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CASE REPORT

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Pulmonary embolism following the third thoracic tuberculosis surgery: A case report and literature review

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Abstract

Background: The study aimed to analyze the clinical effects of pulmonary embolism succeeding a third surgery conducted for multiple recurrences in thoracic tuberculosis (TB).

Case report: A 74-year-old female patient developed thoracic tuberculosis and was subsequently treated in our hospital in March 2019, October 2020, and February 2021. The third surgical intervention included anterolateral thoracic lesion resection, internal fixation, posterior spinal tuberculous sinus resection, and debridement with suture. The operative time was 172 min resulting in a substantial intraoperative blood loss (2321 ml). Postoperative re-examination of chest CTPA indicated a strip filling defect and pulmonary embolism in the external branch of the right middle lobe of the lung. After completing the active treatment, the D-dimer quantification, WBC, CRP, and ESR values were 1261 ng/ml, 7.71 × 10^9/L, 74.66 mg/L, and 63 mm, respectively. Chest CTPA re-examination after the treatment showed no signs of pulmonary embolism.

Conclusion: Patients with a long-term history of multiple operations, high BMI, cerebral infarction, diabetes, and older age group were more likely to develop pulmonary embolism after spinal tuberculosis surgery. Thus, the possibility of postoperative pulmonary embolism should be thoroughly analyzed before any subsequent surgical treatment in patients with recurrent spinal tuberculosis.

KEYWORDS
pulmonary embolism, recurrence, surgery, thoracic tuberculosis

Liyi Chen and Chong Liu contributed equally to this work and should be considered co-first authors.

1 | INTRODUCTION

About 10 million people have been estimated to develop TB worldwide, according to the Global Tuberculosis Report, 2020.[1] Spinal TB is the commonly encountered extrapulmonary form of the disease which accounts for nearly 1%–3% of all TB cases.[2] Although spinal TB mostly involves the thoracic vertebrae[3] and usually displays paraspinal abscess formation, intervertebral disk space destruction along with adjacent vertebrae, and neurological impairment.[3,4] Although the surgical treatment of spinal TB has shown good clinical results, some patients still exhibit TB recurrence leading to subsequent surgical interventions.[5] An earlier study reported that the recurrence rate of spinal TB after the surgery was approximately estimated at 60%.[6] Another study revealed a significant reduction

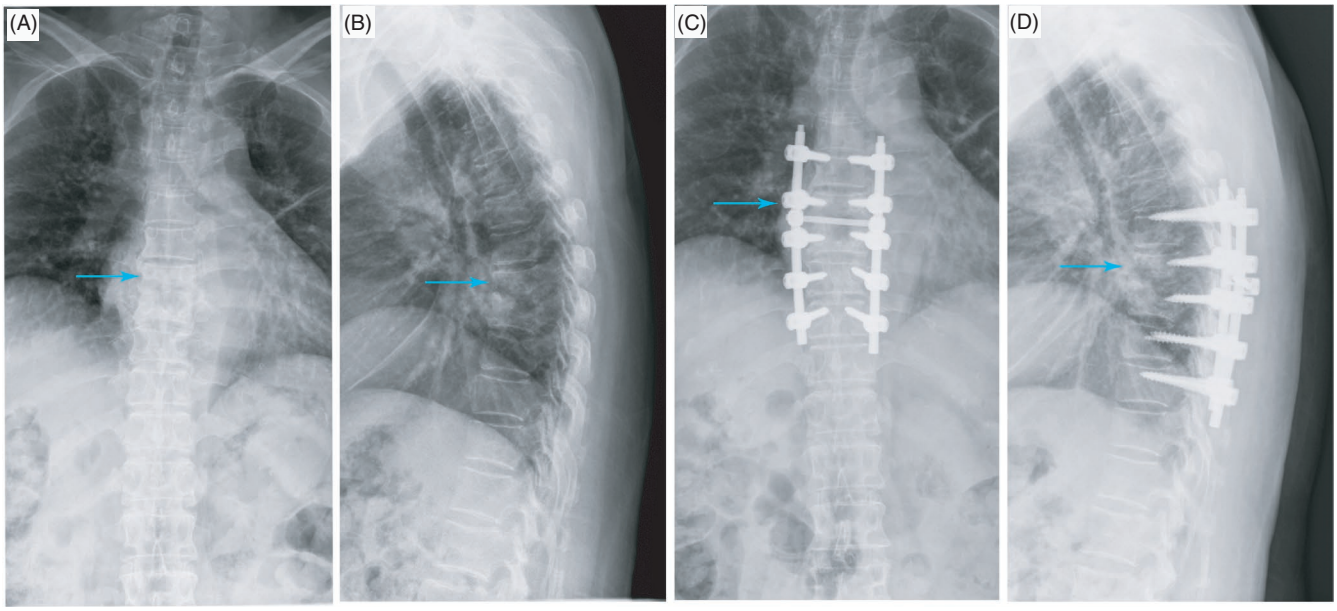


FIGURE 1 Preoperative and postoperative X-ray examinations during the first surgery in March 2019. (A) The arrow points to the preoperative T7 focal vertebral body in the coronal plane. (B) The arrow points to the preoperative T7 focal vertebral body in the sagittal plane. (C) The arrow points to the postoperative T7 focal vertebral body in the coronal plane. (D) The arrow points to the postoperative T7 focal vertebral body in the sagittal plane

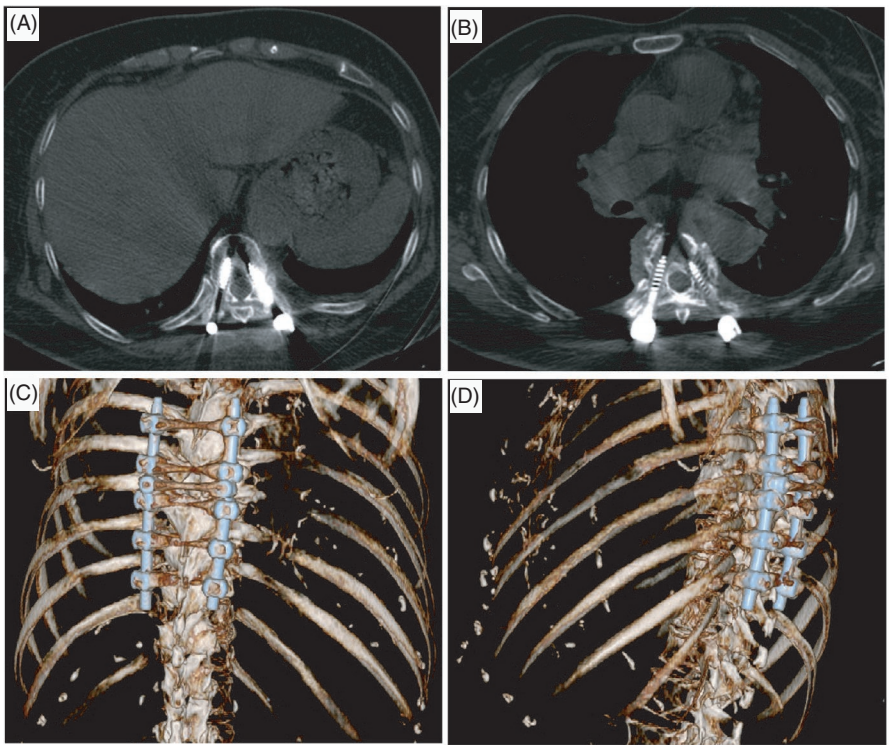


FIGURE 2 Patient re-examined by CT after the first surgery 18 months postoperatively. (A) This is a picture of bilateral pedicle screw placement in T10. (B) This is a picture of bilateral pedicle screw placement in T6. (C) This is a CT 3D reconstruction of the coronal plane. (D) This is a CT 3D reconstruction of the sagittal plane

