



10th Annual Congress of the International
Society of Forensic Radiology and Imaging

16th Meeting of the International Association
of Forensic Radiographers

Book of abstracts

20-22 May, 2021

Kraków, Poland



JAGIELLONIAN UNIVERSITY
MEDICAL COLLEGE
IN KRAKOW

www.isfri2021.uj.edu.pl

Scientific Committee

Natalie L. Adolphi, University of New Mexico, USA
Summer Decker, University of South Florida, USA
Edel Doyle, RMIT University, Melbourne, Australia (IAFR Chair)
Guillaume Gorincour, Aix-Marseille Université, France
Hideki Hyodoh, Hokkaido University, Japan
Jeroen Kroll, Maastricht UMC+, the Netherlands
Peter Mygind Leth, University of Southern Denmark, Denmark
Chris O'Donnell, the Victorian Institute of Forensic Medicine, Melbourne, Australia
Lars Oesterhelweg, Charité Universitätsmedizin Berlin, Germany
Rick R. van Rijn, Academisch Medisch Centrum Universiteit van Amsterdam, the Netherlands
Guy N. Ruttly, University of Leicester, UK
Michael Thali, University of Zurich, Switzerland
Mark Viner, University of London, UK
Krzysztof Woźniak, Jagiellonian University Medical College, Poland (ISFRI Chair)

Organizing Committee

Filip Bolechała
Piotr Kluza
Artur Moskała
Ewa Rzepecka-Woźniak
Marek Sanak
Krzysztof Woźniak - Chairman

Agenda

20 May 2021

08:55-09:00 Congress Opening & Gill Brogdon HONORARY LECTURE:

Chairpersons: Natalie Adolphi, Krzysztof Woźniak

"Humanitarian Forensic Action and Forensic Radiology and Imaging",

Duarte Nuno Vieira, Institute of Legal Medicine and Institute of Bioethics,
Coimbra University Centre for Humanitarian and Human Rights Forensic
Research and Training, Universidade de Coimbra.

9.55-10.05 Break

10:05-11:05 PLENARY SESSION I - COVID - 19 THROUGH CONTINENTS

Chairperson: Michael Thali

[I/1. Post-mortem CT lung findings in SARS-CoV-2 RT PCR positive cases with autopsy correlation, Chris O'Donnell, Forensic Pathology, Victorian Institute of Forensic Medicine.](#)

[I/2. PMCT lung findings in SARS-COV-2 cases: correlation with lung histopathological and autopsy results, Laura Filograna, Diagnostic Imaging, Policlinico Universitario Tor Vergata Roma,](#)

[I/3. Postmortem CT lung findings of Covid-19: A review of 14 decedents and potential triage implications, Emily Helmrich, Office of the Medical Investigator, University of New Mexico.](#)

11.05-11.15 Break

11:15-12:15 PLENARY SESSION II - TRAUMATOLOGY

Chairperson: Guillaume Gorincour

[II/1. Effects of blood loss on liver attenuation on postmortem CT – What role does glycogen play?, Jakob Heimer, Forensic Medicine and Imaging, Institute of Forensic Medicine, University of Zurich.](#)

[II/2. Location specific sensitivity and specificity of PMCT in blunt force skull fractures, Mikkel Henningsen, Section of Forensic Pathology, Department of Forensic Medicine, University of Copenhagen.](#)

[II/3. Case report of a skeleton find in forest – characterizing skull fracture aspects, Wolf Schweitzer, Forensic Medicine and Imaging, Zurich Institute of Forensic Medicine.](#)

[II/4. Can post-explosion perforations with beveling be revealed with PMCT?, Jarosław Berent, Department of Forensic Medicine, Medical University of Łódź.](#)

[II/5. Strikes, Cuts and Cross-sections – Dismemberment in PMCT, Lars Oesterhelweg, Institute of Forensic Medicine, Charité – Universitätsmedizin Berlin.](#)

[II/6. Imaging of intimate partner violence, Thomas Ruder, University Hospital Bern Inselspital.](#)

12:20-12:50

Synergistic Role of Newer Techniques for Forensic and Postmortem CT Examinations, Alain Blum, Guilloz Imaging Department, Nancy University Hospital, Nancy, France.

Chairpersons: Guy Rutty, Lars Ebert

[III/1. PMCT from head to toe - how to approach a stack of 4000 images, Thomas Ruder, University Hospital Bern Inselspital.](#)

[III/2. Automatic generation of images for the visualization of gas, bone and foreign bodies from PMCT, Lars Ebert, 3D Center Zurich, Institute of Forensic Medicine, University of Zurich.](#)

[III/3. Volumetric segmentation in post-mortem computed tomography imaging using deep learning techniques, Akos Dobay, Forensic Imaging, Zurich Institute of Forensic Medicine.](#)

[III/4. The Forensic Holodeck Technical Setup – Recommendations after 7 years, Till Sieberth, Institute of Forensic Medicine, University of Zurich.](#)

[III/5. MR Microscopy of Optic Nerve Sheath Hemorrhage in Non-Accidental Injuries, Barry Daly, Diagnostic Radiology, University of Maryland.](#)

21 May 2021

09:00-10:00 PLENARY SESSION IV

Chairpersons: Rick R. van Rijn, Krzysztof Woźniak

Honorary Lecture:

"Postmortem Angiography - the Past, Present and Future", Silke Grabherr, University Centre of Legal Medicine (CURML), Lausanne and Geneva.

10.00-10.15 Break

10:15-11:15 PLENARY SESSION V - TECHNICAL DEVELOPMENT 2

Chairperson: Peter Mygind Leth

[V/1. The effect of radiographic expertise - Improving image acquisition on PMCT, Sara Tangmose Larsen, Section of Forensic Pathology, Department of Forensic Medicine, University of Copenhagen.](#)

[V/2. 3D whole body spectral imaging in line with PMCT examinations, Soeren Kottner, Zurich Institute of Forensic Medicine, University of Zurich.](#)

[V/3. Local Temperature Estimation in Postmortem Muscle Tissue by in situ Magnetic Resonance Spectroscopy, Niklaus Zoelch, Institute of Forensic Medicine, University of Zurich.](#)

[V/4. High-Resolution 7 Tesla MRI in forensic medicine, Eva Deininger-Czermak, Institute of Forensic Medicine, University of Zurich.](#)

[V/5. Importance of postmortem MRI of the brain for forensic practice, Yohsuke Makino, The University of Tokyo.](#)

[V/6. Remote consultations in Forensic Anthropology and Entomology: examples of conveniences and pitfalls, Edda E. Guareschi, Medical, Molecular and Forensic Sciences, Murdoch University.](#)

11.15-11.30 Break

Chairperson: Chris O'Donnell

[VI/1. The biggest Shipwreck of the Mediterranean Sea as the basis for a multidisciplinary approach between pathology, anthropology and radiology in the evaluation of commingled skeletal remains, Alberto Amadasi, Institute of Legal Medicine and Forensic Sciences of the Charité - Universitätsmedizin Berlin.](#)

