

# The role of multi slice computed tomography in the evaluation of acute non-cardiac chest pain

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## Abstract

**Introduction:** Differential diagnosis of acute chest pain encompasses a broad spectrum of illnesses which are most likely followed by benign outcomes (pneumonia, pneumothorax, pleurisy, pericardial effusion, hiatus hernia), but also illnesses of lethal outcomes (pulmonary embolism, myocardial infarction, aortic dissection, thoracic aortic aneurysms, thoracic aortic aneurysm rupture, etc). Illnesses associated with benign and lethal outcomes may present very similar if not the same symptoms, resulting in a difficult establishment of accurate diagnosis.

**Methods:** During the period of one year, 123 patients presented with non-cardiac acute chest pain were referred for the multi slice computed tomography (MSCT) examination. Scanning of thorax was conducted in two series: unenhanced and contrast-enhanced, using a window for pulmonary parenchyma and mediastinum.

**Results:** From a total number of patients 21.1% had normal results while the other 79.9% had pathological results. Out of the total number of patients with pathological result MSCT established potentially lethal outcome for 35.0%, out of which 83.7% was contributed to vascular territory of pulmonary artery, while 16.3% was contributed to aorta.

**Conclusion:** MSCT scanning, owe to its ability of simultaneous analysis of vascular and non-vascular thoracic structures, represents a very efficient and reliable method for establishing accurate diagnosis and appropriate triage of patients with acute chest pain. Accurate and efficient diagnosis enables beneficial outcome for the patient in this group of illness. MSCT enables the differentiation of etiological factors, which present as acute onset of non-cardiac chest pain.

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## Introduction

Many patient admissions to Emergency Department are due to acute chest pain (1,2). Differential diagnosis of acute chest pain encompasses a broad spectrum of illnesses which are most likely followed by benign outcomes (pneumonia, pneumothorax, pleurisy, pericardial effusion, hiatus hernia), but also illnesses of lethal outcomes (pulmonary embolism, myocardial infarction, aortic dissection, thoracic aortic aneurysms, thoracic aortic aneurysm rupture, etc). Illnesses associated

with benign and lethal outcomes may present very similar if not the same symptoms, resulting in a difficult establishment of accurate diagnosis (2,3). Specialist in the field of emergency medicine can utilize a number of methods (anamnesis, systematic examination, chest X-ray, ECG, biological markers: troponin, CK-MB, D-dimmer) to diagnose chest pain and accurately identify the cause or contributing factors. However, in some cases these tests are insufficient in identifying a cause, and consequently leading to low confidence in establishing accurate diagnosis. Specialist often resort to repetition of the same tests, which leads to mismanagement of time and resource, resulting in an expensive investigation which often delays the initiation of the appropriate treatment and the healing process for the patient (2,4). Numerous

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researchers consider MSCT, owing to its ability of simultaneously analyzing all vascular and non vascular thoracic structures, as a very efficient and reliable tool for establishing accurate diagnosis and appropriate triage of patients with acute chest pain, resulting in a better outcome (1,2,3,5). In this study we present causes of non-cardiac acute chest pain established by the MSCT.

## Methods

In this study, conducted over 12 month period (January–December 2011), 123 patients were triaged by emergency department as having acute non-cardiac chest pain. All the patients admitted to the clinic, had the same medical conduct which entailed thorough anamnesis, systematic examination, ECG, and the laboratory analysis of urea, creatinine, and biological markers: troponin, CK-MB, D-dimmer. Patients with pathological ECG, elevated levels of troponin and CK-MB were eliminated from the study. Likewise, patients with elevated levels of urea and creatinine, and patients with anamnesis which included known allergic reaction to iodine contrast were also eliminated from the study mainly due to inability of administering the contrast intravenously. Patients who were included into the study were of different ages: the youngest patient was 18 years old and the making the average age of the patient 54.4. Out of the total number of patients 46.3% (n=57) were females, while the remaining 53.7% (n=66) were males. Immediately prior to MSCT scanning, patients did not undergo any specific preparation. All the MSCT scans were performed using GE BrightSpeed 4-slice and GE LightSpeed VCT 64-slice in supine position (General Electric Company, Fairfield, Connecticut, USA). On acquired coronal topogram scanning field was planned so that it encompasses the whole of thorax, from the level of first rib to the level of the diaphragm. Scanning of thorax was initially conducted in native serial progression, following intravenous administration of contrast; scanning was conducted using a window for pulmonary parenchyma and mediastinum. Patients were instructed to hold their breath prior to the onset of scanning. Iodine contrast (Ultravist 370, Schering, Germany) was administered via automatic injector; quantity and application speed was adjusted to the age and

body weight of each patient. The waiting period was determined using “smart preparation technique”. During analysis of scanned images MPR, MIP and volume rendering techniques were used.