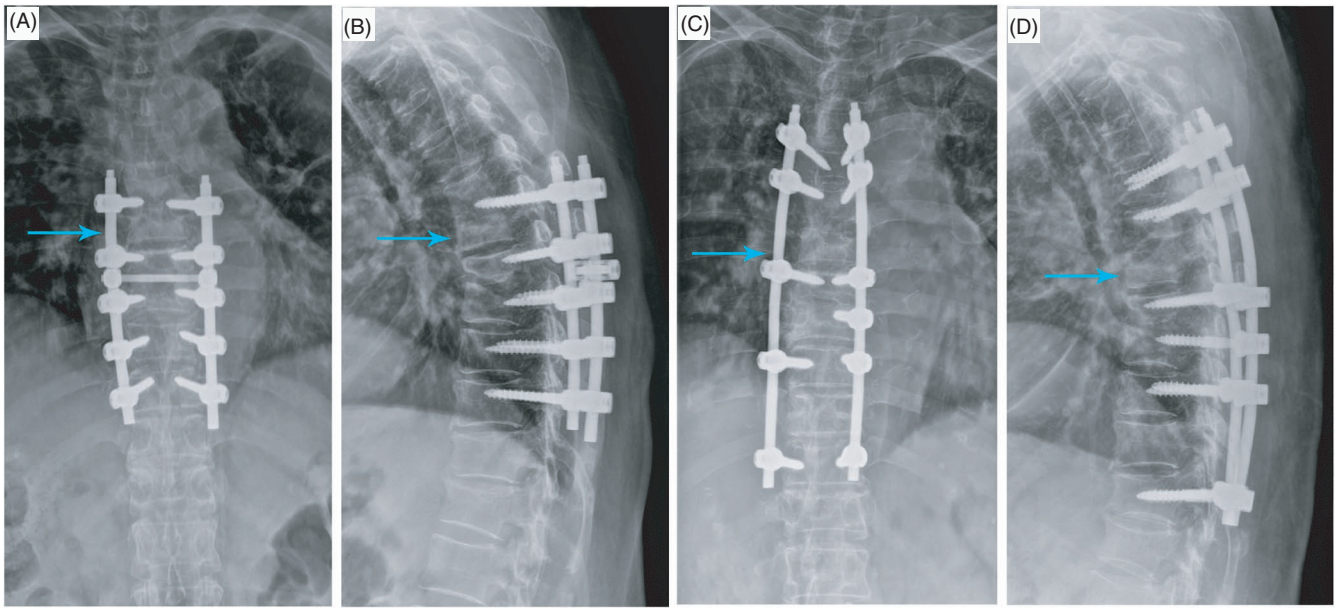
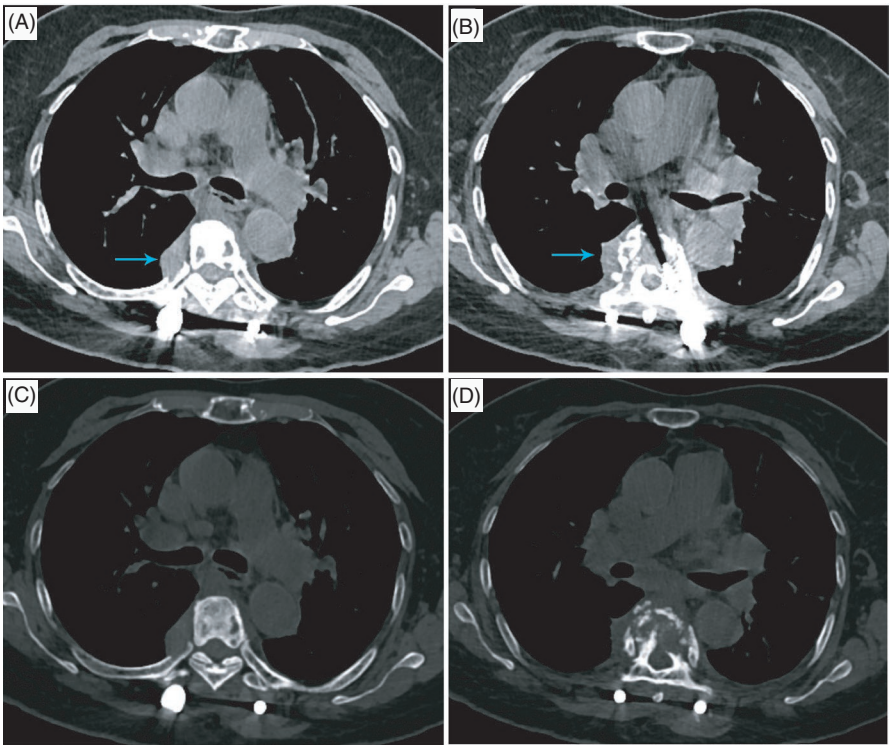


FIGURE 3 Preoperative and postoperative X-ray examinations during the second surgery in October 2020. (A) The arrow points to the preoperative T6 focal vertebral body in the coronal plane. (B) The arrow points to the preoperative T6 focal vertebral body in the sagittal plane. (C) The arrow points to the postoperative T6 focal vertebral body in the coronal plane. (D) The arrow points to the postoperative T6 focal vertebral body in the sagittal plane

FIGURE 4 Preoperative CT examination performed during the second surgery. (A) The arrow points to the T5 paraspinal abscess. (B) The arrow points to the T6 paraspinal abscess. (C) The arrow points to the bone destruction in the T5 vertebral body. (D) The arrow points to the bone destruction in the T6 vertebral body



in recurrent spinal TB after the initiation of the surgical treatment when compared with the earlier studies.[2,5] Several causative factors could lead to a postoperative recurrence of spinal TB,[7] which subsequently required sinus tract excision, lesion debridement, bone graft fusion, and internal fixation.[2] However, only a few studies have reported the multiple recurrences of spinal TB after the initial surgical treatment.

Pulmonary embolism caused by many etiological factors is a disease with a high mortality rate.[8] Although pulmonary embolism is now considered a rare complication of spinal surgery, the obvious risk of pulmonary embolism in such cases is high.[9] At present, pulmonary embolism after spinal TB has been rarely reported in the literature, while the occurrence of pulmonary embolism after multiple spinal TB operations has not been reported to date.

