Journal of
Tissue Science & Engineering

Cook and Sandusky, J Tissue Sci Eng 2016, 7:3
DOI: 10.4172/2157-7552.1000188

Case Report Open Access

A Post Mortem Case Study: Diffuse Pulmonary Ossification and Sudden Death

Shannon Leigh Cook* and George Sandusky

Department of Pathology, Indiana University, Melvin and Bren Simon Cancer Center, Indianapolis, USA

Abstract

A post mortem examination was performed on a 45 year old white male who died suddenly during a competitive athletic swimming event. There were few clinical events seen in the year before his death. Clinical workup was negative and lung scan showed a small coin lesion was attributed to focal bacterial/fungal infection. Antibiotic treatment appeared to clear this condition on another follow up scan and he was sent home with an inhaler. On gross post mortem examination the lungs revealed diffuse pulmonary congestion, focal hemorrhage and edema. Small focal white areas of calcified lesions were also seen. In addition, an enlarged heart with left ventricular hypertrophy and thickened interventricular septum were seen. There was moderate atherosclerosis midway down the left anterior descending branch of the coronary artery observed. Histologic examination of lung tissue proved confirmatory for diffuse pulmonary ossification. Heart microscopic examination was consistent with cardiomyocyte hypertrophy. In conclusion, the diffuse pulmonary ossification was probably related to the sudden death with concomitant myocardial hypertrophy.

Keywords: Diffuse pulmonary ossification; Cardiac hypertrophy; Sudden death; Coronary atherosclerosis

Introduction

Calcification refers to the deposition of calcium salts in tissues whereas ossification refers to bone tissue formation with or without marrow elements. Both require two physiologic requirements: the release of excess calcium salts from bone and their transport through circulation. Calcification of soft tissues can be divided into two categories: metastatic calcification and dystrophic calcification. Metastatic calcification involves calcium deposition in normal tissues while dystrophic calcification involves calcium deposition in previously injured tissue. Metastatic pulmonary calcification is most commonly caused by hemodialysis treatment for chronic renal insufficiency and subtype malignant pulmonary calcification is caused by various carcinomas, myelomas and sarcomas. Dystrophic pulmonary calcification is commonly caused by granulomatous disorders, viral infections, parasitic infections, amyloidosis, pulmonary vascular infections, coal worker's pneumoconiosis and silicosis.

Pulmonary ossification can be idiopathic or can be caused by preexisting pulmonary, cardiac and/or cardiopulmonary diseases. The lungs seem to be particularly susceptible to this morphologic finding [1]. Pulmonary ossification is an unusual condition where bone formation occurs within the parenchyma of the lung. It is often spread diffusely in the lung and can be divided into nodular pulmonary ossifications (NPO) and dendritic pulmonary ossifications (DPO). DPO's are less common and are often associated with pulmonary inflammation, pulmonary fibrosis, COPD, asbestosis and pneumonia; they may also be idiopathic. NPO's are more common and are often associated with chronic heart failure and mitral stenosis, resulting in passive congestion. These two forms of pulmonary ossification often overlap and both may occur at the same time in the same patient [2].

Diffuse pulmonary ossification is a relatively rare restrictive pulmonic disease. This disease is usually under-diagnosed due to lack of sophisticated imaging techniques required to clinically diagnose patients [3]. The pathology can be diagnosed by microscopic examination of the lung tissue with the presence of bone tissue formation with or without marrow elements. Multiple etiologies can exist and many tissues in the body can be affected by this disease [3].

Pulmonary calcification and ossification are restrictive interstitial pulmonary diseases which are often asymptomatic [1,4-6]. In this case very little clinical signs seen were diagnostic of any clinical significance was seen in the lungs.

Case Report

Clinical history and agonal state

The 45 year old white male was participating in a competitive swim event in central Indiana when he became unresponsive towards the end of the race and had to be pulled from the water. According to his wife, he had no history of smoking, alcohol abuse or illicit drug use. He had family history was significant for cardiac events, including his father passing away from a sudden massive heart attack at the age of 47. The decedent had no cardiac history and had no recent complaints.

Several other competitors stated they heard the decedent begin to groan, but thought he was just "swimming through the pain," as they were near the end of the two mile competitive swim. A friend swimming close by helped him into a rescue boat, and he was then transported to a nearby hospital. All attempts to medically stabilize him proved unsuccessful and he was pronounced dead.

According to his wife, he was very physically active. She stated he swam several times a week and was often outside doing activities.