## Results

All 123 patients were successfully examined. Acquired scanning images were satisfactory in quality and suitable for analysis and establishment of diagnosis. Out of the total 123 patients, 8 were unable to hold their breath during the scanning time, which created minor artifacts on the scanning images; however, this did not prevent images to be used in analysis. A satisfactory opacification of arterial blood vessels within the thorax was established by all patients. Out of the total number of examined patients, 21.1% (n=26) had a normal result, while the other 79.9% (n=97) of patients had results which were pathological in nature. Out of the total number of patients with pathological result, MSCT scanning had enabled diagnosis leading to potentially lethal outcome for 35% (n=43). Out of the total number of diagnosis with potential lethal outcome, 83.7% (n=36) was due to vascular territory of the pulmonary artery; more precisely, these patients were diagnosed with pulmonary embolism. Out of the total number of diagnosis with potentially lethal outcome 16.3% (n=7) was

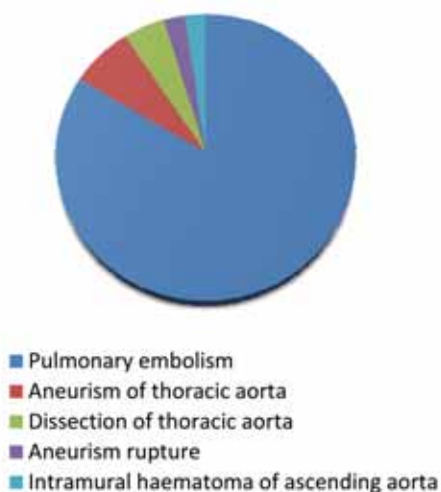


FIGURE 1. Number of diagnosis (n=43), MSCT results with potentially lethal outcome

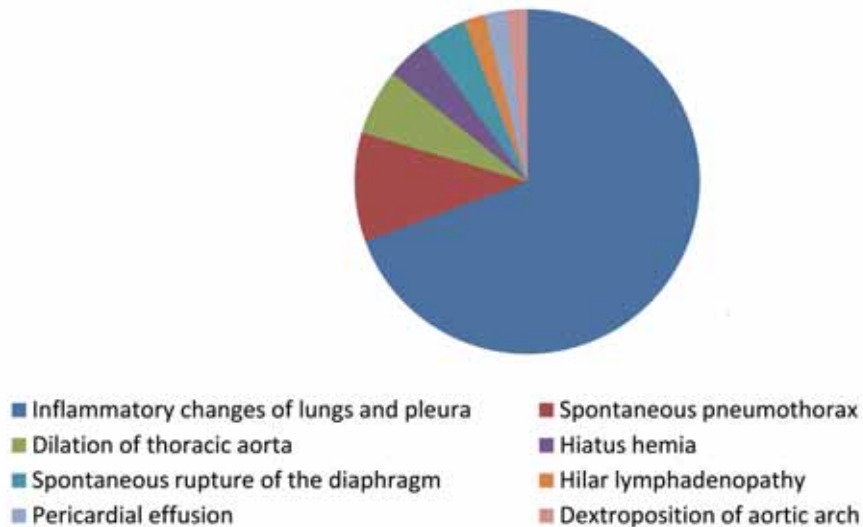


FIGURE 2. Number of diagnosis (n=49), MSCT results with potentially benign outcome

due to aortal vascular territory, more precisely 2 diagnosis of dissection of thoracic aorta were established, 3 aneurisms of thoracic aorta, and 1 rupture of thoracic aorta due to aneurism and 1 intramural hematoma of ascending aorta (fig. 1). Out of the total number of patients with pathological result MSCT identified most probable benign outcome for 50.5% (n=49). Out of the total number of patients with diagnosis leading to benign outcome 79.6% (n=39) was due to the lungs, 8.2% (n=4) due to aorta, 4.4% (n=2) due to intestinal tract and 4.4% (n=2) due to spontaneous rupture of the diaphragm. Also diagnosed were individual cases of hilar lymphadenopathy and pericardial effusion, and 4 cases of primary pulmonary cancer (fig. 2).