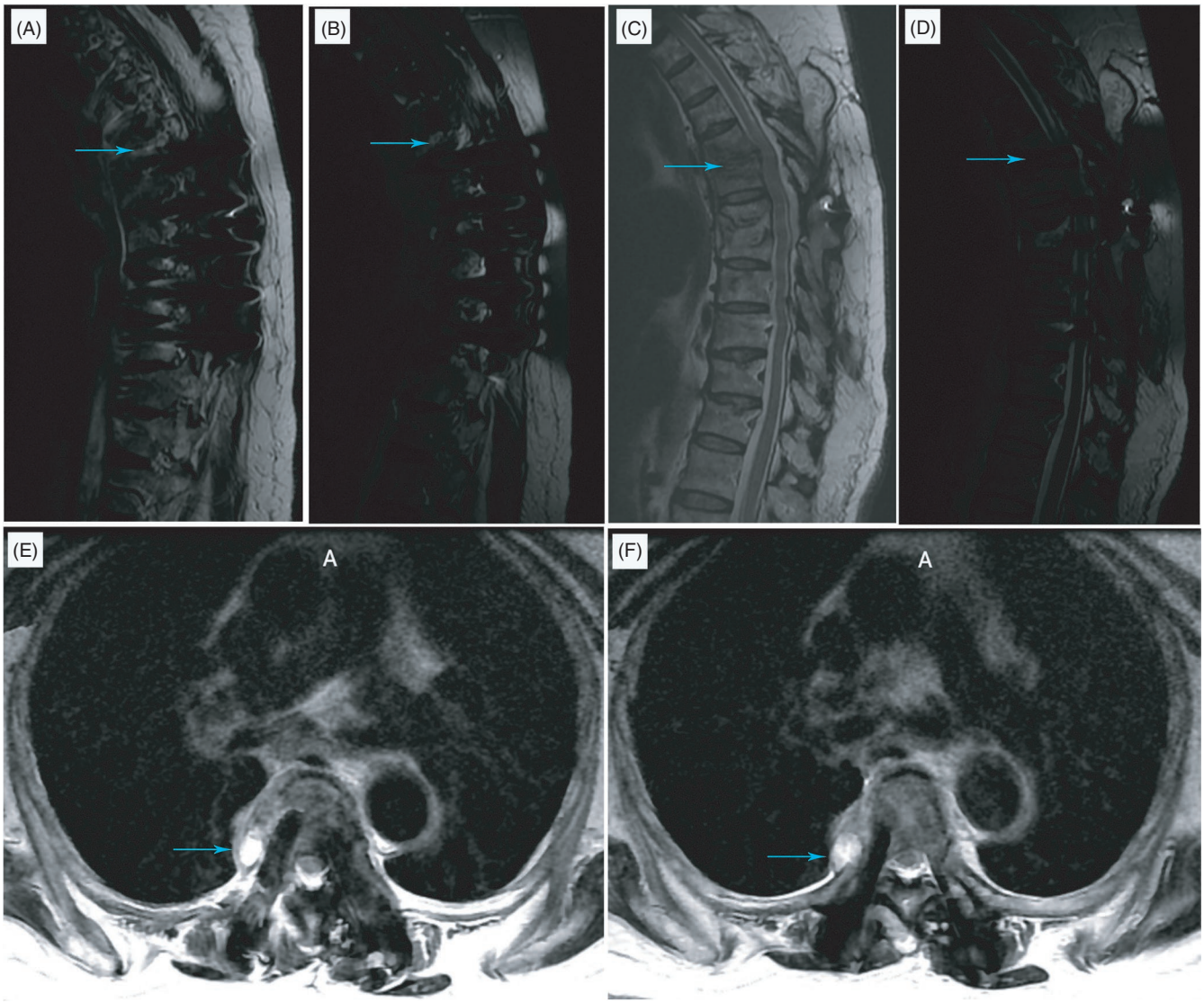


FIGURE 5 Preoperative MRI examination performed during the second surgery. (A) The arrow points to the T5/6 paraspinal abscess in the T2 sequence. (B) The arrow points to the T5/6 paraspinal abscess in the T2 lipid pressing sequence. (C) The arrow points to the T5/6 intervertebral space lesions in the T2 sequence. (D) The arrow points to the T5/6 intervertebral space lesions in the T2 lipid pressing sequence. (E and F) The arrow points to the T5/6 paraspinal abscess in the T2 sequence cross section

This case of pulmonary embolism after the third thoracic TB surgery has been reported for the first time. After the active treatment, the patient's condition improved, and the curative effect was satisfactory. Therefore, this report analyzed the occurrence of pulmonary embolism after succeeding surgical interventions for recurrent spinal TB.

2 | CASE REPORT

A 74-year-old female patient was admitted to the Spine and Osteopathy Ward, the First Affiliated Hospital of Guangxi Medical University, with the chief complaint of recurrent spinal TB at three months postoperatively. Although there were sinus passages and purulent discharge at the incision site, no symptoms of tuberculosis poisoning were observed, such as afternoon low fever, night sweats, and fatigue. The patient had a history of previous treatment for TB and diabetes for four and three years, respectively, along with good blood glucose control. The patient underwent surgery for thoracic TB in our hospital in March 2019 and was later treated by thoracic TB resection in October 2020.

3 | PHYSICAL EXAMINATION

The physiologic spinal curvature was present, along with no obvious tenderness or pain while percussing each spinous process. There was an old surgical scar and two sinus passages on the chest and back measuring about 20 cm and 0.5 cm in size, respectively. Although purulent discharge was observed, obvious inflammation, swelling, and sensory impairment were absent. An assessment of

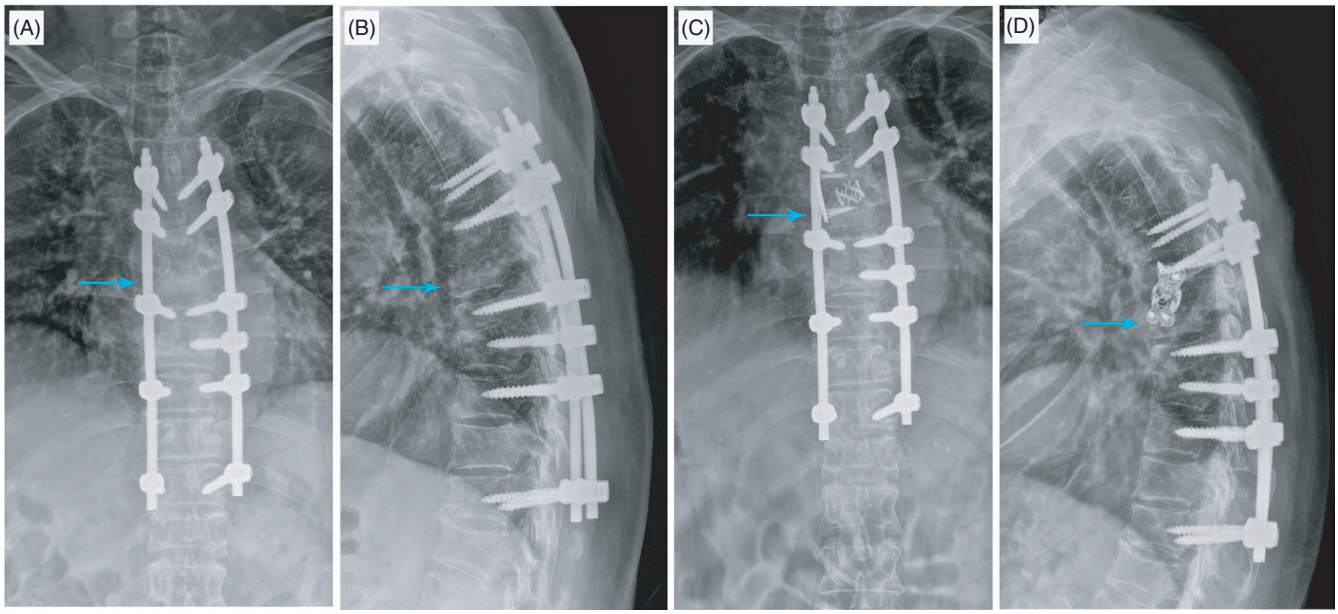


FIGURE 6 Preoperative and postoperative X-ray examinations conducted during the third surgery in February 2021. (A) The arrow points to the preoperative T6 focal vertebral body in the coronal plane. (B) The arrow points to the preoperative T6 focal vertebral body in the sagittal plane. (C) The arrow points to the postoperative T6 focal vertebral body in the coronal plane. (D) The arrow points to the postoperative T6 focal vertebral body in the sagittal plane

the patient's muscle strength revealed a grade IV stage of both left and right iliopsoas muscles, while the remaining muscle strength was depicted as grade V. The knee-tendon and Achilles tendon reflexes were attenuated bilaterally and normally, while the buttock test and the quadruple sign of the lower extremities were positive, respectively. The bilateral thigh muscle tightness was slightly increased with no obvious pathological signs.

4 | LABORATORY INVESTIGATIONS

A blood test was performed after the admission, which showed the values of white blood cells (WBC), hemoglobin (HGB), platelet (PLT) count, D-dimer quantification, CRP, ultra-sensitive C-reactive protein, and ESR as 7.86×10^9/L, 97.30 g/L, 328.60×10^9/L, 338ng/mL, 71.16 mg/L, >10.00 mg/L, and 65 mm, respectively. The blood coagulation function test revealed the prothrombin time as 12 seconds while the fibrinogen was 5.7 g/L. Liver function tests displayed aspartate aminotransferase (AST), alanine aminotransferase (ALT), and albumin (ALB) as 10 U/L, 8 U/L, and 39.8 g/L, respectively. The acid-fast bacilli test for wound secretion smear showed a (+) result, while the non-tuberculous bacterial smear test for wound secretion showed a (-) outcome.

