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Review article

Ventilated post-mortem computed tomography – A historical review

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ABSTRACT

In an attempt to improve the diagnostic quality of post-mortem computed tomography (PMCT) lung image interpretation, a series of authors have developed an approach that mimics deep inspiration and breath hold clinical thoracic CT imaging in the dead. Known as *ventilated post-mortem computed tomography* or *VPMCT* this technique has now been developed and applied to adult and paediatric PMCT imaging. This review, authored by the principal pioneers of this system, outlines the developmental stages of VPMCT, bringing the reader up to date with current knowledge and practice.

Contents

1. Introduction

After death, time dependent post-mortem hypostasis (livor mortis) is observed to the external surface and internal organs of the body. For the lungs this change leads to increased attenuation, particularly in the dependent areas of the lungs. This can result in obscuration of lung pathology and can be mistaken for aspiration, pulmonary oedema or pneumonia. Although this is recognised as one of several time dependent changes observed with post-mortem cross sectional imaging, only a limited number of authors have given consideration to this problem to date [1–3].

Clinical computed tomography (CT) scans of the thorax are undertaken with breath-hold after inspiration. This lowers average lung density and reduces 'dependent' changes caused by atelectasis and fluid settling. This process makes interstitial or nodular changes more apparent. If functional information is required, for example in the assessment of emphysema or air trapping, then inspiration and expiration scans may be performed [4,5].

In an attempt to improve the diagnostic quality of PMCT lung

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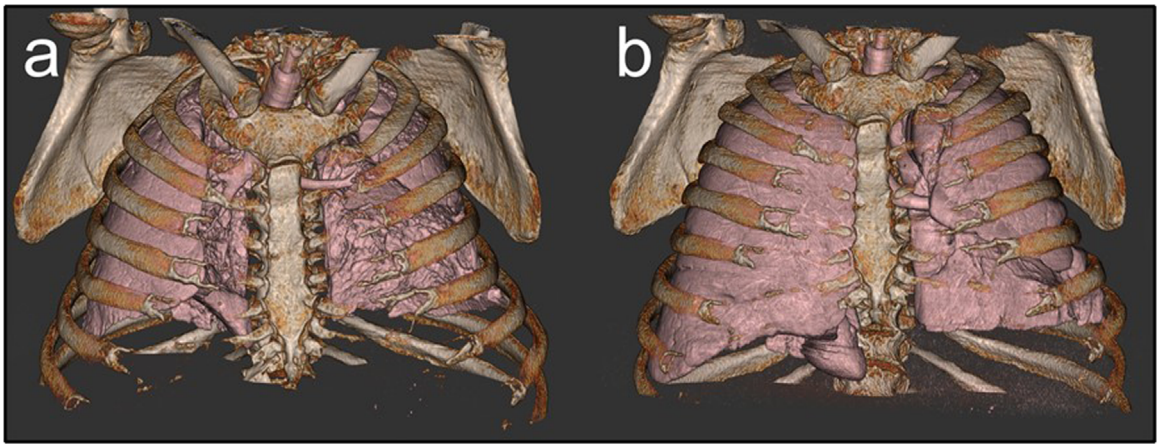

Fig. 1. Pre (a) and post (b) ventilation of a cadaver using a Draeger portable home ventilator.
Source: [6].

