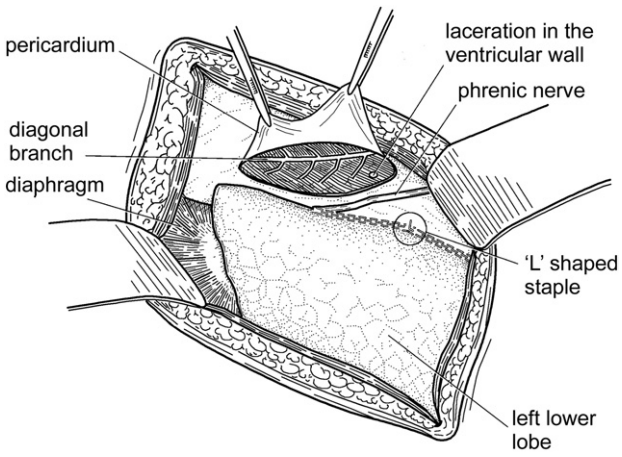

Fig 1. Schematic diagram shows the second surgical exploration.

was found between the two cuttings performed in the first operation along the incomplete oblique fissure and corresponded to the location of the ventricular and pericardial rupture. This malformed staple had a protruding edge (in an L-shape) on the lung margin, and the sharp edge of the staple had evidently punctured the adjacent pericardium and the ventricular wall (Fig 1).

The patient recovered well and was discharged on the 12th day after the second operation. Pathologic evaluation showed moderately differentiated adenocarcinoma of the left upper lung, with no metastasis to the lymph nodes (T2 N0 M0). She was in good status when seen in the follow-up clinic.

Comment

Acute cardiac tamponade is most often seen after chest trauma or cardiovascular operations but is not usually considered a complication associated with pulmonary lobectomy. Cardiac tamponade is a life-threatening situation, and the patient may die quickly if pericardial decompression is not performed promptly. Owing to lack of experience, the possibility of cardiac tamponade was not considered at the beginning of this case. Fortunately, an urgent operation, prompted by the failure of medication to improve the vital signs, saved her life.

The reexploration found the L-shaped staple had caused the left ventricular rupture. However, the 45-mm linear stapler has been widely used in the separation of incomplete pulmonary fissures, and malformation of the staples was quite common [6]. The results of Nakayama and colleagues [6] showed that proper staple formation is correlated with tissue thickness, precompression time, and location (proximal or distal part) of the cartridge. Although this precise measurement is not easy in the clinical setting, tissue thickness influenced the staple shape after firing. Compared with the proximal part, the distal part of the jaw had a lower chance of optimal staple formation [6].

The staple malformation in the middle of the two cuttings occurred because the tissue to be separated was too thick and the staples were put over those put in previously, which made the lever too heavy to manipulate. Therefore, to reduce the risk of damage to the adjacent tissue, staple height should be chosen to match the tissue thickness, and tissue bunching at the crotch of the stapler must be avoid because it can lead to poor staple formation and tissue acquisition [7]. The cut surface should be carefully examined. A malformed staple should be removed and absorbable materials used to cover the unsmooth margin. Devices with 3-point gap control mechanism in the jaws might ensure consistent proximal-to-distal alignment during firing, thus causing less staple malformation.

Teacher Chen Tongxiong helped us create the schematic diagram (Fig 1).

References

1. Morimoto M, Ohashi M, Nobara H, et al. Rupture of the ascending aorta after surgical resection for lung cancer—a case report. Jpn J Surg 1991;21:476–9.
2. Pillai JB, Barnard S. Cardiac tamponade: a rare complication after pulmonary lobectomy. Interact Cardiovasc Thorac Surg 2003;2:657–9.
3. Pradhan S, Iyer AP, Parija C, et al. Cardiac tamponade: an unusual complication following left upper lobectomy for post-tubercular aspergilloma: a case report. Ind J Thorac Cardiovasc Surg 2006;22:143–4.
4. Kotoulas C, Meraj S, Odom NJ. Asymptomatic fatal post-lobectomy hemopericardium. Monaldi Arch Chest Dis 2008; 69:134–6.
5. McLean RH, Parandian BB, Nam MH. Pericardial tamponade: an unusual complication of lobectomy for lung cancer. Ann Thorac Surg 1999;67:545–6.
6. Nakayama S, Hasegawa S, Nagayama S, et al. The importance of precompression time for secure stapling with a linear stapler. Surg Endosc 2011;25:2382–6.
7. Baker RS, Foote J, Kemmeter P, Brady R, Vroegop T, Serveld M. The science of stapling and leaks. Obes Surg 2004;14:1290–8.