5 | RADIOGRAPHIC EXAMINATIONS

Imaging data of the first operation conducted in March 2019 were collected. As the preoperative and postoperative X-ray examinations were taken in our hospital (Figure 1), a CT scan was obtained 18 months after the surgery (Figure 2). After the collection of the imaging data of the second operation in October 2020, preoperative and postoperative X-ray examinations are shown (Figure 3). The preoperative CT and MRI examinations were performed (Figures 4 and 5). The radiographic assessments of the third operation in February 2021 were also easily collected since the patient's preoperative X-ray (Figure 6A,B), CT (Figure 7), and MRI (Figure 8) imaging modalities were all undertaken in our hospital, respectively.

6 | FIRST SURGICAL PROCEDURE

The patient underwent surgery on March 5, 2019. After the general anesthesia was given, the patient was placed in the prone position, and the skin was routinely disinfected and covered with sterile towels. After fully exposing the operating field, the thoracic (T) 7/8 vertebral lesions were completely excised. The bone defects were filled with bone granules and streptomycin powder. Pedicle screws were inserted into the bilateral pedicles of T6-T10, followed by the placement of a cross-connecting device between T7 and T8. After sufficient hemostasis, a drainage tube was placed, followed by the layered suturing.

7 | SECOND SURGICAL PROCEDURE

The patient underwent a second operation on October 21, 2020. After the application of general anesthesia, the patient was placed in the prone position, while the skin was routinely disinfected and covered with sterile towels. After incising the skin layers, the original internal fixation device was removed. The T5-T8 vertebral lesions

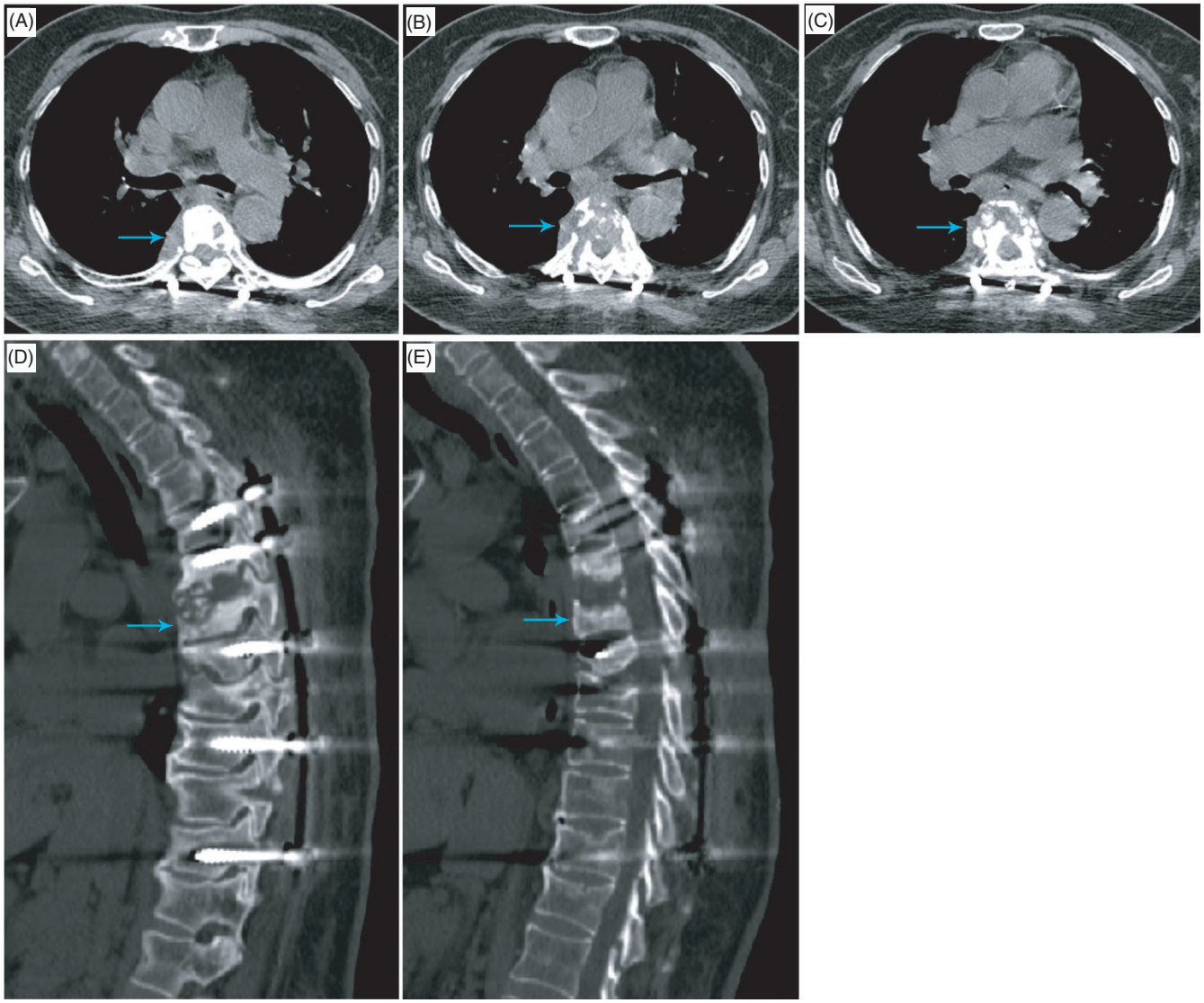


FIGURE 7 Preoperative CT examination performed during the third surgery. (A) The arrow points to the T5 paraspinal abscess. (B) The arrow points to the T5/6 paraspinal abscess. (C) The arrow points to the T6 paraspinal abscess. (D and E) The arrow points to the bone destruction in the T6 vertebral body

were fully removed succeeded by adding the bone granules and streptomycin powder in the lesion areas. Pedicle screws were placed in the bilateral and the left pedicles of the T4, T5, T7, T9, T11, and T8, respectively. After achieving sufficient hemostasis, a drainage tube was placed, followed by the layered suturing.

8 | THIRD SURGICAL PROCEDURE

8.1 | Anterolateral approach to thoracic vertebral lesion resection and internal fixation

Under general anesthesia, surgery was performed with the patient in the lateral decubitus position. After the skin was incised layer by layer, one rib at the lesioned site was excised after the determination of the respective segment by the C-arm fluoroscopy. The paraspinal abscess at the diseased segment, granulation tissue, and the necrotic bone was completely excised. The diseased disk segment was removed, and the upper and lower vertebral bodies formed a new bone slot. After the bone fragments were implanted in the interbody fusion device, it was placed in the bone slot. A suitable titanium plate was selected to fix the upper and lower vertebral bodies of the interbody fusion apparatus. Additionally, the wound was cleaned, and no active bleeding sites were observed. A closed thoracic drainage device was placed, followed by the suturing.