[VI/2. Personal Identification Using Part-to-Part Comparison of L1-L5 Vertebra from AMCT and PMCT Scans, Summer Decker, Radiology, University of South Florida.](#)

[VI/3. Standardized Image Acquisition and Reporting in Pediatric Paleoradiology: Interdisciplinary Approach, Katherine Van Schaik, Department of Radiology, Harvard Medical School.](#)

[VI/4. Investigating the average thickness and density of the human neurocranium, Samantha Rowbotham, Human Identification Service, Victorian Institute of Forensic Medicine.](#)

[VI/5. Multidisciplinary study of a South American natural mummy: a practical example, Fabrice Dedouit, Medico-legal department, Chu Toulouse.](#)

12.30-12.45 Break

12.45-14.00 2021 ISFRI Members General Assembly

22 May 2021

09:30-10:30 PLENARY SESSION VII - IAFR SESSION - THE DEFINITION OF "THE FORENSIC RADIOGRAPHER" AROUND THE WORLD, PART 1

Chairperson: Jeroen Kroll

[VII/1. The roles of the forensic radiographer in Finland \(20 min.\), Fox Marttinen, Finland,](#)

[VII/2. The roles of the forensic radiographer in Denmark \(20 min.\), Christina Caroe Ejlsvkov Pedersen, Department of Forensic Medicine, Aarhus, Denmark,](#)

[VII/3. The roles of the forensic radiographer in Australia \(20 min.\), Anthony Buxton, Australia.](#)

10.30-10.40 Break

10:40-11:40 PLENARY SESSION VIII - IAFR SESSION - THE DEFINITION OF "THE FORENSIC RADIOGRAPHER" AROUND THE WORLD, PART 2

Chairperson: Edel Doyle

[VIII/1. The roles of the forensic radiographer in the UK \(20 min.\), Claire Robinson & Amy Lee Brookes, UK,](#)

[VIII/2. The roles of the forensic radiographer in Switzerland \(20 min.\), Alejandro Dominguez, Switzerland,](#)

[VIII/3. The roles of the forensic radiographer in Japan \(20 min.\), Tomoya Kobayashi, Japan.](#)

10:40-12:00 PLENARY SESSIONS VII / VIII – IAFR SESSIONS: QUESTIONS AND ANSWERS

Chairperson: Mark Viner

12.00-12.10 Break

12:10-13:10 PLENARY SESSION IX

Chairperson: Lars Oesterhelweg

[IX/1. A Comparison of Post Mortem CT and External Examination of the Neck in Suspected Hanging Cases, Danielle Chew, Staffordshire University.](#)

[IX/2. Exploring Metabolic Changes in Post-mortem Muscle Tissue by In-Situ Magnetic Resonance Spectroscopy, Dominic Gascho, Institute of Forensic Medicine, University of Zurich.](#)

[IX/3. Imaging Findings of Contraband Smuggling in 2021, Barry Daly, University of Maryland.](#)

[IX/4. Personal identification using post-mortem CT image corresponding to periodontal disease examination, Hideko Fujimoto, Kyoto Forensic Odontology Center.](#)

[IX/5. Anatomical variability of the maxillary sinus and their application in human identification, Dorota Lorkiewicz-Muszyńska Department of Forensic Medicine, Uniwersytet Zielonogórski.](#)

[IX/6. Forensic face reconstruction based on postmortem computed tomography, Marta Barszcz, Department of Forensic Medicine and Doctoral School of Medical Sciences and Health Sciences, Jagiellonian University Medical College.](#)

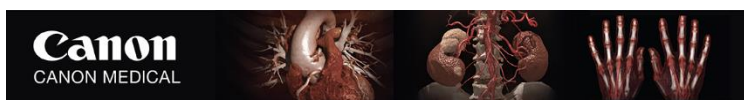
13.10-13.20 Break

13.20-13.30 Closing Ceremony

Chairpersons: Summer Decker, Krzysztof Woźniak, Hideki Hyodoh, Fabrice Dedouit



[Archives of Forensic Medicine and Criminology](#)



I/1 Post-mortem CT lung findings in SARS-CoV-2 RT PCR positive cases with autopsy correlation

Authors: O'Donnell Chris¹, Iles Linda¹, Woodford Noel¹,

¹Victorian Institute of Forensic Medicine and Department of Forensic Medicine, Monash University

Introduction/purpose

CoVID-19 is a novel viral infection with now well-established clinical course and radiological findings. There is limited data on post-mortem imaging.

Materials and Methods

In an 11-week period, 39 deceased persons were referred for medicolegal investigation with pre-existing or subsequent nasopharyngeal swabs showing positivity on SARS-CoV-2 RT PCR testing. All 39 had routine whole-body CT scans on admission and 12 underwent medicolegal autopsy. These 39 cases were contrasted with 4 other cases which were negative on nasopharyngeal swabs despite PMCT findings suggestive of CoVID-19 pneumonia (designated false positive).

Results

There were 8 patterns of PMCT lung abnormality including typical findings of CoVID-19 alone, minimal changes of CoVID-19 alone, typical agonal findings alone, mixed typical agonal and CoVID-19 findings, dense airless lungs, gross decomposition, and features of another pathology +/- typical agonal changes. Nine of the 12 autopsies showed lung histology of varying severity, consistent with those reported in CoVID-19 pneumonia. Typical clinical CoVID-19 lung findings on PMCT were detected in 5 (42%). In 3 of 4 false positive cases, lung findings showed non-CoVID-19 histology but in 1, findings were identical.

Discussion

PMCT CoVID-19 findings in the lungs are not specific and may not be detected in all cases due to obscuration by expected agonal CT findings in the chest or other pathologies that pre-dated SARS-CoV-2 infection. PMCT findings may otherwise be subtle and autopsy histological findings similarly minimal.

Conclusion

Given this spectrum of change on PMCT, the challenge for pathologists and radiologists is to determine whether death has been caused by, or merely associated with SARS-CoV-2 infection.

Keywords: CoVID-19, SARS-CoV-2, PMCT, lung

I/2 PMCT lung findings in SARS-COV-2 cases: correlation with lung histopathological and autopsy results

Authors: Filograna Laura¹, Manenti Guglielmo¹, Oliva Antonio², Arena Vincenzo³, Di Donna Carlo¹, Nardoni Francesco⁴, Colosimo Cesare⁵, Pascali Vincenzo Lorenzo², Floris Roberto¹

¹ Diagnostic Imaging, Policlinico Universitario Tor Vergata Roma, Italy

² Forensic medicine, Catholic University of Rome, Italy

³ Pathology, Catholic University of Rome, Italy

⁴ Forensic Medicine, Catholic University of Rome, Italy

⁵ Diagnostic imaging, Catholic University of Rome, Italy

Introduction/purpose

Post-mortem computed tomography (PMCT) has been already applied in deaths related to SARS-COV-2 infection. The purpose of this study is to investigate a correlation between PMCT lung findings in autopsy cadavers positive for SARS-COV-2 infection and the severity of SARS-COV-2 lung disease on histopathological analysis.