### Discussion

Acute chest pain is one of the most common causes of admission to the emergency department. Traditional non radiology based examination protocol, in certain number of cases, does not allow for the establishment of successful diagnosis or origin of chest pain. This is a common scenario in particular with cases which present atypical symptoms, leading to delayed administration of appropriate treatment. Delayed medical treatment carries significant risks, in particular if the diagnosis of the patient has a potentially lethal outcome. Countless studies have shown that MSCT is a reliable diagnostic method which enables to establish

early and accurate diagnosis of pathological conditions which often present with acute chest pain. Due to its ability to quickly scan the entire chest area, the MSCT is regarded universal diagnostic instrument for the evaluation of acute chest pain (4,6,7). Apart from the evaluation of pulmonary parenchyma, pleural and pericardial spaces and thoracic part of gastrointestinal tract, the contrast enhanced angiography phase of scanning enables for analysis of coronary and pulmonary arteries, as well as thoracic aorta via MSCT (6-8). The greatest proportion of cases with potentially lethal non-cardiac related acute chest pain is in fact related to pathology of pulmonary arteries and aorta (6-8). In this study pulmonary embolism was identified to be the most common, potentially lethal cause of acute chest pain. MSCT is a golden standard in diagnosis of acute pulmonary embolism, and as a first-line imaging modality it has replaced previously used conventional pulmonary angiography and ventilation – perfusion scintigraphy (9-11). On the other hand, the greatest number of patients with normal results was referred for MSCT scanning under preliminary diagnosis of pulmonary embolism. This diagnosis is most probably related to the fact that the positive D-dimmer test is not specific enough to establish accurate diagnosis of pulmonary embolism. This, together with inadequate assessment of risk factors (such as immobilization, malignant illnesses, conditions related to

