Ring down artefacts on abdominal sonography to predict pulmonary abnormalities in the emergency department

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Ring down artefacts are sometimes found when emergency physicians perform abdominal ultrasound to differentiate between various abdominal problems. We describe a patient who presented with right upper quadrant abdominal pain and whose ultrasound examination showed ring down artefacts posterior to the right hemidiaphragm, which led to the eventual diagnosis of pneumonia. Ring down artefacts on ultrasound may be used to predict pulmonary abnormalities. Awareness of this sonographic finding may assist in accurate diagnosis and administration of appropriate treatment without delay.

Emergency physicians (EPs) frequently encounter abdominal complaints. Abdominal ultrasound (US) is of great assistance in differential diagnosis of these problems. However, during the abdominal US examination, meaningful artefacts are sometimes seen. In particular, posterior to the liver, the examiner may encounter multiple, vertical, long and narrow bands or lines trailing down from the posterior surface of the right hemidiaphragm, the so-called “ring down” artefacts. We describe a patient whose US examination showed these ring down artefacts, which contributed to his final diagnosis of pneumonia. We discuss the implications of these findings for EPs.

CASE REPORT

A 58 year old man presented to the emergency department (ED) with sudden onset of right upper quadrant abdominal pain. No fever, diarrhoea, or nausea was noted. He was a heavy smoker who had suffered from chronic productive cough for years. He denied other significant past medical or surgical history. On arrival, blood pressure was 113/59 mmHg and body temperature was 38°C. On physical examination, the breath sounds were relatively clear. The abdomen was soft, and there was a positive Murphy's sign. Laboratory examinations showed leucocytosis with white blood cell count of 13.870/ml and 80% neutrophils. Aspartate aminotransferase and bilirubin values were within normal limits. Emergency US was performed by an EP, working on suspicion of acute cholecystitis. However, the US did not show gallstones or wall thickening of gall bladder, which would have supported the diagnosis of acute cholecystitis. Instead, numerous ring down artefacts posterior to the right hemidiaphragm were disclosed with the US probe placed transversely, right subcostally, and in the cephalic direction (fig 1), which led to suspicion of abnormalities in the right lung base. Chest radiography was subsequently performed, and showed increased lung markings at the right lower lung. Finally, pneumonia was diagnosed and the patient was treated with intravenous antibiotics. He was discharged uneventfully 10 days later and his follow up chest x ray showed complete resolution.

DISCUSSION

Traditionally, ring down artefacts have been thought to be similar to the comet tail artefacts the are associated with

foreign bodies, particularly metallic objects and cholesterol crystals.^{1,2} These two artefacts are both reverberation artefacts, producing a series of parallel bands radiating from their sources. They appear when a large mismatch in acoustic impedance occurs between two types of tissue. This interface has two effects: firstly, as it reflects 99% of the sound beam and produces strong reverberation artefacts parallel to the transducer, the interface totally obscures the underlying tissue, and secondly, it generates showers of vertical echo that will be projected into the underlying tissue.³

Avruch and Cooperberg postulated that ring down artefacts appear because of multiple reflections of the US pulse occurring between air bubbles of the lung parenchyma.⁴ Lim *et al* further speculated that the distribution and extent of ring down artefacts posterior to the right hemidiaphragm may depend on the distribution and the severity of abnormalities in the right lung base.⁵ They found that various pulmonary diseases can show ring down artefacts on US scan. In their study, when the pulmonary abnormalities are localised, ring down artefacts are seen focally at the area of abnormalities. In contrast, nearly all cases of idiopathic interstitial pneumonia elicit numerous ring down artefacts.⁵ In our case, although the patient's Murphy's sign was positive, it did not carry sufficient weight to establish the diagnosis of cholecystitis.⁶ Furthermore, clinical presentation with right upper quadrant abdominal pain has been reported to be associated with pulmonary pathologies, such as pulmonary embolism or tension pneumothorax.^{7,8} Therefore, abdominal US serves a crucial role to confirm diagnosis in patients presenting with right upper quadrant abdominal pain.

Ring down artefacts were found in our patient and redirected the physicians to the possibility of pneumonia. The case underlines the importance of ring down artefacts—that is, to remind clinicians that the possible diagnosis may be located above the diaphragm.

Figure 1 Abdominal sonogram shows numerous ring down artefacts (arrow) posterior to the aspect of the right hemidiaphragm.

Abbreviations: ED, emergency department; EP, emergency physician; US, ultrasound

Ring down artefacts may also be seen in conditions ranging from non-significant focal interlobular septal thickening to diffuse interstitial fibrosis. In deciding whether the artefacts are meaningful or not, the number of artefacts becomes an important index. There have been reports showing that <5 ring down artefacts are seen in 28–68% of normal healthy individuals.^{5–9} “Numerous” ring down artefacts, however, may implicate pulmonary pathological conditions in 95% patients, as in our patient.^{5–10} Numerous ring down artefacts, also called the “aurora sign”, have been proved by three dimensional computed tomography to be derived from the irregularity of air spaces immediately below the pleura.¹⁰

In conclusion, the ring down artefacts seen using US may be used to predict pulmonary abnormalities in the ED. When EPs encounter ring down artefacts posterior to the right hemidiaphragm while performing abdominal US for evaluation of right upper quadrant pain, they should consider pulmonary abnormalities in addition to abdominal problems. Awareness of this sonographic finding may assist in accurate diagnosis and administration of appropriate treatment without delay.

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Brugada syndrome, manifested by propafenone induced ST segment elevation

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We report a case of a 43 year old man who was diagnosed with Brugada syndrome after propafenone administration for chemical cardioversion of new onset atrial fibrillation. Brugada syndrome has been described in the medical literature and is thought to be responsible for the majority of sudden cardiac deaths in patients without ischaemic heart disease. This syndrome has not yet been extensively discussed in the emergency medicine literature despite its importance. Emergency physicians should consider Brugada syndrome in patients who present to the emergency department with right bundle branch block and ST segment elevation in the right precordial leads, which is the classic electrocardiographic pattern of this syndrome.

Ventricular fibrillation (VF) is the main cause of sudden cardiac death (SCD). Most SCDs are associated with acute coronary ischaemia near the time of death. However, 10–20% of SCD patients have no evidence of structural or ischaemic heart disease, and these patients have been referred to as having “idiopathic VF”.^{1,2} Brugada syndrome (BS) is now suspected to be responsible for 40–60% of cases of idiopathic VF.³

CASE REPORT

A 43 year old man presented to the emergency department (ED) complaining of palpitations, which had started 1 hour prior to presentation. He denied syncope or chest pain. Blood pressure was 135/76 mmHg, pulse 138 beats/min, O₂ saturation 98%, respiratory rate 14 breaths/min, and temperature 36.0°C. Past medical history included a negative treadmill stress test for atypical chest pain 1.5 years previously, as his mother had died of sudden cardiac death (SCD) at 44 years of age. The patient was placed on a monitor and an intravenous catheter was inserted. The initial ECG demonstrated atrial fibrillation with rapid ventricular response (134 beats/min) and incomplete right bundle branch block (RBBB) without ST segment elevation (fig 1A). A prior ECG, which was obtained for comparison, showed sinus rhythm with RBBB and 1 mm ST elevation in leads V1–2. Intravenous diltiazem (40 mg) was administered, which achieved rate control. Complete blood count, serum electrolytes, and initial cardiac markers were normal.

Abbreviations: BS, Brugada syndrome; ED, emergency department; ICD, implantable cardioverter defibrillator; RBBB, right bundle branch block; SCD, sudden cardiac death; VF, ventricular fibrillation; VT, ventricular tachycardia