Materials and Methods

We reviewed chest PMCT findings with particular attention to lung parenchyma in 8 autopsy cases positive for SARS-COV-2. Correlation between chest PMCT findings and histopathological findings was assessed. Correlations with ante-mortem clinical status and comorbidities were also investigated. The primary cause of death was finally considered.

Results

In the 6/8 cases with severe pulmonary coronavirus disease 2019 (COVID-19) on histopathological analysis, the pulmonary PMCT findings were massive consolidation (4/8), and bilateral, diffuse mixed densities with crazy paving pattern (2/8). In the cases 4/8 cases with massive consolidations, important comorbidities were associated. In these 6/8 cases the autopsy ascertained cause of death was cardio-respiratory failure due to SARS-COV-2 infection. In the remaining 2/8 cases, pulmonary PMCT findings were ground glass and consolidations with a prevalent gradient distribution. In these 2/8 cases the histopathological analysis revealed lung alterations due to oedema and few signs of SARSCOV-2 infection. In these 2/8 cases the cause of death was not attributed to SARS-COV-2 infection.

Discussion and Conclusion

Chest PMCT findings correlate with the severity of COVID-19 lung disease. Although the paucity of cases, PMCT findings of the lungs in cadavers positive for SARS-COV-2 infection might correlate with the cause of death, especially after consideration of clinical antemortem data.

Keywords Post-mortem CT, COVID-19, SARS-COV-2, lung findings, pulmonary hystopathology.

I/3 Postmortem CT lung findings of COVID-10: a review of 14 decedents and potential triage implications

Authors: Helmrich Emily¹, Decker Lauren¹, Adolphi Natalie², Makino Yohsuke³

¹ Office of the Medical Investigator, University of New Mexico, United States

² Center for Forensic Imaging, Office of the Medical Investigator, University of New Mexico, United States

³ Graduate School of Medicine, University of Tokyo, Japan

Introduction

Computed tomography has significant utility as a diagnostic tool for coronavirus disease 2019 (COVID-19) in the clinical setting. COVID-19 deaths are sometimes examined by forensic pathologists, often in the setting of an unknown diagnosis. We assessed the utility of postmortem computed tomography (PMCT) for use as a triage tool for these autopsy examinations.

Materials and methods

We reviewed PMCT findings in 14 and histopathology in 11 decedents who were positive for COVID-19.

Results

Eleven decedents (79%) demonstrated mixed densities (near-equal amounts of both ground-glass opacities [GGOs] and consolidations). Seven decedents (50%) had ill-defined rounded consolidations. Other common features included traction bronchiectasis (eleven decedents, 79%), interseptal thickenings (ten decedents, 71%) and crazy paving pattern (nine decedents, 64%). Therefore, the predominant imaging findings were bilateral mixed densities in either a diffuse or peripheral distribution, with traction bronchiectasis, interseptal thickenings and/or crazy paving. In particular, we found that traction bronchiectasis, ill-defined rounded consolidations, and reverse halo sign were useful when distinguishing from other postmortem changes.

Conclusion

We conclude that triage with a PMCT may aid the forensic pathologist in diagnosing possible COVID-19 infection prior to autopsy examination.

Keywords

COVID-19, Postmortem CT, Autopsy

II/1 Effects of blood loss on liver attenuation on postmortem CT – What role does glycogen play?

Authors: Heimer Jakob¹, Chatzaraki Vasiliki¹, Schweitzer Wolf¹, Thali Michael J.¹, Ruder Thomas D.²

¹ Forensic Medicine and Imaging, Institute of Forensic Medicine, University of Zurich, Switzerland

² 2Department of Diagnostic, Interventional and Pediatric Radiology, Inselspital, Bern University Hospital, University of Bern, Switzerland

Purpose

To investigate the effects of blood loss on the CT attenuation of the liver.

Methods

A total of 125 cases with blood loss were sex- and age-matched to 125 control cases without blood loss. Individual liver attenuation was measured on transverse CT images. Bivariate comparison of means of liver attenuation between both groups as well as multiple regression with liver attenuation as the response variable and sex, age, BMI, postmortem interval, liver fat content, and performed reanimation as predictors were performed.

Results

CT attenuation of the liver was significantly higher (61 HU > 49 HU, $p < 0.001$) in cases with blood loss compared with controls. When adding an approximation of "agony time" based on the cause of death to the multiple regression model, the R^2 increased from 0.47 to 0.61, and the new variable had the largest effect size among all predictor variables.

Conclusion

The increased liver attenuation in cases with blood loss compared to controls was an unexpected finding. One probable interpretation refers to different levels of hepatic glycogen. The high effect size of agony times suggests that the difference in liver attenuation is indeed a consequence of liver glycogen, which appears to be strongly correlated to the individual agony time.

Keywords: postmortem computed tomography; blood loss; liver attenuation; agony

II/2 Location specific sensitivity and specificity of PMCT in blunt force skull fractures

Authors: Henningsen Mikkel¹, Jacobsen Christina¹, Villa Chiara¹

¹ Section of Forensic Pathology, Department of Forensic Medicine, University of Copenhagen, Denmark

Congruence between PMCT and autopsy is an important area of forensic medical research. Several papers have examined the ability of PMCT to detect skull fracture and found high sensitivity and specificity. Almost all reported the presence or absence of a fracture systems in the base and vault. The aim of this study was to assess the congruence between PMCT and autopsy in detecting the individual fracture lines in each bone, producing location specific sensitivity and specificity of PMCT.

We retrospectively included 99 cases of cranial blunt force trauma in adults autopsied between 2013 and 2019. Cases with severely comminute fractures, missing bone parts, insufficient reporting, or lack of PMCT were excluded. PMCT was interpreted blindly from autopsy findings. All fracture lines from both autopsy and PMCT were registered and compared. Sensitivity and specificity of PMCT were calculated.

We present here only preliminary results from a larger study also including the cranial base and sutures of the 99 cases. We identified more than 1,800 fracture lines in total. For the individual bones of the cranial vault, we found sensitivities ranging from 0.68 to 0.83 and specificities ranging from 0.77 to 0.94

This study adds to the existing knowledge by providing sensitivities and specificities of PMCT for individual cranial bones by a novel approach of considering individual fracture lines. Our findings differ from those previously published and will be discussed thoroughly. Our study indicates that the need for autopsy persists if advanced fracture analysis is warranted.

Keywords

PMCT, skull fracture, diagnostic test accuracy, sensitivity & specificity, autopsy

II/3 Case report of a skeleton find in forest – characterizing skull fracture aspects

Authors: Schweitzer Wolf¹, Thali Michael¹, Bolliger Stephan¹, Roidou Magda¹

¹ Forensic Medicine and Imaging, Zurich Institute of Forensic Medicine, Switzerland

Case: Partly skeletonized human remains which constituted an almost complete skeleton were found in a forest. The identity was confirmed as being that of an approximately 45-year-old man. What appeared to us as an outstanding feature was the fracture pattern of the skull, which seemed to present a strong contrast with the remaining skeleton, which was almost completely unharmed. The skull fracture pattern, particularly as seen in post-mortem CT (PMCT) was then compared to skull data from other cases in our database. There, we looked at cases of blunt trauma and various firearm injuries. Based on this data comparison, we deemed an explosive trauma to be the best explanation for the findings in the case at hand. Further investigation then found that the deceased, who had a history of depression, had indeed been a trained pyrotechnician. Based on this and further results of the examination, suicide was considered a plausible manner of death.