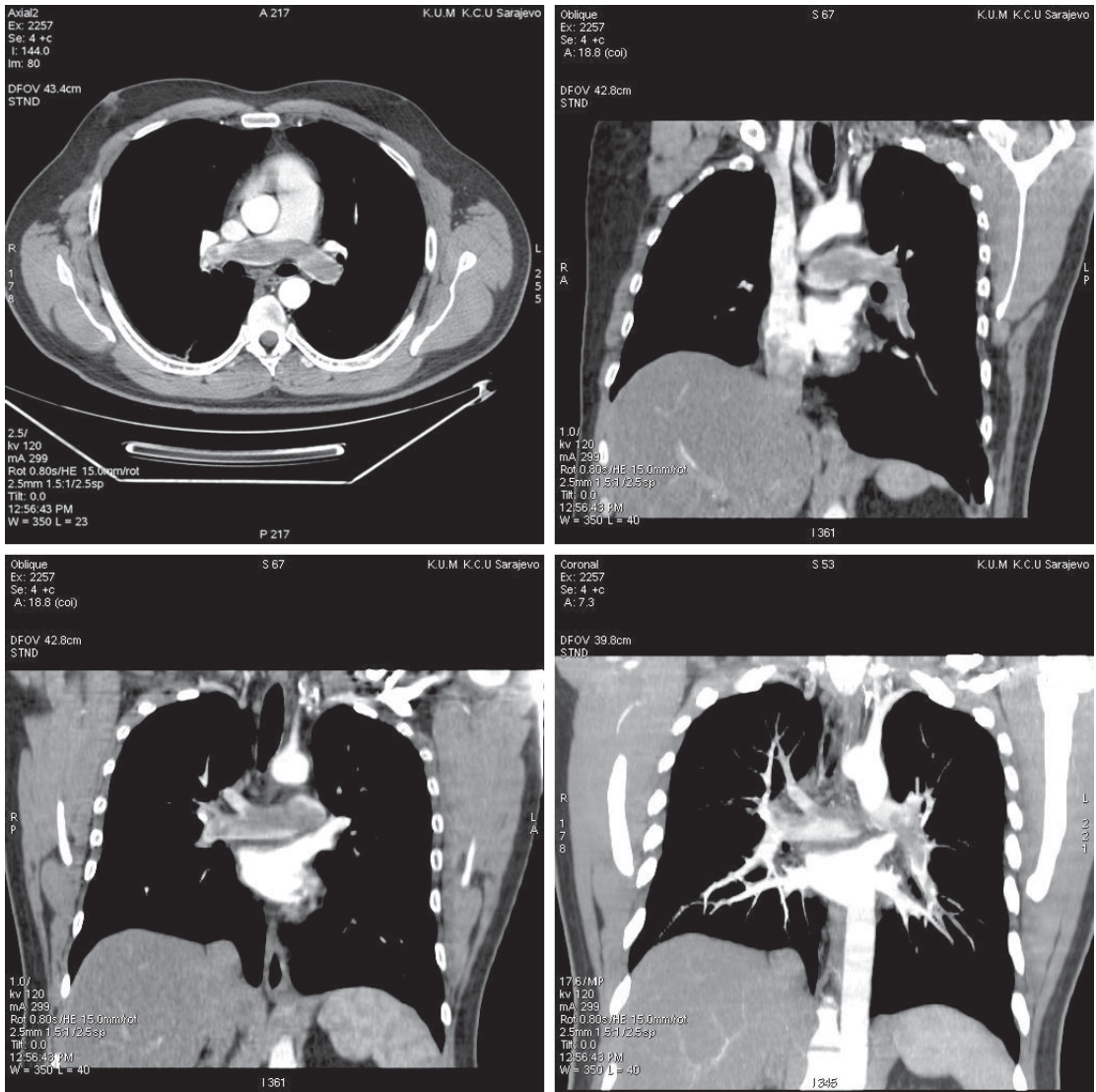


FIGURE 3. Massive pulmonary embolism: thrombotic masses in both pulmonary arteries

elevated levels of estrogen, hyper coagulating conditions, previous vein thrombosis, and age greater than 65 years old) brings about the overuse of this method. MSCT scanning can therefore be exposed to a risk of misuse as a more of a screening rather than diagnostic test. This type of negligent practice is directly related to non effective use of this resource, which leads to increased costs of health care and unnecessary exposure of patients to radiation and iodine contrast medium (fig. 3) (11,12). Acute thoracic aortic dissection is a life threatening condition that requires immediate diagnosis and

treatment and is the most common cause of aortic emergency. Due to the fact that MSCT sensitivity and specificity is almost 100% accurate in diagnosis of acute aortic dissection, this method should therefore be used as a first-line of diagnostic tests that should be performed as soon as acute dissection of thoracic aorta is suspected (13,14). MSCT enables not only the detection of dissection of the thoracic aorta, but also provides the information necessary for classification according to the Stanford system. MSCT also differentiates between true and false lumen, which is very important

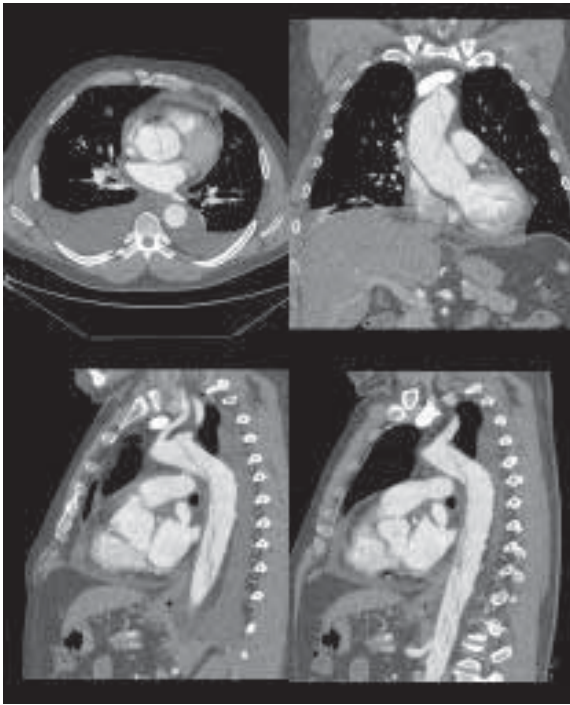


FIGURE 4. Dissection of thoracic aorta: Stanford type "A"

