *J Thorac Cardiovasc Surg.* 2007;133:1004-11.
3. Messas E, Pouzet B, Touchot B, Guerrero JL, Vlahakes GJ, Desnos M, et al. Efficacy of chordal cutting to relieve chronic persistent ischemic mitral regurgitation. *Circulation.* 2003;108(Suppl 1):II111-5.
4. Watanabe N, Ogasawara Y, Yamaura Y, Kawamoto T, Toyota E, Akasaka T, et al. Quantitation of mitral valve tenting in ischemic mitral regurgitation by transthoracic real-time three-dimensional echocardiography. *J Am Coll Cardiol.* 2005;45:763-9.
5. Soga Y, Nishimura K, Yamazaki K, Komeda M. Simplified chordal reconstruction: ‘oblique’ placement of artificial chordae tendineae in mitral valve replacement. *Eur J Cardiothorac Surg.* 2003;24:653-5.

doi:10.1016/j.jtcvs.2007.03.071