Details of the skull fractures, and comparison with other cases, will be presented and discussed.

II/4 Can post-explosion perforations with beveling be revealed with postmortem computed tomography (PMCT)?

Authors: Berent Jarosław¹, Smędra Anna¹

¹ Department of Forensic Medicine, Medical University of Lodz, Poland

PMCT is a commonly acknowledged diagnostic method in forensic pathology, but its usefulness may vary on a case-by-case basis. Fragments moving at high velocity during explosions may cause different types of bone injuries. Among these, perforating lesions with beveling are the most interesting ones, from the evidential point of view. Such lesions are diagnostic for an impact of objects moving at high velocity (high energy objects), such as projectiles fired from firearms or fragments released during an explosion. Other reasons for the occurrence of such lesions are so extremely rare that the finding of such lesions during a forensic autopsy practically confirms that they have been caused by the trauma described. The purpose of this paper was to examine the usefulness of PMCT in the detection of postexplosion perforating bone lesions with beveling.

In order to do this, two experimental explosions were carried out (thermobaric load and penthrite) featuring flat bone models (Synbone®). Both explosions resulted in diagnostic lesions in the form of perforations with beveling of different sizes. The bone models had subsequently been CT scanned and a 3D reconstruction was prepared. The conducted experiment showed that PMCT 3D reconstructions are of limited value when analyzing the morphology of small lesions. Such bone injuries can be revealed with PMCT only in case of large lesions. It is not possible to recognize smaller lesions due to the limitations of digital 3D reconstruction algorithms. Therefore, PMCT cannot replace the classic visual evaluation of such small lesions during forensic autopsy.

Keywords: explosion, blast, lesion, beveling

II/5 Strikes, cuts and cross-sections - dismemberment in PMCT

Authors: Oesterhelweg Lars¹, Dümpelmann Denise¹, Hartwig Sven¹, Tsokos Michael¹

¹ Institute of Forensic Medicine Charite - Universitaetsmedizin Berlin, Germany

Dismembered bodies are rare but highly noticed entities in Legal Medicine. When mutilated or dismembered bodies or body parts have been found, the criminal investigation department and medico legal services are facing several reconstructive questions. A complete documentation of all injuries is mandatory for the police to reconstruct the course of events and is the grounding of high court decisions. PMCT gives us a valuable tool for a complete head-to-toe documentation and for reconstructions, measurements, and 3D-demonstrations of injuries and findings. In the forensic literature dismemberment of bodies is classified in offensive and defensive actions. In offensive dismemberment the disintegration is part of the act of killing while in defensive dismemberment it is a process to hide or to transport the deceased or to hinder the identification. In 4 cases the different classifications of dismemberment will be demonstrated.

II/6 Imaging of intimate partner violence

Authors: Ruder Thomas¹

¹ Department of Radiology, University Hospital Bern Inselspital, Switzerland

The COVID-19 pandemic has triggered an increase in intimate partner violence (IPV). Reasons for this rise in IPV include elevated levels of stress from social isolation and economic hardship as well as the confinement of families at home for extended periods during lockdowns.

The aim of this presentation is to review injury patterns of IPV on imaging and to outline the role of radiologists in the detection of IPV.

Based on a review of the radiologic literature, this presentation provides an overview of frequent patterns and imaging findings in IPV victims.

IPV-related injuries are found both in target areas and in defensive locations. Target areas include the face, neck and back. Typical defence injuries occur in the forearms and hands. The presence of acute, healing, and healed fractures is suggestive for IPV.

Imaging can play a crucial role in the detection of IPV and it therefore is important that radiologists are aware of imaging patterns and red flags for IPV.

III/1 Post-mortem CT from head to toe – how to approach a stack of 4000 images

Authors: Ruder Thomas¹

¹ Department of Radiology, University Hospital Bern Inselspital, Switzerland

Post-mortem computed tomography (PMCT) is often part of the preliminary investigations in a Coroner's Inquest. The imaging findings can guide triage and management decisions regarding subsequent post-mortem investigations. At the time of the PMCT, information regarding the circumstances of death is often very limited. This means that radiologists and pathologists who read a PMCT do not know what abnormalities they are looking for and where they should be looking for abnormalities. Therefore, a thorough review and careful interpretation of all CT images is crucial. Reading through thousands of images from head to toe is challenging.

The aim of this presentation is to present a systematic approach for reading and reporting PMCT using a structured report template.

Structured reporting has several advantages over traditional free-text report. For the beginner, a report template serves as checklist and ensures the completeness of a report. Structured reporting also represents a countermeasure against bias from case irrelevant context information. In addition, it increases both inter-rater consistency and clarity of a radiology report.

This presentation provides practical tips on how to approach a whole-body post-mortem CT.

III/2 Automatic generation of images for the visualization of gas, bones and foreign bodies from PMCT

Authors: Ebert Lars¹, Seckiner Dilan¹, Sieberth Till¹, Thali Michael², Franckenberg Sabine³

¹ 3D Center Zurich, Institute of Forensic Medicine, University of Zurich, Switzerland

² Institute of Forensic Medicine, University of Zurich, Switzerland

³ Institute for Diagnostic and Interventional Radiology, University Hospital Zurich, Switzerland

Introduction

Post mortem computed tomography (PMCT) can aid in localizing foreign bodies, bone fractures, and gas accumulations. The visualization of these findings play an important role in the communication of radiological findings. We developed an algorithm, that allows for the automated visualization of gas distributions on PMCT image data of the thorax and abdomen.

Materials and Methods

The algorithm calculates different projection images (namely an average projection, a minimum intensity projection (minIP) and a maximum intensity projection (MIP)) that are differently colored and layered to build up the final overview image. The algorithm was tested on a total of 955 PMCT scans of the thorax and abdomen.

Results and Discussion

In all cases, the algorithm managed to generate useful images, visualizing foreign bodies as well as gas distributions. While this type of visualization cannot replace a real radiological analysis of the image data, it can provide a quick overview for briefings and image reports.

III/3 Volumetric segmentation in post-mortem computed tomography imaging using deep learning techniques

Authors: Dobay Akos¹, Gaspar Dominic¹, Kurmann Astrid¹, Handschin Philippe¹, Garyfalia Ampanozi¹, Franckenberg Sabine¹, Affolter Raffael¹, Sieberth Till¹, Ebert Lars¹

¹ Forensic Imaging, Zurich Institute of Forensic Medicine, Switzerland

Aims and objectives

Automated segmentation of volumetric data remains a challenging problem, especially in medical imaging. In this study we present a deep learning algorithm able to segment automatically multiple organs on post-mortem computed tomography (PMCT) scans.