He had a clinical history significant for some coughing and bloody sputum occurring 1.5 years prior to death. A bronchoscopy was performed by a pulmonologist; a CT scan was also performed, which

***Corresponding author:** Shannon Leigh Cook, Department of Pathology, Indian -a University, Melvin and Bren Simon Cancer Center, Indianapolis, USA, Tel: 219-406-5927; E-mail: shlcook@iupui.edu

Received November 16, 2016; **Accepted** December 06, 2016; **Published** December 16, 2016

Citation: Cook SL, Sandusky G (2016) A Post Mortem Case Study: Diffuse Pulmonary Ossification and Sudden Death. J Tissue Sci Eng 7: 188. doi: 10.4172/2157-7552.1000188

was significant for a small spot in one lung. No specific diagnosis was ever determined. He was prescribed an antibiotic, and upon a follow up CT scan, the small spot was found to have cleared. About a year later, he had a similar episode. After presenting to a pulmonologist with a productive cough, he underwent another CT scan. He was again given antibiotics, an inhaler, and was scheduled for a follow up scan within the next 30 days of his appointment.

Autopsy

All data was collected with consent from decedent's next of kin. The responding coroner's report, autopsy report, toxicology report, lung tissue, and histological analysis were collected and analyzed.

The body had several enlarged organs which included cardiomegaly (580 g), hepatomegaly (2470 g) and splenomegaly (490 g). The heart and cardiovascular system were found to have multiple lesions, including left ventricular free wall hypertrophy (1.8 cm) and a thicker interventricular septum (2.2 cm). There was moderate stenosis of the left descending coronary artery (LAD) in the middle of the artery, approximately up to 80% occlusion, and mild thickening of the right and left circumflex coronary arteries. Moderate aortic atherosclerosis was seen. The lungs were slightly edematous and congested. Focal areas of pulmonary hemorrhage were seen. The right lung weighed 940 g and the left lung weighed 950 g. Bilateral multiple pleural scars were also noted and a small focal area of calcification (Figures 1 and 2).

Ancillary findings

Toxicology results are positive for Pseudoephedrine, and slightly above the normal range for this compound (blood – 867 ng/mL). The patient was given an inhaler to be used daily by his pulmonary specialist. This had no impact on his death. Tests for drugs of abuse were all negative.

Histologic samples of lung tissue were collected and the tissues were fixed overnight at room temperature in 10% NBF after which they were transferred through graded concentrations of alcohol to xylene inside a Leica Automated Vacuum Tissue Processor. They were embedded in paraffin wax before being cut into 5 µ thick sections, mounted onto positively charged slides, and baked at 60°C. The prepared slides were stained with H&E. Two pathologists, one resident and one pulmonary specialist reviewed all slides.

Diffuse pulmonary congestion was seen in all lung sections. Six of 10 sections contained multiple areas of small bone formation (Figure 3) and one section had bone marrow (Figure 4). Eight of 10 sections had focal areas of pleural thickening, 7 sections had focal areas of pulmonary edema and 5 sections had focal pulmonary hemorrhage and hemosiderin laden alveolar macrophages. One section had bone marrow forming inside the bone in it. Two sections were found to have fibrocartilage beginning to form bone.

In the heart there were no areas of myocardial acute infarction. The myocardium showed areas of interstitial edema, foci of enlarged myocytes with enlarged basophilic nuclei and increased eosinophilic cytoplasm. Areas of perivascular fibrosis were also observed.

Discussion

In sudden cardiac death there may be few macroscopic and microscopic lesions. Most are attributed to cardiac ischemia, cardiac arrhythmias, and death. Excessive stress due to acute vigorous physical exertion and job hazards such as those accompanying firefighters can also cause acute sudden death with a release of epinephrine [7,8]. Recent research has also shown cardiovascular damage can result from chronic excessive endurance exercise [9,10]. In this case, the decedent had diffuse pulmonary ossification with cardiac lesions. We could not detect a scientific etiology for the pulmonary ossification in addition to the cardiovascular lesions seen. The decedent had a family history of cardiac disease; specifically, his father expiring at a young age from a myocardial infarction. The decedent had several minimal pulmonary events. The clinical workups with scans did not determine what caused these events. A little over a year apart, the decedent experienced two bouts of a productive cough with bloody sputum. A small spot on the decedent's lungs were also discovered in conjunction with one episode. On a pulmonary workup a few months later, the etiology of these pulmonary events was undetermined. He was scheduled to go in for new images and scans 3 days after the terminal event in the open water 2 mile competitive swim. The diffuse pulmonary ossification was probably associated with his sudden death.