Primary Adrenal Melanoma With Inferior Vena Caval Thrombus

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Primary adrenal melanoma is a rare tumor. Most lesions are confined to the adrenal gland, without extension to surrounding structures. We report a primary adrenal melanoma discovered during an evaluation for pulmonary embolism. Tumor thrombus was present in the

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inferior vena cava extending into the right atrium. A complete resection was obtained using cardiopulmonary bypass and profound hypothermic circulatory arrest. Long-term survival with melanoma is still limited, regardless of the organ of origin.

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Primary melanoma of the adrenal gland is an extremely rare tumor that is usually discovered as an incidental finding [1]. The diagnosis is most commonly made at the time of pathologic examination. Only a few of these tumors are symptomatic. We present a patient with primary melanoma of the adrenal gland discovered during evaluation for a pulmonary embolism. The tumor was associated with extensive inferior vena caval (IVC) thrombus extending into the right atrium. Complete resection was accomplished with a combined laparotomy and sternotomy approach using cardiopulmonary bypass (CPB) and deep hypothermic circulatory arrest.

A 43-year-old woman with hypertension, type 2 diabetes, gastroesophageal reflux disease, and morbid obesity presented to another hospital with dyspnea. A contrast computed tomography scan of the chest, abdomen, and pelvis revealed bilateral pulmonary emboli. Further examination of this study revealed a 2-cm tumor of the right adrenal gland, with extension into the IVC (Fig 1). Anticoagulation with enoxaparin and warfarin was started and the patient was discharged home after complete resolution of symptoms.

She was referred to an oncologic surgeon for further evaluation of the mass. However, 3 weeks later, her dyspnea worsened and she was again evaluated with a computed tomography scan. This revealed propagation of the IVC thrombus from the iliac vein confluence to the right atrium (Fig 2). The preoperative diagnosis was an adrenocortical carcinoma with IVC thrombus extending into the right atrium. The patient was transferred to our institution for definitive surgical management.

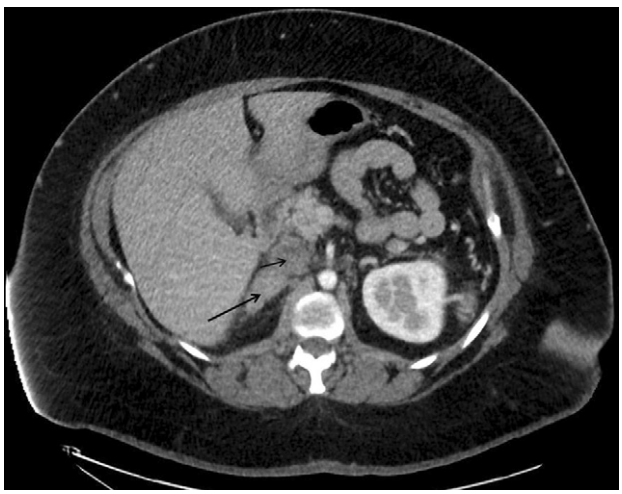

Fig 1. A computed tomography scan of the abdomen shows a right adrenal mass (long arrow) with thrombus in the inferior vena cava (short arrow).