Materials and methods

A total of 40 post-mortem cases were retrospectively selected from our database at the Zurich Institute of Forensic Medicine. We excluded cases with signs of advanced decomposition. For each case the PMCT scan of the dead body was imported in Amira, a software platform for 3D data visualization and data processing. Two medical students supervised by a certified board forensic pathologist manually segmented the volume corresponding to the lungs, the liver, the heart, the kidneys, and the bladder. The volumetric data were subsequently used to train, validate, and test a deep learning algorithm for automated organ segmentation. The algorithm was derived from an existing neural network architecture called U-Net and adapted to work on volumetric PMCT scans.

Results

Based on a visual inspection of the resulting outcome, the algorithm was able to segment the volume corresponding to the lungs, the liver, the heart, the kidneys, and the bladder. However, volumetric overlaps between adjacent organs were still visible.

Discussion and Conclusion

In this study, we were able to show that a deep learning algorithm can be used to automatically segment organs on volumetric PMCT scans. However, the current version of the algorithm still suffers from a lack of precision based on our visual assessment of the resulting images.

Keywords

Deep learning, PMCT

III/4 The forensic holodeck technical setup – recommendations after 7 years of experience with virtual reality head-mounted displays in forensics

Authors: Sieberth Till¹, Seckinger Dilan¹, Dobay Akos¹, Dobler Erika², Affolter Raffael¹, Ebert Lars¹

¹ Institute of Forensic Medicine, University of Zurich, Switzerland

² Zurich Forensic Science Institute, Switzerland

Introduction/Purpose

In 2013 we introduced the use of Virtual Reality in forensic under the name Forensic Holodeck. Since then we applied it in several case, both during the forensic investigation as well as in court trails. This presentation will have a look at the equipment we use in addition to the Virtual Reality set-up.

Materials and Methods

For an all-round documentation for the usage of Virtual Reality in forensic investigations and court trails we use TV broadcast and streaming grade equipment. This equipment includes cameras, Mix Effect (M/E) switchers and audio equipment, but also networking equipment for multiple VR set-ups.

Discussion and Conclusion

After 7 years of using virtual reality in a professional forensic capacity it showed that advanced equipment is necessary to fulfil customer and court requirements and forensic standards. This mostly includes audio-visual and broadcasting technology for complete documentation of the application of virtual reality, but also some other IT equipment, which should be available for as low as 20'000 US\$.

Keywords: Virtual Reality, Forensic Holodeck, 3D Reconstruction, Experience Report

III/5 MR microscopy of optic nerve sheath hemorrhage in non-accidental injuries

Authors: Daly Barry¹

¹ Diagnostic Radiology, University of Maryland, United States

Purpose

There is a known association between non-accidental injuries in children and the presence of optic nerve sheath hemorrhages. This study explores the practicality and accuracy of using high-resolution MR microscopy with an orbital surface coil as both an adjunct to traditional enucleated globe pathology procedures and a potential in-vivo diagnostic tool for optic nerve hemorrhage.

Materials and Methods

In this pilot study we identified nine deceased children (ages 1-40 months) following suspected non-accidental head injuries. Using a 7-Tesla MRI scanner and hemorrhage-sensitive T2* (star) sequences, we obtained high resolution images of ex-vivo globes and optic nerves. These images were interpreted blindly by two radiologists and compared with pathology findings. We also tested a prototype orbital surface coil for in-vivo acquisition of high resolution imaging of the optic nerve in volunteers.

Results: The results show high concordance between MR microscopy and traditional surgical pathology with agreement in 6 true positive and two true negative cases. MR was negative in one case of subtle hemorrhage noted at pathology. A prototype orbital surface coil at 3 Tesla was shown to provide satisfactory high resolution images of the optic nerve in volunteers.

Conclusion

This study supports the potential of high-resolution 7T MR microscopy to detect optic nerve sheath hemorrhages and to augment or possibly replace traditional autopsy procedures. A dedicated orbital surface coil in combination with 3 Tesla clinical MR magnets may allow detection of optic nerve hemorrhage in-vivo, allowing a more definitive imaging diagnosis of suspected pediatric non-accidental head injuries.

Key Words: Pediatric non-accidental injury, Optic Nerve Sheath Hemorrhage, MR Microscopy

V/1 The effect of radiographic expertise - Improving image acquisition on PMCT

Authors: Slot-Svendsen Knud¹, Larsen Sara Tangmose¹, Jacobsen Christina¹

¹ Department of Forensic Medicine, University of Copenhagen, Section of Forensic Pathology, Denmark

Introduction

The acquisition of PMCT scans at our institution was until recently based on bodyweight dependent standard protocols. The actual scans were performed by forensic technicians, with limited radiographic knowledge. The adaptation of parameters was performed utilizing the suggestions of the CT-scanner software based on dosage modulations. Image quality was generally estimated to be sufficient, serving the purpose of facilitating the planning of the forensic autopsy and possibly providing a preliminary cause of death. Since spring 2020, the PMCT scans have been performed by a radiographer. The aim of this study is to evaluate how the radiographic adaptations have improved image quality of PMCT scans.

Materials and Methods

Using a Siemens SOMATOM Definition AS 64-slice CT-scanner, three deceased were scanned using the previous bodyweight dependent standard protocol and the radiographically adjusted standard protocol.

The three whole body scans were performed focusing on the cerebrum and abdomen. Image quality of the PMCTs from these anatomical locations were compared regarding several parameters.

Results

The preliminary subjective visual difference on the PMCT scans in different anatomic locations as well as objective measurements show an improvement in image quality using radiographically adapted standard CT-scan protocols.

Discussion and Conclusion

Based on preliminary visual examinations as well as ongoing objective measurements, the use of radiographically adapted CT-scan protocols shows that image quality has improved and thereby may optimize the diagnostic opportunities of PMCT scans prior to forensic autopsies. Further evaluation of objective data are needed to confirm the improved image quality using radiographically adjusted standard protocols.

Keywords: Post mortem CT, Image quality, CT protocols

V/2 3D whole body spectral imaging in line with PMCT examinations

Authors: Kottner Soeren¹, Schulz Martin M.², Berger Florian¹, Thali Michael¹, Gascho Dominic¹

¹ Zurich Institute of Forensic Medicine, University of Zurich, Switzerland

² Institute of Forensic Medicine, Ludwig-Maximilians-University Munich, Germany

Introduction/purpose

Two-dimensional (2D) and three-dimensional (3D) external body documentation is commonly used to capture the visible part of the electromagnetic spectrum. Although multispectral photography is used for a wide range of applications in line with forensic investigations, it seems that, in this context, 3D multispectral imaging is not yet well known nor widely used.

Materials and Methods

A multi-camera setup in conjunction with a medical X-ray computed tomography (CT) scanner was used to conduct multispectral photogrammetry alongside whole body postmortem CT examinations. Multispectral imaging was done in the range between 365 and 960 nm. The multi-camera setup was based on four digital cameras, ultraviolet and near-infrared light sources as well as additional lens filters.