8.2 | Sinus debridement and suturing

After the anterolateral approach was completed, the patient was placed in the prone position. After the routine disinfection of the

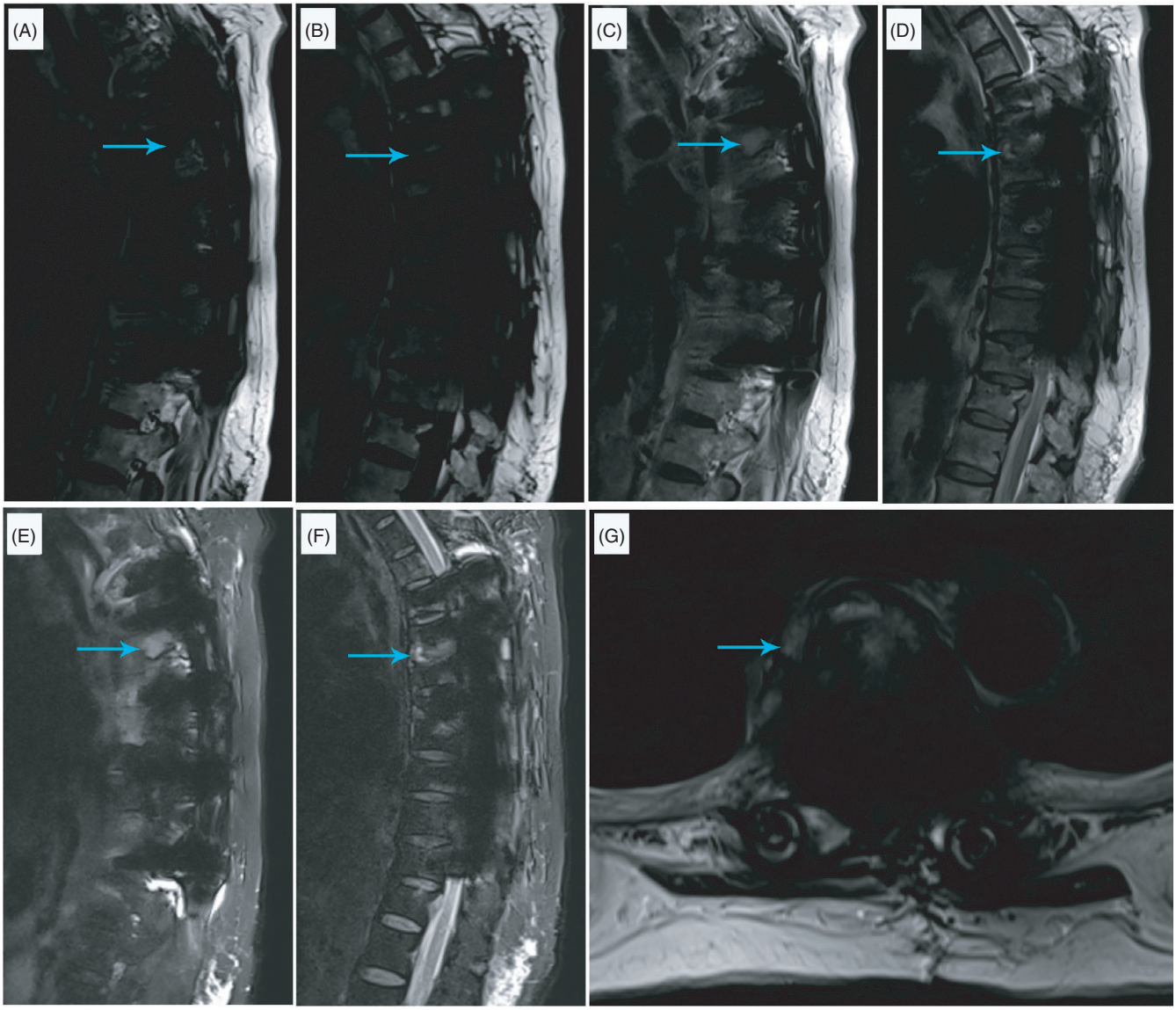


FIGURE 8 Preoperative MRI examination performed during the third surgery. (A) The arrow points to the T5/6 paraspinal abscess in the T1 sequence. (B) The arrow points to the T5/6 intervertebral space lesions in the T1 sequence. (C) The arrow points to the T5/6 paraspinal abscess in the T2 sequence. (D) The arrow points to the T5/6 intervertebral space lesions in the T2 sequence. (E) The arrow points to the T5/6 paraspinal abscess in the T2 lipid pressing sequence. (F) The arrow points to the T5/6 intervertebral space lesions in the T2 lipid pressing sequence. (G) The arrow points to the T5/6 paraspinal abscess in the T2 sequence cross section

infected wound, the skin and subcutaneous tissue were incised layer by layer to expose the sinus tract. The sinus tract was thoroughly resected, and the necrotic tissue was removed. After the wound was cleaned, the drainage tube was placed, and the skin was sutured.

9 | RESULTS

The patient underwent anterolateral thoracic lesion resection, internal fixation, and posterior spinal tuberculous sinus resection along with debridement and suturing in our hospital. The operative time was 172 min resulting in an intraoperative blood loss (2321 ml). A closed thoracic drainage device was placed during the operation, which resulted in closed thoracic drainage (250 mL) on the first day postoperatively. The wound dressing was dry, and there was no obvious inflammation and swelling around the skin. However, on the third day after surgery, the patient developed cough and expectoration along with dyspnea, while displaying no fever, hemoptysis, or chest pain. As the lungs displayed coarse breathing sounds, the lower hepatic portion produced a small amount of wet and dry rales. Preoperative and multiple postoperative blood tests were performed during the hospital stay, including WBC (Figure 9A), HGB (Figure 9B), PLT

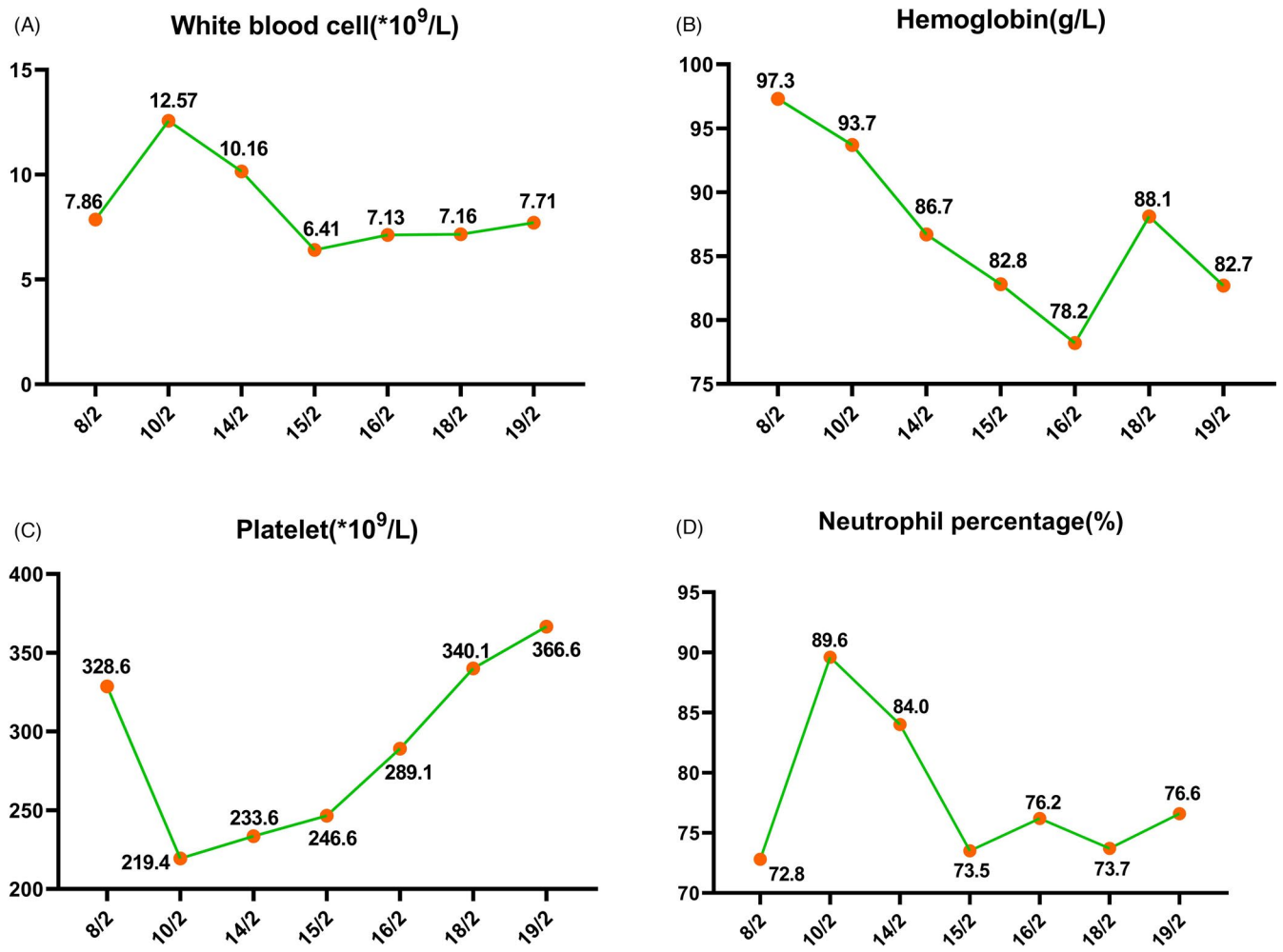


FIGURE 9 Preoperative and postoperative blood tests performed during the hospital stay. (A) The WBC value. (B) The HGB value. (C) The PLT value. (D) The neutrophil percentage value