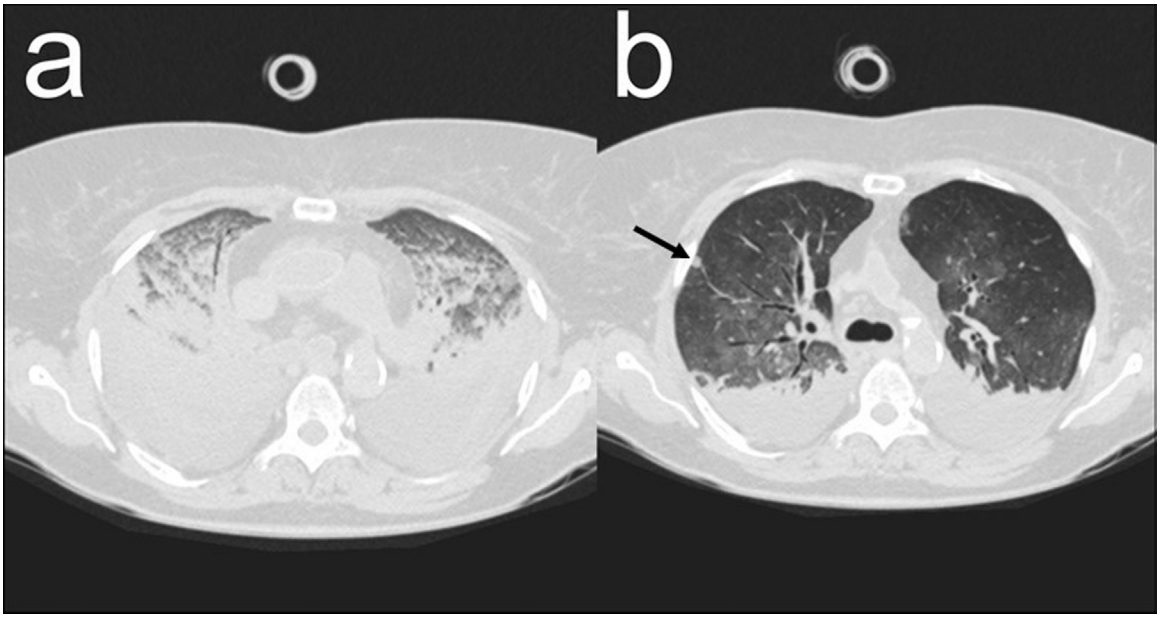

Fig. 2. Pre (a) and post (b) ventilation of a cadaver illustrating the clearing of the lungs. When the left lung is better aerated, a pleural nodule is identified, which was previously obscured by post mortem hypostasis.
Source: [6].

imaging a series of researchers have developed approaches to mimic deep inspiration and breath hold clinical thoracic CT imaging in the dead. Known as *ventilated post-mortem computed tomography* or *VPMCT* this technique can now be applied to both adult and paediatric PMCT imaging [6–10,13]. This review, authored by the principal pioneers of this technique, outlines the developmental stages of VPMCT and summarises current knowledge and practice.

2. Pioneering VPMCT technique in adults

In 2010 Germerott et al., published the first paper concerning VPMCT [6]. To achieve VPMCT they used a portable home care ventilator (Draeger, Hemel Hempsted, UK) set to 'pressure support' ventilation mode using a constant pressure with maximum of 40 mbar. Ventilation pressure was delivered to the lungs using a variety of airway adjuncts. Where an endotracheal tube was already in place (e.g. due to failed cardiopulmonary resuscitation) they used this, otherwise ventilation was delivered by means of a laryngeal mask (if possible) or a Continuous Positive Airway Pressure (CPAP) mask. Prior to ventilation a baseline scan was undertaken of the thorax with the arms elevated using a 6-slice Scanner (Emotion 6, Siemens Germany). The lungs were then ventilated with simultaneous thoracic imaging. The pre- and post-ventilation lungs were compared and lung volumes measured using a segmentation technique (AMIRA, Visage Imaging GmbH Germany). Initially 5 cadavers were examined: 2 suicides (one intoxication, one exsanguination), and 3 natural deaths due to heart failure. None had chest trauma. The post-mortem interval was 4.5–58 h (mean 32.3 h). They demonstrated lung inflation after death (Fig. 1) in all five cases showing a decrease in lung attenuation in areas affected by hypostasis. They considered they could evaluate the lung parenchyma better for true ante mortem pathology, such as consolidation or lung nodules (Fig. 2). No observable ventilator induced lung damage was demonstrated and