Results

Multiview 3D reconstruction based on multispectral image data from four example cases was carried out successfully. The overall quality of the 3D reconstruction varied in regards to the spectral range of the image data. Generally, ultraviolet-visual datasets improved the visibility of foreign substances on the skin and highlighted superficial bruising. Near-infrared datasets showed enhanced visibility of vein patterns and emphasized subcutaneous injuries and bruises.

Discussion and Conclusion

Multispectral imaging facilitates the detection of latent trace evidence and allows enhancing the visibility of findings. 3D whole body spectral imaging in line with PMCT examinations allows combining multispectral information from the external body documentation with radiological findings from the internal body documentation.

V/3 Local temperature estimation in postmortem muscle tissue by in situ magnetic resonance spectroscopy

Authors: Zoelch Niklaus^{1,2}, Heimer Jakob¹, Thali Michael¹, Gascho Dominic¹

¹Department of Forensic Medicine and Imaging, Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland

²Hospital of Psychiatry, Department of Psychiatry, Psychotherapy and Psychosomatics, University of Zurich, 8032 Zurich, Switzerland

Keywords: magnetic resonance spectroscopy; muscle; temperature; forensic radiology

Purpose: The objective of this study is to investigate the feasibility of local temperature estimation by in situ proton magnetic resonance spectroscopy (1H-MRS) in postmortem muscle tissue. The 1H chemical shift of water has an almost linear dependence on temperature and therefore allows for temperature measurements if referenced to a temperature-stable compound.

Methods: 24 decedents with different postmortem interval (range: 4 to 356 h) underwent 1H-MRS (3T). Single voxel measurements were performed in the vastus intermedius muscle and/or in the adductor magnus muscle of the left and right thigh. The local temperature was estimated based on the chemical-shift difference between water and creatine and using published calibration values.

$$TMRS = (\delta_{water} - \delta_{cre} - 2.0505) / -0.00999$$

Finally, the agreement between the temperature estimated by MRS (TMRS) and rectal body temperature (Trectal) was compared.

Results

The median difference between TMRS and Trectal was -0.63 (TMRS lower than Trectal). The differences ranged from 2 to -6.3 °C, two-thirds of all TMRS measurements were between ±2 °C. Larger differences were observed in cases of open fractures. There was no correlation between the PMI and the deviation between TMRS and Trectal. Only small deviations between TMRS measured in the left and right thigh were observed (median: -0.4 °C, max: 1.1, min: -1.2 °C).

Conclusion: In-situ 1H-MRS provides reasonable local temperature estimates in muscle tissue using creatine as reference over a wide range of estimated PMIs. This indicates that both creatine and water chemical shift are rather insensitive to pH and ionic strength fluctuations within the ranges encountered here.

V/4 High-resolution 7 Tesla MRI in forensic medicine

Authors: Gascho Dominic¹, Zoelch Nikolaus¹, Sommer Stefan², Tappero Carlo¹, Thali Michael¹, Deininger-Czermak Eva¹

¹ Institute of Forensic Medicine, University of Zurich, Switzerland

² Swiss Center for Musculoskeletal Imaging, Balgrist Campus, Switzerland

Introduction/Purpose

Recently, 7 Tesla (7-T) MRI scanner were approved for clinical use, which will facilitate access to these ultra-high-field MRI scanners for noninvasive examinations and scientific studies on decedents. 7-T MRI has the potential to provide a higher signal-to-noise ratio (SNR), a characteristic that can be directly exploited to improve image quality and invest in attempts to increase resolution. Therefore, evaluating the diagnostic potential of 7-T MRI for forensic purposes, such as assessments of fatal head injuries, was deemed essential.

Materials and methods

Two decedents with severe head injuries underwent a CT, 3-T, and 7-T MRI examination. The CT, 3-T and 7-T images were graded regarding the detectability and the delineation of microlesions, coup/contrecoup and shearing injuries using 3-point Likert scales.

Results

While on CT microlesions and small coup/contrecoup injuries were missed, they were detectable on 3-T and 7-T MRI. However, the 3-T images showed less delineated lesions in direct comparison with the 7-T images, thus the detectability and diagnostic confidence was improved on 7-T MRI.

Discussion and Conclusion

7-T images provided higher detectability of traumatic brain injuries and microlesions. However, it was able to determine the cause of death on all modalities. Certainly, the relevance of the higher resolution and the potential to identify even microlesion on 7-T promises a further development in forensic imaging. Despite the advantages, it has to be considered that 7-T scanner are only limited accessible, therefore it lacks practicability.

Keywords: Virtual autopsy, Brain injuries, Contrecoup injury, Magnetic resonance imaging

V/5 Importance of postmortem MRI of the brain for forensic practice

Authors: Makino Yohsuke¹, Kojima Masatoshi², Yoshida Maiko², Hoshioka Yumi², Tsuneya Shigeki¹, Inokuchi Go², Hattori Shinya³, Mukai Hiroki³, Yokota Hajime³, Iwase Hirotarō²

¹ Forensic Medicine, The University of Tokyo, Japan

² Legal Medicine, Chiba University, Japan

³ Radiology, Chiba University Hospital, Japan

Purpose

To evaluate the added value of brain postmortem MRI (PMMR) for practical use in forensic medicine compared to non-contrast postmortem CT (PMCT).

Materials and Methods

Forty-one consecutive forensic cases with PMCT, PMMR, and autopsy including detailed brain histopathology were reviewed. Cases were selected in which the causes of death associated with brain lesions were determined by board-certified forensic pathologists. The findings of PMCT and PMMR were compared and classified into the following three categories. Category 1, PMMR shows more detailed brain lesions associated with the cause of death than PMCT; Category 2, PMMR is equivalent to PMCT; Category 3, PMMR is inferior to PMCT.

Results

In total, 14 of 41 causes of death were associated with brain lesions. Of these, 6 (43%) were classified into Category 1, none into Category 2, and 8 (57%) into Category 3. The Category-1 findings included traumatic axonal injuries, cerebral contusions, hemorrhagic necrosis, old hemorrhage, necrosis related to carbon monoxide poisoning, and Wernicke's encephalopathy.

Discussion and Conclusion

There are already many articles dealing with PMMR, but most of them are aimed at replacing autopsy, and there are quite a few reports on the importance of supporting forensic practices. In this preliminary case series study, brain PMMR showed added values on forensic practices, revealing traumatic brain injuries, poisoning-related lesions or malnutrition. Routine PMMR can change forensic practices, as it is thought to be useful for routine screening of these normally hard-to-find but sometimes forensic important brain lesions.