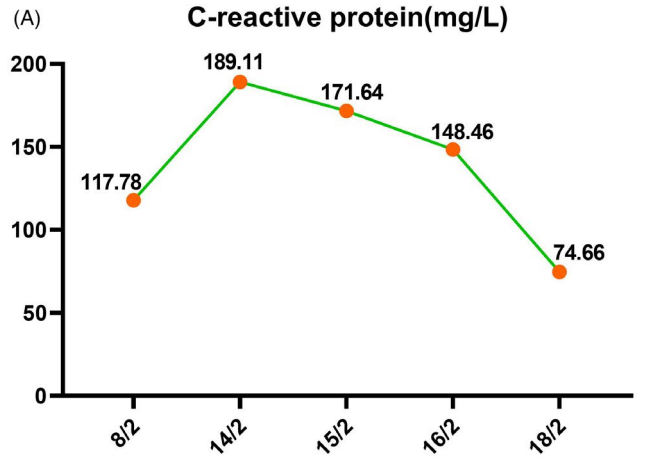
(Figure 9C), neutrophil percentage (Figure 9D), CRP (Figure 10A), ESR (Figure 10B), and D-dimer quantification (Figure 10C). Liver function, kidney function, and electrolyte test results are shown (Table 1). The patient's vital signs were measured daily (Figure 11). A postoperative CT re-examination showed that the internal fixation device was aligned well (Figure 12). The BMI measurement categorized the patient as overweight in all three hospital visits (Figure 13).

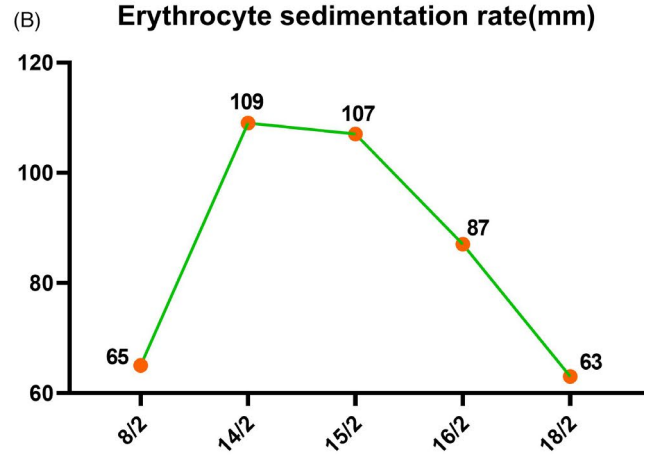
However, postoperative chest CT pulmonary angiogram (CTPA) indicated a strip filling defect and pulmonary embolism in the external branch of the right middle hepatic lobe and double pneumonia, respectively (Figure 14A,B). A specialist consultation request was granted, considering the following factors: (1) The low-risk group of acute pulmonary thromboembolism; (2) Double pneumonia. The anticoagulant enoxaparin therapy along with specific anti-infection modalities was given owing to the specialist consultation.

After the completion of active treatment, chest CTPA re-examination showed no signs of pulmonary embolism (Figure 14C,D). The patient had no other complications and was highly satisfied with the treatment. The patient was again examined and discharged ten days after the surgery. The postoperative radiographs after three months showed that the internal fixation device was in good condition (Figure 6C,D).

10 | DISCUSSION

Osteoarticular TB is a common manifestation of the extrapulmonary form, while spinal TB most commonly occurs after the initiation of osteoarticular tuberculosis.[10,11] Spinal tuberculosis mainly occurs in the thoracic vertebrae, leading to several constitutional symptoms like back pain, spinal tenderness, paraplegia, and spinal deformities.[3,4,11,12] Pulmonary embolism following spinal TB surgery has been rarely reported in the literature. This case report analyzed the clinical effect of pulmonary embolism following the third surgical intervention in a patient with multiple recurrences of thoracic TB.





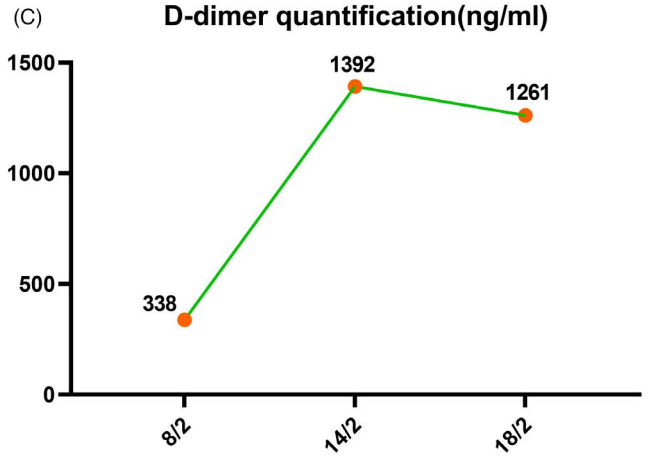


FIGURE 10 Preoperative and postoperative blood tests performed during the hospital stay. (A) The CRP value. (B) The ESR value. (C) The D-dimer quantification value

However, due to the appearance of drug-resistant *Mycobacterium tuberculosis*, spinal TB has now become a global concern and is frequently prone to recurrence.[13,14] Early literature reported that the postoperative recurrence rate of spinal tuberculosis was estimated to be 60%.[6] In this case, the patient with

TABLE 1 Liver function, kidney function, and electrolyte test values are displayed

Date	Total bilirubin	Direct bilirubin	Indirect bilirubin	ALT	AST	ALB	Urea	Creatinine	Uric acid	Potassium	Sodium	Calcium
2021/2/8	7.0	1.8	5.2	8	10	39.8	8.47	68	337	4.48	137.20	2.36
2021/2/10	28.0	13.0	15.0	14	19	28.8	4.33	70	211	4.82	139.80	1.88
2021/2/14	9.1	3.4	5.7	13	9	26.3	6.31	71	242	4.40	141.80	2.02
2021/2/15	12.3	5.4	6.9	24	18	33.1	3.82	59	218	3.75	144.50	2.01
2021/2/16	8.3	3.2	5.1	7	6	29.8	3.8	62	194	4.14	143.40	2.16
2021/2/18	7.4	2.3	5.1	8	11	33.2	3.77	58	186	3.49	144.00	2.12
2021/2/19	7.5	3.4	4.1	15	31	33.0	3.61	54	186	3.49	143.30	2.00