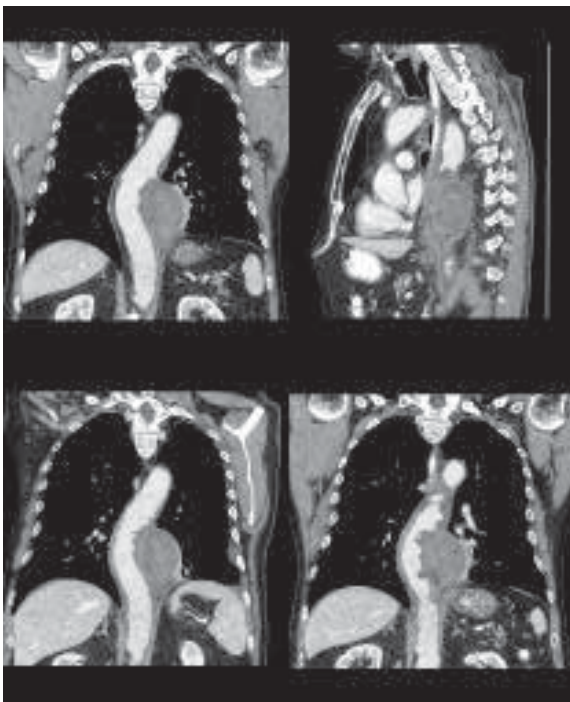


FIGURE 5. Rupture of the thoracic aorta aneurysm with hematoma formed in the place of rupture

from the perspective of furthering our abilities in the field of endovascular treatment (13, 14). In this study all the cases of thoracic aortic dissection fall within the category "A" according to Stanford classification system (Figure 4). In the case of aneurism of thoracic aorta, and in particular the rupture of aortic aneurism as a most serious related complication which requires immediate prompt and aggressive treatment, MSCT angiography is the preferred method for the evaluation of these cases (15, 16). This method enables a total analysis of thoracic aorta aneurism; more specifically, it enables detailed morphology, expansion, relation to nearby structures and branches, exact location of rupture and associated measurements necessary for undertaking of endovascular treatment (15, 16). In this study one case of rupture of aneurism of thoracic aorta was diagnosed. Successful MSCT angiography provided results for accurate and efficient diagnosis which resulted in the endovascular treatment of the patient (fig. 5). Spontaneous rupture of the diaphragm is a rare cause of acute chest pain. Although the initial method for evaluating of this condition is chest X ray, MSCT is a method of choice due to its coronal and sagittal reconstruction ability. MSCT scanning in emergency cases enables not only diagnosis of rupture but also the analysis of the herniated contents in thoracic area and possible subsequent pathological conditions in the chest (17, 18). In this study we diagnosed two cases of spontaneous rupture of left hemi-diaphragm with consequential herniation of intestine into the left hemi-thorax. Patients were successfully treated through necessary surgery (fig. 6). In this study most often acute chest pain with probable benign outcome was identified via MSCT in patients suffering from inflammatory changes in the lungs and pleura, spontaneous pneumothorax, hiatus hernia and pericardial effusion. The importance of MSCT scanning is not only reflected in the fact that these conditions were accurately diagnosed, furthermore differentiation between this group of pathological conditions and conditions requiring immediate attentions