Keywords: Postmortem MRI, Forensic pathology, Forensic medicine, Neuroradiology, Brain

V/6 Remote consultations in forensic anthropology and entomology: examples of conveniences and pitfalls in two cases

Authors: Guareschi Edda E.¹, Van de Goot Franklyn R.W.², Ziogos Stevie S.¹, Magni Paola A.^{1,3}

¹ Discipline of Medical, Molecular & Forensic Sciences, Murdoch University, 90 South Street, Murdoch, Western Australia 6150, Australia

² Department of Pathology, VU University Medical Centre, Amsterdam, The Netherlands

³ Murdoch University Singapore, King's Centre, 390 Havelock Road, Singapore 169662

Introduction/purpose

The recent pandemic has emphasized the global resorting to remote consultation which, in the last 20 years, has mostly been applied to clinical imaging. An extension to forensic imaging is soon to be expected. Two cases are presented here, with the aim of both highlighting the conveniences and the pitfalls of remote consultation in forensic anthropology and entomology, and of encouraging the discussion about the need of guidelines.

Materials and Methods

In the forensic anthropology case, two sets of apparently ancient human bones have been investigated, in order to assess the biological profile and the possible cause of death. In the entomology case, clothes associated with decomposing remains and colonized by insects were analysed, in the attempt to estimate the minimum post-mortem interval and the nature of the textile damage. The examinations were performed through remote consultation, and were based on discussion and photographs.

Results

The ancient human bones belonged to multiple individuals of both sexes; the distribution and the pattern of trauma pointed to widespread violence, with a likely fatal outcome. The evaluation of the damage on clothes was based on the knowledge of the nature of the clothing and the presence of insects typically found in such products.

Discussion and Conclusion

The remote consultations were essential to solving both forensic cases. However, some formal and substantial aspects proved challenging, including but not limited to, the legitimacy of the assignment, the liability of the consultant and the limitations of the provided documentation in asynchronous examinations.

Keywords: remote, consultation, forensic, anthropology, entomology

VI/1 The biggest shipwreck of the Mediterranean Sea as the basis for a multidisciplinary approach between pathology, anthropology and radiology in the evaluation of commingled skeletal remains

Authors: Amadasi Alberto¹, Mazzarelli Debora², Cappella Annalisa², Magli Francesca², De Angelis Danilo², Porta Davide², Cattaneo Cristina²

¹ Institute of Legal Medicine and Forensic Sciences of the Charité - Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin, Humboldt-Universität zu Berlin and Berlin Institute of Health, Germany

² Dipartimento di Scienze Biomediche per la Salute, LABANOF, Laboratorio di Antropologia e Odontologia Forense, Sezione di Medicina Legale, Università degli Studi di Milano, Italy

The shipwreck of April 18, 2015 is currently the largest mass disaster in the Mediterranean Sea since the Second World War. It thus represents an exceptional event due to the toll of human lives as well as for the recovery and identification procedures. A multidisciplinary approach was crucial for the collection of all anthropological antemortem data. Moreover, human remains underwent CT scans using an on-site mobile device. The experience demonstrated the crucial importance of radiological CT investigations (especially if supported by 3D reconstructions) in the context of mass disasters. In this case, however, the context was particular in the field of mass disasters, with such a large amount of remains within a small environment (the internal areas of a boat). This has led, given the considerable variability of the state of decomposition of the corpses, and the high amount of skeletonized remains, to a considerable commingling of bone remains. This situation has therefore greatly lowered the possibility of correctly identify bone remains. In particular, the study has shown that a fundamental contribution for identification purposes can be provided by TAC assessments, for example in the distinction between different individuals on the basis of the anatomical position inside the body bag, in the detection of personal effects, recognition of features (eg pathologies, bony calluses) with bone or soft tissue localization, detection and positioning of prostheses, recognition of anatomical structures for the reconstruction of the biological profile, possibility of carrying out centimeter measurements with greater reliability and repeatability compared to on-site measurements. Moreover, a 3D reconstruction of entire individuals or skeletal parts before they were subjected to forensic analysis and sampling has been of utmost importance.

Keywords: dead migrants, identification, biological profile, anthropology – radiology

VI/2 Personal identification using part-to-part comparison of L1-L5 vertebra from AMCT and PMCT scans

Authors: Decker Summer¹, Rutty Guy², Martin Daniel¹, Amoroso Jasmin², Biggs Michael², Ford Jonathan¹

¹ Radiology, University of South Florida, United States

² East Midlands Forensic Pathology Unit, University of Leicester, United Kingdom

Introduction

The confirmation of identification for an unknown individual is a critical part of forensic practice. The comparison of ante mortem imaging for the purposes of personal identification is a common tool in both odontology and radiographic comparisons. This study utilizes AMCT scans and compares them against PMCT scans.

Materials and Methods

As part of an ongoing project, University of Leicester acquired 14 matching ante mortem scans for individuals that passed through their facility for PMCT scanning. All scans were anonymized and sent to the University of South Florida for identification testing. Each scan was imported into the Mimics Innovation Suite v. 24. Each Lumbar vertebra was then isolated and modeled via segmentation and thresholding. Each series of 14 AM vertebra were registered with a target unknown PMCT derived vertebra. A part-to-part comparison was conducted for each vertebra and a match ratio was measured. A threshold of +/- 1 mm was set for the part comparison.

Results

Every unknown PMCT vertebra was correctly matched to the corresponding AMCT vertebra, signifying complete accuracy for this sample. A ROC curve was calculated to determine 100% sensitivity and specificity with a cutoff match ratio of 0.705. True identifications had an average match ratio of 0.943 +/- 0.539. Negative identifications had an average match ratio of 0.375 +/- 0.1.

Discussion and Conclusion

With the increase usage of post-mortem CT (PMCT) there is an equal increase in the availability and opportunity to utilize 3D tools, such as part-to-part comparison, for successful personal identification.

Keywords: PMCT, DVI, Personal Identification

VI/3 Standardized image acquisition and reporting in pediatric paleoradiology: interdisciplinary approach

Authors: Van Schaik Katherine¹, Tsai Andy², Liston Maria³

¹ Department of Radiology, Harvard Medical School, United States

² Department of Radiology, Boston Children's Hospital/Harvard Medical School, United States

³ Department of Anthropology, University of Waterloo, United States

Introduction/Purpose

This paper evaluates the use of paleoradiology techniques in the analysis of pediatric remains from bioarchaeological contexts and offers standardized, multi-modality protocols for the acquisition, evaluation, and publication of findings.

Materials/Methods

An interdisciplinary team of pediatric radiologists, anthropologists, archaeologists, and historians completed a literature search of three major bioarchaeological journals, PubMed, and the Yearbook of Mummy Studies, and supplemented this review with protocols and studies published in radiological journals.

Results

Although radiological techniques are used with increasing frequency in pediatric bioarchaeology studies, no standardized pediatric imaging acquisition and reporting protocols exist. In most cases, radiography is not used systematically, and when it is used, imaging acquisition parameters are not reported, compromising data interpretation. These issues of inadequate reporting and interpretation are especially acute for plain film radiography, the most frequently-used modality in archaeological contexts: use of plain film radiography without clear protocols and interpretive frameworks is problematic, as recent research (Spies et al. 2021) has demonstrated that interpretation of such films without adequate training leads to inaccurate assessments of findings.