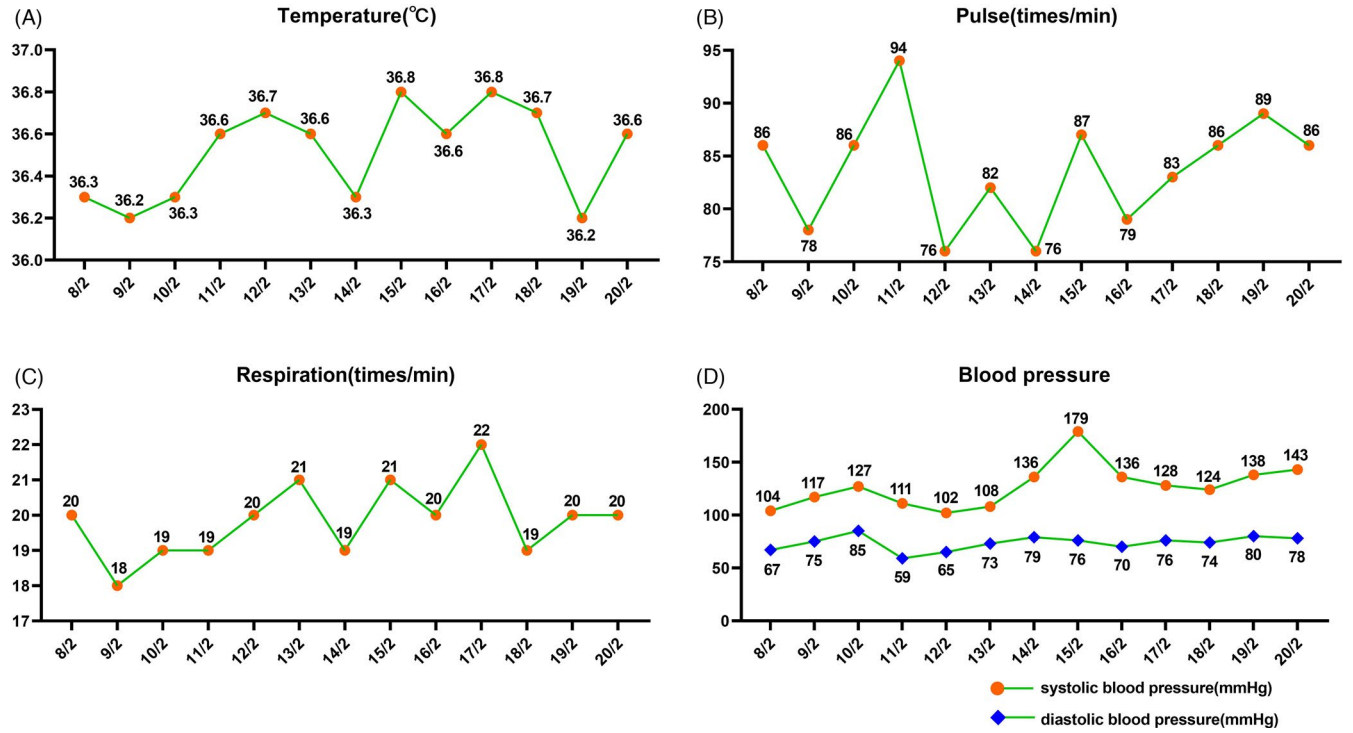


FIGURE 11 Daily monitoring of the patient's vital signs in the hospital. (A) The temperature examination value. (B) The pulse examination value. (C) The respiration examination value. (D) The blood pressure examination value

spinal TB, after two recurrent episodes, underwent a third surgery in our hospital. This might be related to the fact that superinfection occurred with drug-resistant strains during the treatment.[13,14] Additionally, the failure of the spinal stability reconstruction device was also a causative factor for the subsequent recurrence.[2,15] Although several literary insights have displayed the safety profiles and effectiveness of using internal fixation devices for treating TB,[16,17] few other studies demonstrated that bacterial presence could generate a biofilm matrix consisting of proteins and polysaccharides on the surface of implanted materials, which might cause re-infection.[18]

The patient reported to our department three times, and the BMI measurement in each hospitalization visit showed an excessive measure of obesity (Figure 13). Multivariate analysis of the recent literature revealed that independent risk factors for pulmonary embolism included total operative time and BMI.[19] Obese people had twice the risk of developing postoperative pulmonary embolism.[20] This might be due to the fact that increased BMI and obesity usually prolong the operating time, which could easily lead to postoperative complications.[21] In this case report, the BMI of the patient in all three hospitalization visits was over 26, while the BMI in the third hospitalization was as high as 26.14, thus implying that this might be a high-risk factor for initiating pulmonary embolism following spinal TB surgery.

The reported patient had a three-year history of stroke. Although the patients did not have a significant sequel of stroke, their behavior was significantly altered when compared with those without this disease. This might be due to decreased mobility after stroke and increased susceptibility to deep vein thrombosis, which is a potential side effect of pulmonary embolism.[22] Pulmonary embolism after a stroke has been frequently reported due to an association of the stroke mechanism with hypercoagulability in vivo.[23] Thus, it was easily speculated that pulmonary embolism was also closely related to hypercoagulability.[24]

It has been indicated that the process of the diabetic patients undergoing Charcot foot reconstruction was complicated by the pulmonary embolism initiation.[25] This was in accordance with our result reporting a pulmonary embolism after the surgical treatment. It has also been reported that the incidence of pulmonary embolism was particularly high in type 2 diabetes patients.[26] The underlying mechanism in such cases might be the innate activation of hyperglycemia that leads to abnormal coagulation and impaired fibrinolysis and thus increasing the risk of thrombosis.[27,28]

This case report presented a 74-year-old female patient with postoperative pulmonary embolism. The elderly population is more susceptible to pulmonary embolism after the surgical treatment than the younger age group.[29] It was also evident that the mortality rates increased with the advancing age.[30] A study by Zhou et al. showed that hypertensive patients older than 60 years were more prone to pulmonary embolism,[31] which might be attributable to the hypercoagulable state of elder patients with hypertension.[32] The patient in this case report was 74 years old and had a slightly higher blood pressure during the entire hospitalization, which was consistent with the results of previous studies.[29-32]