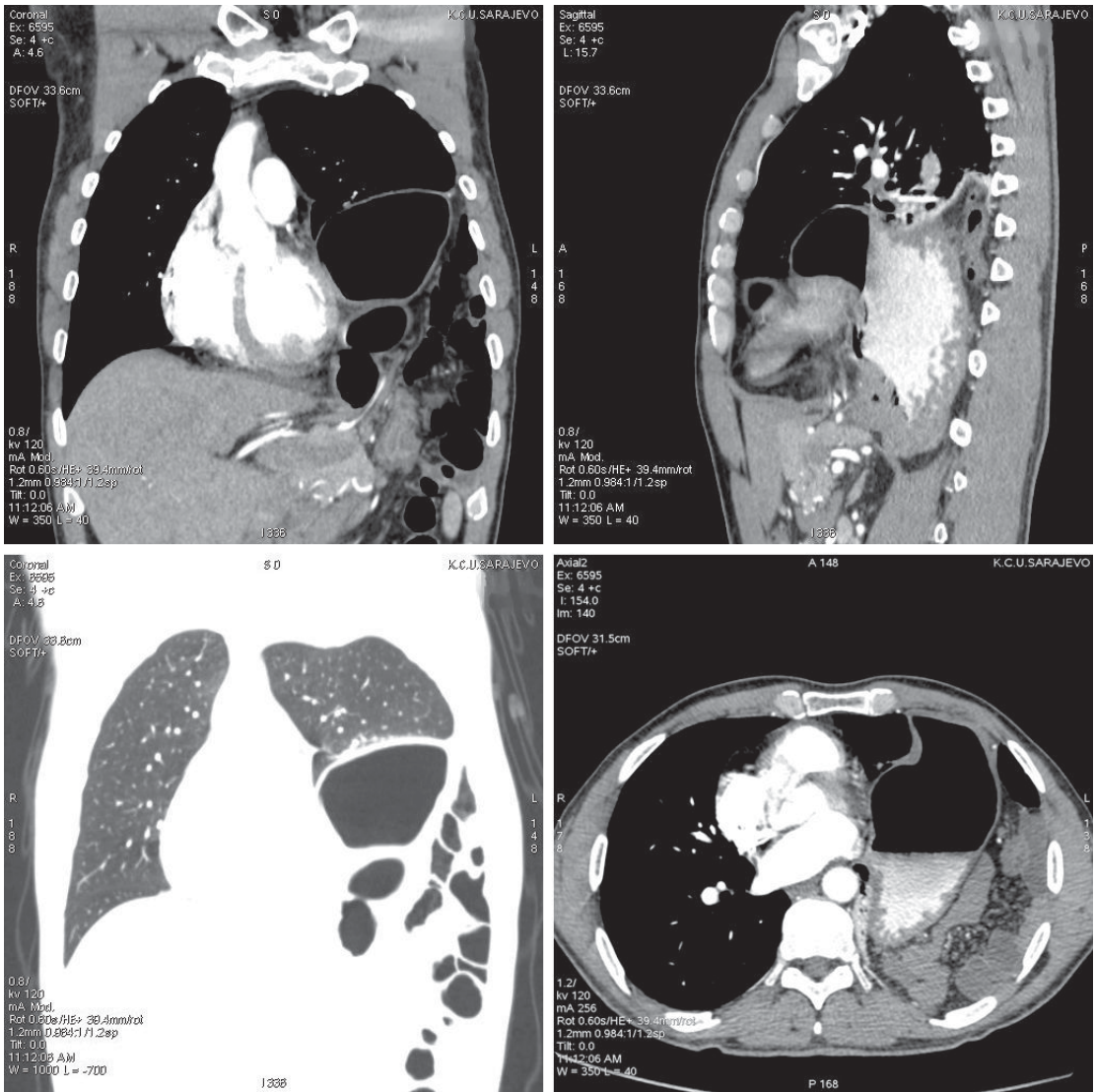


FIGURE 6. Spontaneous rupture of the diaphragm with the herniation of stomach and intestine in the left hemi-thorax

where patients were in life threatening situations was promptly established (Figure 7 and 8) (2-5).

### Conclusion

MSCT scanning, owing to its ability of simultaneously analyzing vascular and non vascular thoracic structures represents a very efficient and reliable method for establishing accurate diagnosis and appropriate triage of patients with acute chest pain. Accurate and efficient diagnosis enables beneficial outcomes for the patient in this group of illness. MSCT enables the differentiation

of etiological factors which present as acute onset of non cardio vascular chest pain that may lead to a benign or lethal outcome. Because of all the previously mentioned advantages, MSCT should be a first choice method in evaluating acute non-cardiac chest pain which is more sensitive and specific in comparison to more conventional physiological, laboratory or other radiological methods.