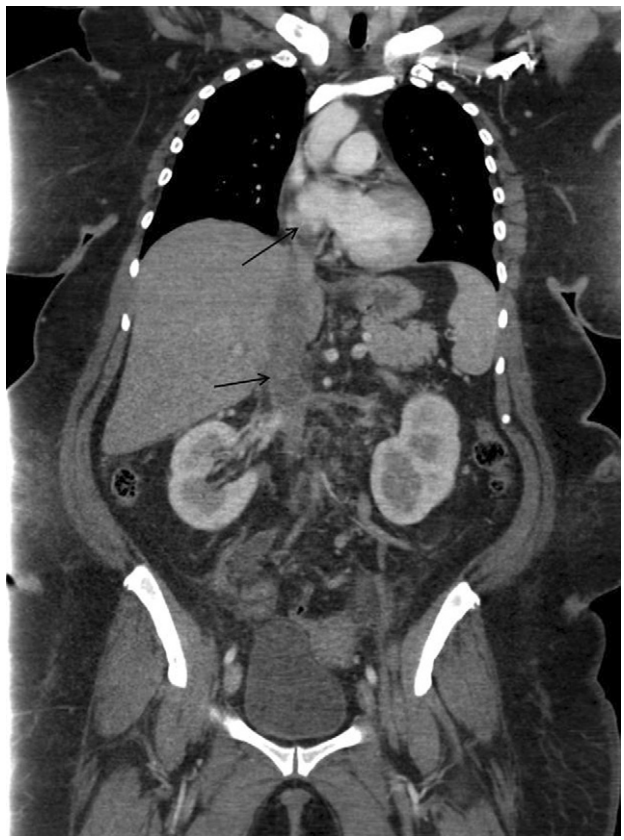

Fig 2. A coronal view computed tomography scan of the chest and abdomen shows the thrombus of the inferior vena cava extending to the right atrium (arrows).

The preoperative workup included a positron-emission tomography–computed tomography scan that showed no metastatic disease, a cardiac catheterization that showed no coronary artery disease, and an echocardiogram demonstrating an ejection fraction of 0.60. The thrombus was easily visualized within the right atrium and was now protruding across the tricuspid valve into the right ventricle.

The abdomen was entered through a bilateral subcostal incision. The right adrenal gland was mobilized after medial rotation of the abdominal viscera. The IVC was exposed to the level of the hepatic veins. Meticulous attention to hemostasis was paramount during the abdominal portion of the procedure. A median sternotomy was then performed. Heparin was given at 400 IU/kg.

Standard arterial cannulation of the ascending aorta was performed. Venous cannulation consisted of a cannula in the superior vena cava and a second cannula in the right atrium, 3 cm above the atriocaval junction. CPB was initiated, and the patient was cooled to a bladder temperature of 18°C. Circulatory arrest and retrograde cerebral perfusion were initiated.

The right atrium and IVC were opened simultaneously. A large amount of tumor thrombus was evacuated

from the atrium and the IVC down to the level of the iliac vein confluence. Tumor thrombus was seen to be involving the ostia of the left renal vein and the hepatic veins and was easily extracted. The tumor thrombus was quite adherent in the area of the IVC around the right adrenal vein ostium, and a portion of IVC wall was resected en bloc with the primary adrenal resection.

The right atrium was closed primarily, and the 32F right atrial venous cannula was positioned into the infrahepatic IVC under direct vision. The IVC was then primarily closed with two layers of 4-0 polypropylene suture. CPB was resumed and systemic warming was initiated. Cardiac ischemic time was 53 minutes, including 46 minutes of circulatory arrest. Total CPB time was 180 minutes. During the entire procedure, the patient received 2 units of packed red blood cells, 2 units of fresh frozen plasma, and 6 units of platelets.

To our surprise, the final pathologic analysis revealed malignant melanoma of the right adrenal gland measuring 5 mm, with positive tumor markers S-100, human melanoma black 45, and melan-A (A103). The caval and right atrial thrombus showed no evidence of tumor. A thorough dermatologic and ophthalmologic evaluation revealed no evidence of a primary melanoma.

The patient was discharged on postoperative day 9. She is currently alive and well (5 months since discharge), without any tumor recurrence, and receiving adjuvant chemotherapy.