The mechanism of sudden death was most likely caused by the decedent's left ventricular hypertrophy and moderate coronary atherosclerosis. He had an enlarged left ventricle due to his increased need for oxygenated blood flow during his frequent exercising often over duration of 2 h daily in the pool. During the terminal event, the excess strain on his physiological condition exceeded the capabilities of his cardiopulmonary system. His state of restricted pulmonary capability due to extensive ossification combined with his left ventricle hypertrophy and atherosclerosis of the coronary arteries led to a state of

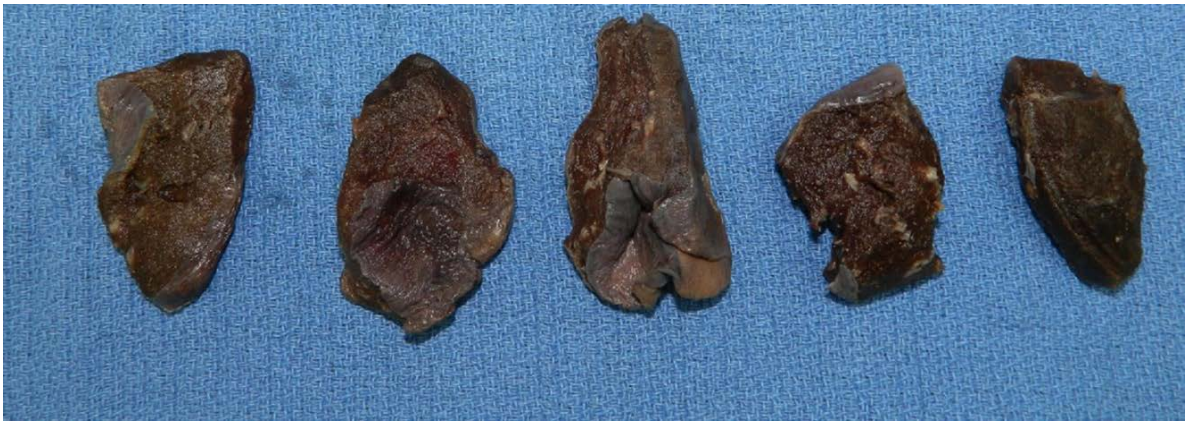

Figure 1: Five gross sections of lungs taken during autopsy. Lung samples are numbered 1 through 5 from left to right.

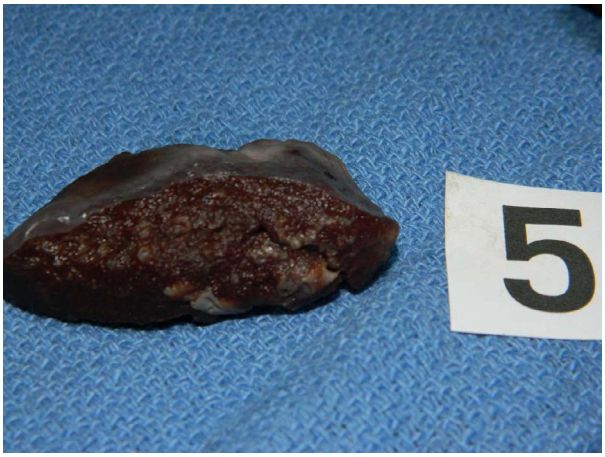

Figure 2: Transverse aspect of the fifth gross section. Ossification is apparent throughout the section.

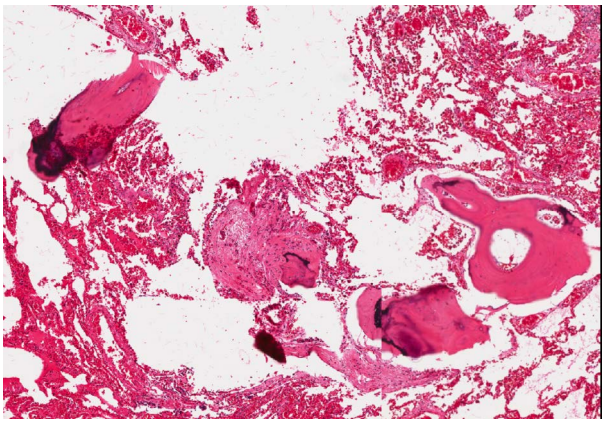

Figure 3: Areas of bone and diffuse pulmonary congestion are noted. H&E 4x.