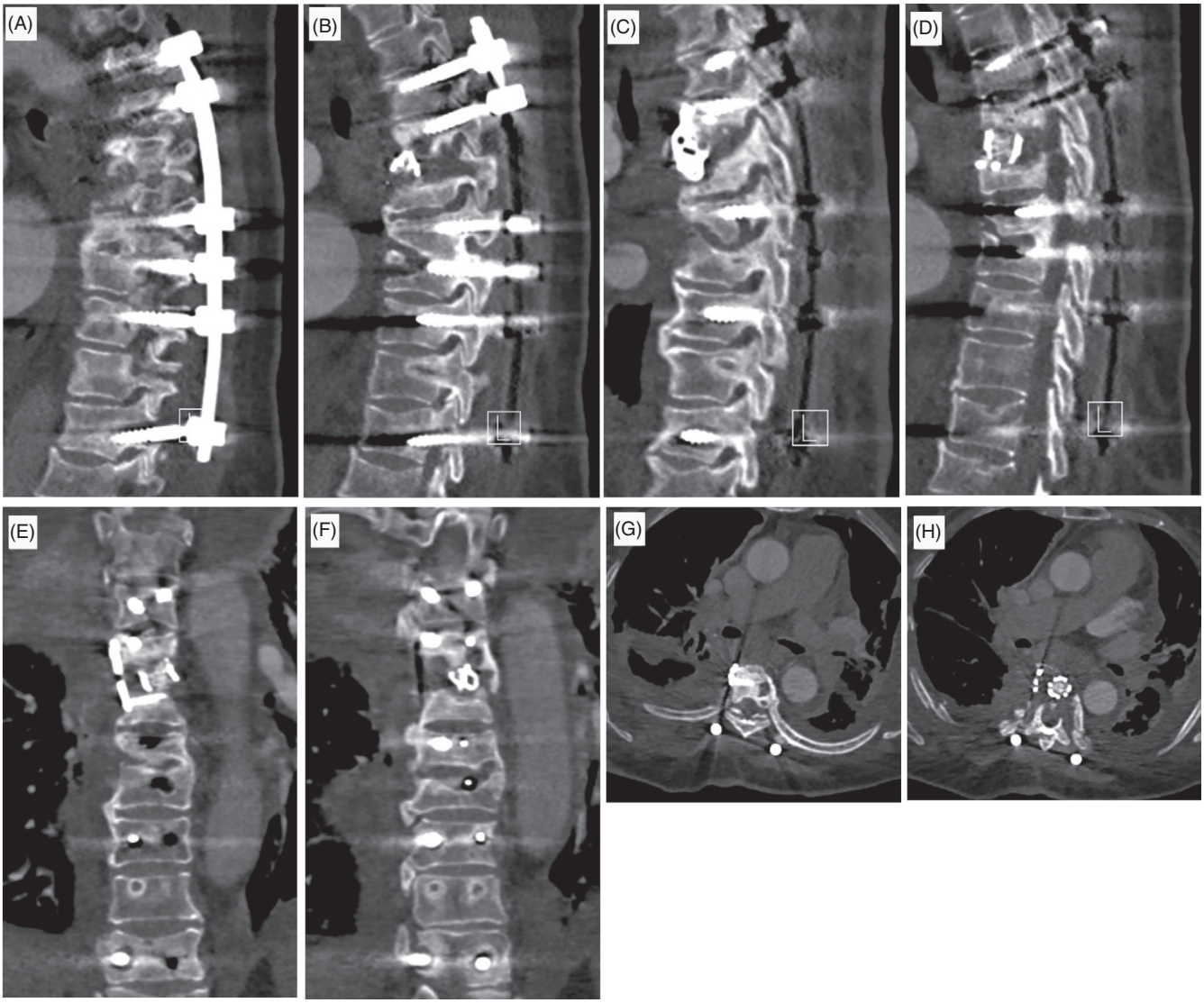


FIGURE 12 Postoperative CT examination performed during the third surgery. (A and B) The nail bar system is fixed well in the sagittal plane. (C and D), The titanium cage and the plate system are aligned correctly in the sagittal plane. (E and F) The titanium cage and the plate system are fixed well in the coronal plane. (G and H) The titanium cage and the plate system are aligned correctly in the cross-sectional area

Although this case reported no pulmonary embolism after the first two spinal TB operations, a subsequent pulmonary embolism occurred after the third surgery, thus stating that spinal TB surgeries might be associated with the initiation of the pulmonary embolism. Fatimah et al.[33] reported a 29-year-old woman who was diagnosed with spinal tuberculosis and developed a pulmonary embolism in the postoperative third week. It is evident that the spinal TB abscess invades the spinal canal and compresses the spinal cord, further leading to a spinal cord injury. The incidence of deep vein thrombosis in patients with spinal cord injury has been reported to range from 14.3% to 33.3%,[34-36] stating that the occurrence of deep vein thrombosis was an important risk factor for pulmonary embolism. In this case report, the recurrence of TB abscess after spinal TB surgery caused spinal cord injury and deep vein thrombosis, which might have initiated pulmonary embolism.

After active anticoagulation and anti-infection treatment, the clinical effect of the patient was satisfactory, and no thrombosis was found in the lung CTPA re-examination. Throughout the hospitalization, the patient's routine blood tests indicated a gradual improvement in her condition (Figures 9 and 10, Table 1). The patient's vital signs were stable (Figure 11). Anticoagulant therapy is extremely important in such patients with pulmonary embolism, and its efficacy does not significantly differ from thrombolytic therapy.[37] Since the patients with pulmonary embolism were given timely and effective anticoagulant therapy, the exercise capacity and ventilatory efficiency improved significantly, and the clinical treatment outcome was satisfactory.[38] This was in accordance with the treatment strategy and clinical effect reported in our case.

11 | CONCLUSION

Patients with a history of multiple operations, high BMI, cerebral infarction, diabetes, and advancing age group were more likely to develop pulmonary embolism after the spinal tuberculosis surgery. The possibility of postoperative pulmonary embolism should be thoroughly analyzed before initiating further surgical interventions in patients with recurrent spinal tuberculosis.

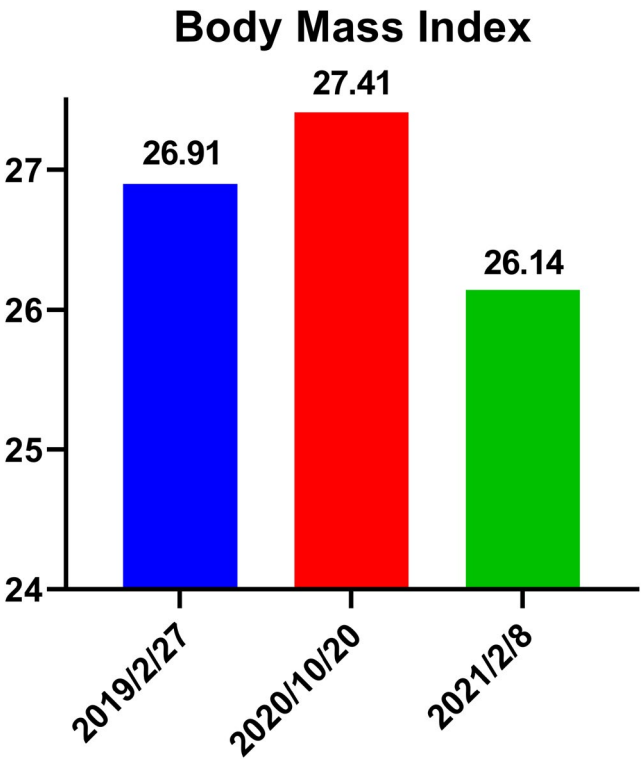


FIGURE 13 Body mass index measured thrice in all the hospital visits

ACKNOWLEDGEMENTS

Not applicable.

CONFLICT OF INTERESTS

All authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Ly C wrote the article and prepared Figures 1–14 and Table 1. C L contributed equally to this work and should be considered co-first authors. All authors reviewed the article and have read and approved the study.

CONSENT FOR PUBLICATION

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, and further inquiries can be directed to the corresponding author/s.

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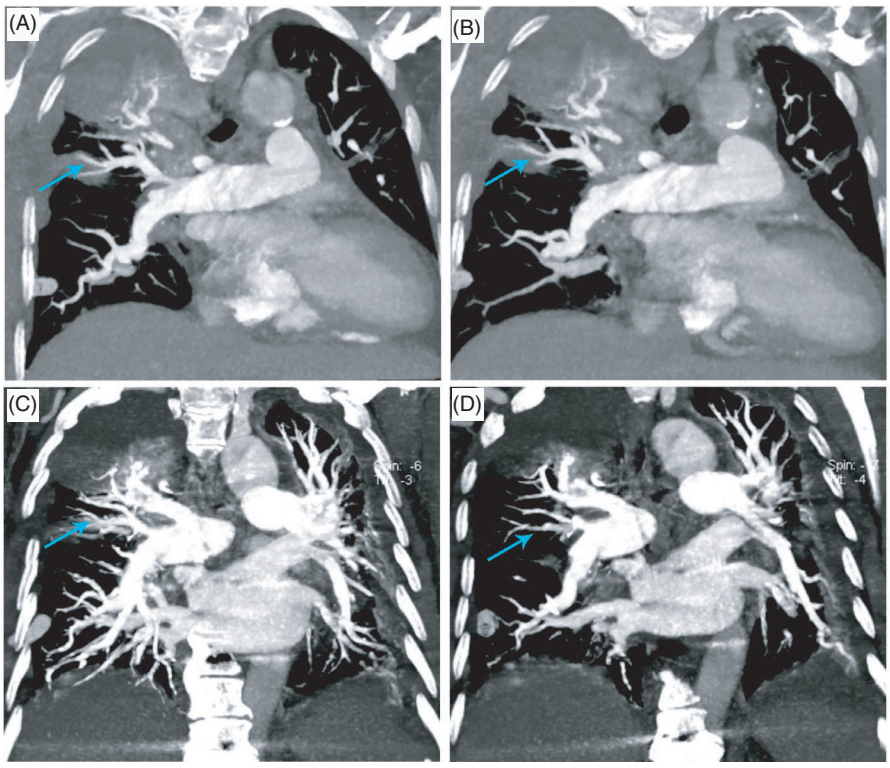

FIGURE 14 Preoperative chest CTPA examination performed during the third surgical intervention. (A and B) The arrow points to the pulmonary embolism in the external branch of the right middle hepatic lobe. (C and D) The arrow points to the normal pulmonary architecture in the external branch of the right middle hepatic lobe, showing no signs of pulmonary embolism after the treatment

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