Comment

Malignant melanoma is most commonly identified as a primary neoplasm of the skin or the ocular apparatus. Less frequently, primary melanomas originate from the oral cavity, larynx, bronchi, esophagus, rectum, ovaries, uterus, vaginal wall, and the adrenals. The adrenal medullary blasts and melanoblasts have a common embryologic origin at the neuroectodermal level, similar to the nervous system and the skin [1]. As a result, ectopic melanocytes can exist in this location and undergo metaplasia and malignant transformation.

Primary melanoma of the adrenal gland is an extremely rare tumor, with few descriptions in the literature. These adrenal lesions are usually discovered incidentally during routine imaging of the abdomen. When clinically evident, however, pain is the most common manifestation, secondary to compression of adjacent organs such as the kidney, colon, or liver [2]. This patient presented with associated extensive IVC tumor thrombus, a condition more commonly seen with primary adrenocortical or renal cell carcinomas. As with our patient, it is quite rare to diagnose a primary adrenal melanoma preoperatively. However, pathologic examination of the surgical specimen confirms the cell type of origin quite easily.

The adrenal glands can also be the site for melanoma metastases. Differentiating between primary and metastatic lesions in the adrenal gland can be challenging. Carstens and colleagues [3] established three criteria to confirm the diagnosis of primary adrenal melanoma: (1) single gland involvement, (2) absence of melanoma in the rest of the body, and (3) absence of previous excision of pigmented mucous, cutaneous, or ocular lesions. The patient in this report meets these criteria, having no evidence of another primary lesion after a complete oncologic evaluation.

Long-term survival after resection of a primary adrenal melanoma is quite poor. Median survival after complete resection is still less than 19 months from the time of diagnosis and only 8 months for metastatic melanoma [4]. Advanced stage and most metastatic melanomas often require adjuvant chemotherapy or immunotherapy, with dacarbazine, interleukin-2, and interferon being the first-line agents [5]. Participation in a clinical trial should be considered the standard of care for any metastatic melanoma.

The approach to the tumors originating in the abdomen and extending to the right atrium through the IVC is well described [6]. A multidisciplinary team of cardiac surgeons, urologists, and surgical oncologists is essential for a successful outcome. If there is evidence of extension of tumor or thrombus above the level of the hepatic veins, the use of CPB and circulatory arrest should be strongly considered. Tumors like adrenocortical carcinomas and renal cell tumors frequently have a component of direct caval invasion.

The bloodless field offered with circulatory arrest allows the best opportunity for complete tumor resection. This technique also provides the surgeon the best visualization for extensive caval reconstruction should that be deemed necessary. Meticulous surgical hemostasis is essential to limit the need for significant blood product transfusion after these extensive surgical procedures. This patient was treated successfully with a large incision and use of aggressive CPB and deep hypothermic circulatory arrest methods, mainly due to her large body habitus and the extension of the disease. Future avoidance of pulmonary embolism was based on complete evacuation of the right atrium and the IVC from the thrombus as well as complete resection of the primary adrenal tumor.

References

1. Sasidharan K, Babu AS, Pandley AP, Rao MM, Walter A. Primary melanoma of the adrenal gland: a case report. J Urol 1977;117:663–4.
2. Dao A, Page D, Reynolds V, Adkins RJ. Primary malignant melanoma of the adrenal gland: a report of two cases and review of the literature. Am Surg 1990;56:199–203.
3. Carstens PH, Kuhns JG, Ghazi C. Primary malignant melanomas of the lung and adrenal. Hum Pathol 1984;15:910–4.
4. González-Sáez L, Pita-Fernández S, Lorenzo-Patiño MJ, Arnal-Monreal F, Machuca-Santacruz J, Romero-González J. Primary melanoma of the adrenal gland: a case report and review of the literature. J Med Case Rep 2011;5:273.
5. Bajetta E, Del Vecchio M, Bernard-Marty C, et al. Metastatic melanoma: chemotherapy. Semin Oncol 2002;29:427–45.
6. Prager RL, Dean R, Turner B. Surgical approach to intracardial renal cell carcinoma. Ann Thorac Surg 1982;33:74.