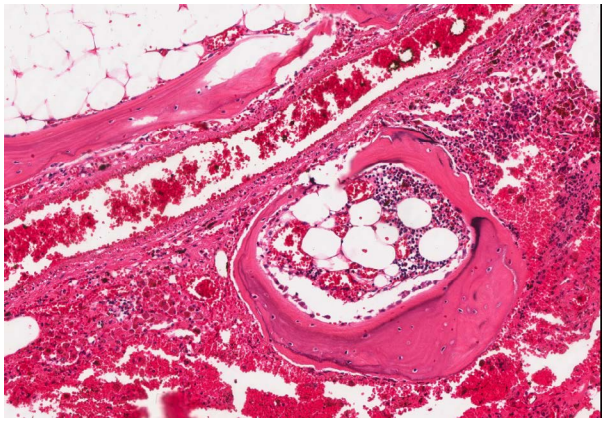

Figure 4: Bone with bone marrow formation, alveolar macrophages and pulmonary hemorrhage are noted. H&E 20x.

oxygen deprivation, ultimately causing the decedent to cease function and drown.

A diligent search was performed to see if diffuse pulmonary ossification and cardiac lesions were concurrently observed in post mortem examinations. In a previous pathology study, there were 17 out of over 10,000 autopsies in 64 months where these diseases were both concurrently observed. The median age was 72 years and the most common associated disease was COPD (35%) followed by pulmonary fibrosis (35%). The earlier study had 26 cases reported in the literature which presented with intermittent fever, dyspnea and mild restrictive changes on pulmonary function tests [11,12]. This current case fits these criteria.

In the previous study, patients older than age 65 were found to have cardiac lesions that had diffuse pulmonary ossification. Cardiac lesions at this age are common and probably had no correlation to the diffuse pulmonary ossification [11,12].

Conclusion

In conclusion, pulmonary ossification probably had some correlation with his sudden death. No discernible causes were found for this pulmonary disease either clinically or on autopsy. The pulmonary ossification is most likely not related to the cardiac findings.

References

1. Chan ED, Morales DV, Welsh CH, McDermott MT, Schwarz MI (2002) Calcium deposition with or without bone formation in the lung. Am J Respir Crit Care Med 165: 1654-1669.
2. Burkett A, Coffey N, Voduc N (2014) Diffuse pulmonary ossification as a rare cause of interstitial lung disease. Can Respir J 21: 23-24.
3. Pear BL (1968) Idiopathic disseminated pulmonary ossification. Radiology 91: 746-748.
4. Konoglou M, Zarogoulidis P, Baliaka A, Boutsikou E, Dramba V, et al. (2013) Lung ossification: An orphan disease. J Thorac Dis 5: 101-104.
5. Bai P, Sun YC, Chen DN, Jin JM, Zhuo J, et al. (2009) Idiopathic diffuse pulmonary ossification: A case report and review of the literature. Zhonghua Jie He He Hu Xi Za Zhi 32: 588-592.
6. Lara JF, Catroppo JF, Kim DU, da Costa D (2005) Dendriform pulmonary ossification, a form of diffuse pulmonary ossification: Report of a 26 year autopsy experience. Arch Pathol Lab Med 129: 348-353.
7. Albert CM, Mittleman MA, Chae CU, Lee IM, Hennekens CH, et al. (2000) Triggering of sudden death from cardiac causes by vigorous exertion. N Engl J Med 343: 1355-1361.
8. Kales SN, Soteriades ES, Christophi CA, Christiani DC (2007) Emergency duties and deaths from heart disease among fire-fighters in the United States. N Engl J Med 356: 1207-1215.
9. Patil H, O'Keefe J, Lavie C, Magalski A, Vogel R, et al. (2012) Cardiovascular damage resulting from chronic excessive endurance exercise. Mayo Clinic Proc 109: 312-321.
10. Patil H, O'Keefe J, Lavie C, Magalski A, Vogel R, et al. (2012) Potential adverse cardiovascular effects from excessive endurance exercise. Mayo Clinic Proc 87: 587-595.
11. Gielis J, Torfs M, Luijks M, Salgado R, Van Schil PE (2011) Nodular pulmonary ossifications in differential diagnosis of solitary pulmonary nodules. Eur Respir J 37: 966-968.
12. Tesung J, Duflou J (2006) Diffuse pulmonary ossification: An uncommon incidental autopsy finding. Pathology 1: 45-48.