### Competing interests

None declared

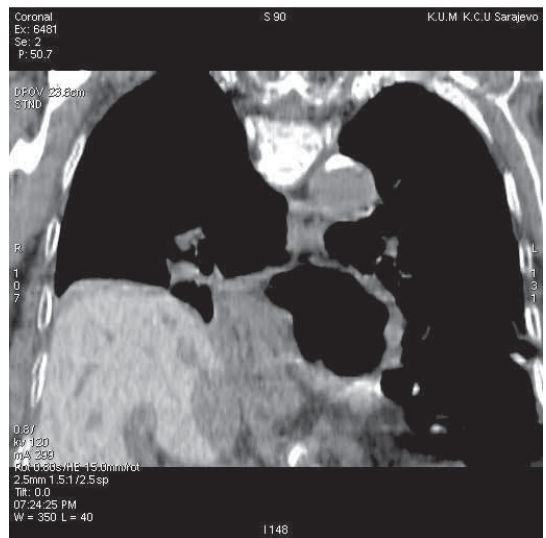
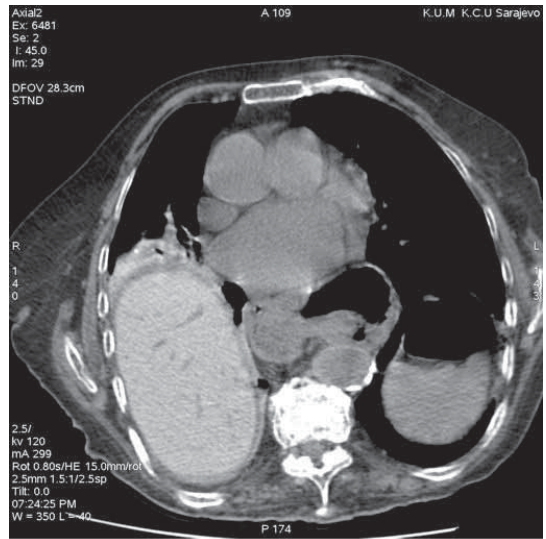
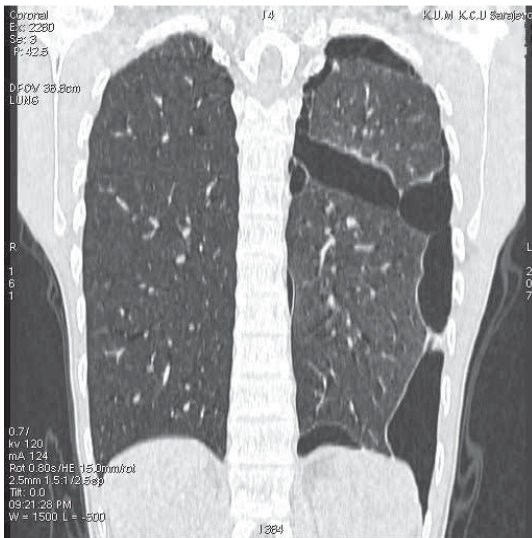
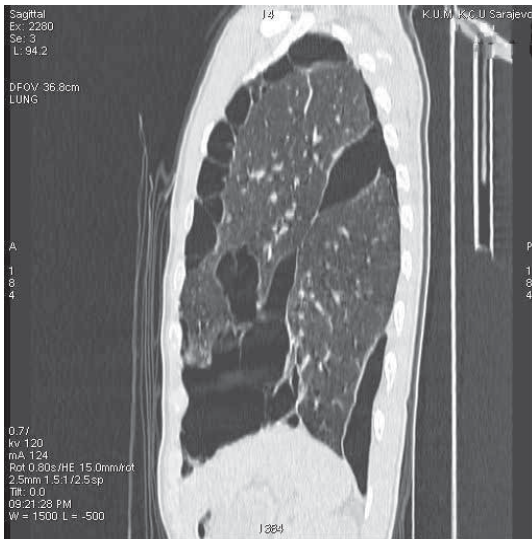


FIGURE 7. Spontaneous pneumothorax with large bullae

FIGURE 8. Hiatus hernia as the cause of acute non-cardiac chest pain

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