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FORENSIC RADIOLOGY SPECIAL FEATURE EDITORIAL

Forensic radiology special feature: preface

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In the past decades, the technological progress of radiological sciences has considerably advanced. The improved visualization of structural–anatomical details and the multi-parametric analysis of physiopathological changes have been leading an evolution towards a wider concept of “imaging”, bringing together two apparently distant disciplines, radiology and forensic medicine.

This timely special feature encapsulates some key topics in forensic radiology, giving a state-of-the-art overview of current research and future directions in forensic imaging from leaders in the field.

Although sharing the same principles, with the study and interpretation of anatomical findings acting as the common cornerstone, the co-operation between radiology and forensic medicine has been limited for a long time to the use of conventional radiology in the study and detection of foreign bodies in corpses, particularly bullets in firearm deaths.

Despite the fact that conventional radiology is still a valuable tool in the identification of drug carriers who hide drug-filled packets in their gastrointestinal tract, it is actually classified as a secondary identifying system in post-mortem investigation and, with the exception of a recognized rule in mass fatality investigations, has been substantially replaced by multidetector CT (MDCT). This powerful technique provides a full-body multiplanar study, which can be enhanced by several advanced image post-processing techniques and has been proven to be useful in the assessment of bone structure, in the detection of internal haemorrhage, greater soft-tissue masses and foreign bodies.

Nevertheless, unenhanced post-mortem MDCT (pmMDCT) has shown several limitations caused by weak soft-tissue contrast and poor visualization of the vascular system. In fact, with the exception of major vascular lesions such as aortic rupture, pmMDCT has demonstrated limited diagnostic value, particularly in coronary heart disease,

pulmonary embolism and other vascular-related pathologies. These limitations have led to the worldwide development of several minimally invasive approaches, each using different injection methods and liquids, with the aim to perform a contrast-enhanced pmMDCT. In the past years, intensive research has been carried out on revealing the potential of multiphase pmMDCT angiography to improve the diagnostic sensitivity of forensic radiological investigations, particularly in the detection of the source of a haemorrhage.

Beside virtual autopsy, MDCT has found a new developing application field called virtual anthropology, which aims to identify unknown bodies or dry bones through comparative or reconstructive criteria. Comparative identification is usually performed in post-mortem images analysing every pre-existing abnormality, anatomical variation, previous surgical procedure and any other peculiar finding comparable with antemortem images. Reconstructive identification transposes to MDCT examinations the criteria used in physical anthropology on dry bones, allowing the determination of age at death, racial phenotype, gender and stature. As for anthropology, MDCT has been applied to palaeopathology, the study of ancient diseases. This so-called “paleoradiology” also showed promising results on recent skeletal remains in a forensic context, helping with the differentiation of bone lesions.

Over the past decade, post-mortem MRI (pmMRI) has gained a constantly growing adoption in forensic investigation. One of the most important fields of application is in cardiovascular diseases, where recent studies have shown the potential of pmMRI in detecting early cardiac ischaemia. Moreover, owing to its excellent visualization of central nervous structures and soft tissues, pmMRI has been successfully adopted in the assessment of brain and spinal cord anomalies in fetuses and children.

Although the recent advances described in this special feature are impressive, intensive research is still required to obtain full validation and to better define the role of imaging in such a complex and heterogeneous forensic context.

On the other hand, there is increasing recognition of the need for advanced training in forensic imaging: radiologists have to be up to speed with the different available techniques and familiar with their strengths and weaknesses. They also need to be aware of post-mortem changes that may cause particular difficulties in radiological evaluation, such as free air, fluid collections and other potential pitfalls like post-mortem intravascular clots.

The major challenge for forensic radiology in the future is for international organizations to fulfill all these expectations, setting standards with certification of training and requirements for accreditation.

I hope this collection of articles sets the scene of where forensic radiology stands now and provides some insight into the future directions of this rapidly growing field.