Discussion/Conclusion

Based on imaging parameters published in the reviewed articles, as well as forensic and clinical imaging protocols, we propose acquisition and reporting protocols and best-practices guidelines that are specific for the paleoradiographic assessment of pediatric human remains. This is, to the authors' knowledge, the first literature review to focus exclusively on pediatric paleoradiology and the first proposal of imaging protocols tailored for the assessment of pediatric remains from bioarchaeological contexts.

Keywords: paleoradiology, pediatric, plain film radiography, imaging protocols, bioarchaeology

VI/4 Investigating the average thickness and density of the human neurocranium

Authors: Rowbotham Samantha¹, Mole Calvin², Tieppo Diana³, Blaszkowska Magda⁴, Cordner Stephen⁵, Blau Soren¹

¹ Human Identification Service, Victorian Institute of Forensic Medicine, Australia

² Division of Forensic Medicine and Toxicology, University of Cape Town, South Africa

³ Department of Forensic Medicine, Monash University, Australia

⁴ Centre for Forensic Anthropology, University of Western Australia, Australia

⁵ International Programs, Victorian Institute of Forensic Medicine, Australia

Introduction

Attempting to interpret the degree of force required to produce neurocranial fractures relies on understanding details about the event (extrinsic information) and the individual (intrinsic data). Whilst some of these variables may be available, the intrinsic variables of 'average' skull thickness and density are poorly understood and so cannot be accounted for; limiting interpretations of the degree of force. The aim of this study was to identify the average thickness and density of the bones of the human neurocranium.

Methodology

Thickness (mm) and density (Hounsfield units - Hu) were measured at 20 points across the frontal, left and right parietal, left and right temporal and occipital bones. Measurements were taken from post-mortem computed tomography head scans of 604 individuals. Descriptive statistics were applied to establish thickness and density means. Inferential statistics assessed how age, sex and ancestry influenced measurements.

Results

Mean thickness of the neurocranial bones ranged from 2.11mm (squamosal portion of the temporal bone) to 19.19mm (petrous portion). Mean density ranged from 77 Hu (mastoid process) to 1323 Hu (squamosal portion of the temporal bone). Statistically significant differences were noted in thickness and density between the variables of age, sex and ancestry.

Discussion/Conclusion

Findings will allow forensic anthropologists, pathologists and radiologists to identify when a neurocranial bone is abnormally 'thin' or 'thick', or of abnormally 'high' or 'low' density. Accounting for such intrinsic variables will augment and improve interpretations of degree of force in cases of blunt force neurocranial fractures.

Keywords: Neurocranial fractures, skull thickness, skull density, blunt force trauma, degree of force

VI/5 Multidisciplinary study of a South American natural mummy: a practical example of potential infectious disease of the central nervous system

Authors: Dedouit Fabrice^{1,2,3}, Mokrane Fatima Zohra^{1,3}, Guilbeau-Frugier Céline³, Savall Frédéric^{2,3}, Buscail Louis^{4,5}, Duranthon Francis³, Theves Catherine³, Crubezy Eric³, Berry Antoine^{6,7}, Rousseau Hervé¹, Telmon Norbert^{2,3}

¹ Radiology department, CHU Toulouse-Rangueil, 1 avenue Professeur Jean Poulhès, 31059 Toulouse, France

² Medico-legal department, CHU Toulouse-Rangueil, 1 avenue Professeur Jean Poulhès, 31059 Toulouse, France

³ Center for Anthropobiology and Genomics of Toulouse (CAGT, UMR 5288), 37 allées Jules Guesde, 31073 Toulouse Cedex, France

⁴ Université Fédérale Toulouse Midi-Pyrénées, Université Toulouse III Paul Sabatier, INSERM, CRCT, 31330 Toulouse, France

⁵ Department of Gastroenterology and Pancreatology, Toulouse University Hospital, 31059 Toulouse, France

⁶ Infectious & Tropical Diseases Service, CHU de Toulouse, place du Dr Baylac, 31300 Toulouse, France

⁷ UMR1043, Inserm, 31300 Toulouse, France

Introduction

A South American child mummy, discovered in a Colombian cave, and exposed at the Natural History Museum of Toulouse (France) was investigated by a multidisciplinary team in the Toulouse University Hospital, to undergo PMCT and transcranial endoscopic investigation. The aim of this study was to document a potential central nervous system disease (CNS) and extract biological samples for analysis.

Material and methods

External examination of the mummy, and PMCT were performed to detect any elements to determine cause of death, any paleo-pathological abnormalities, estimate age at death, and confirm the process of mummification. Due to imaging cerebral abnormalities, transcranial endoscopic exploration, cerebral samples of tissues were performed (with histological and bio-molecular analyses).

Results

External examination: very young mummified female, curled up on herself, with an intentional cranial deformation. No trauma stigmata was visible.

PMCT: radiological aspect was consistent with a natural mummification, and a potential infectious process of the CNS because of numerous calcified millimetric lesions observed in the remaining brain parenchyma and meninges. Such calcifications are nowadays secondary to TORCH syndrome, cysticercosis, and tuberculosis. Bone age was consistent with 1.9 years old; dental analysis, between 1.7 and 2.5 years old.

Complementary investigations on endoscopical cerebral samples: HES coloration revealed meningeal areas of spots of circular birefringent microcalcifications; PCR focused on the *Taenia solium* was inconclusive.

Discussion/Conclusion

Several hypotheses were possible concerning the micro calcification origin: a neurocysticercosis or other CNS calcifying conditions (parasitosis as hookworm and whipworm or eventually other bacterial, viral, or fungal diseases).

VII/1 The roles of the forensic radiographer in Finland

Author: Fox Marttinen

- Introduction to Finland and Forensic Imaging
- Suspected Physical Abuse
- Age Assessment
- Trafficking
- Post-mortem Imaging
- DVI Finland

Within the forensic field there are different approaches to how forensic radiology / imaging is used and legally embedded.

The approach depends on different legal systems, traditions, financial resources, applicant, case load, accessibility to scanners, ambition level field etc.

The above results also the difference in the interpretation of the role "forensic radiographer". In one country it remains "only" to perform imaging such as conventional radiology and CT, in another country the role of forensic radiographer is supplemented to do interventions such as PMCTA, PMVCT, taking biopsies, reporting, doing research, etc.

Eg. In one country a role of forensic radiology consultant has even been added to bridge the gap between the forensic radiology unit and the police / the public prosecution service, this has to do with how radiology is used within the legal system as a forensic tool in the early phase of a death investigation.

In order to get a better overview and understanding of all the difference interpretations of the role, we would like to give an overview with their advantages and disadvantages.

VII/2 The roles of the forensic radiographer in Denmark

Author: Pedersen Christina Caroe Ejlskov¹

¹ Department of Forensic Medicine, Aarhus, Denmark

Introduction

The first Danish radiographer started dedicated forensic development, by working part time at the Department of Forensic Medicine in August 2017 and has now gradually moved up to a full time position. However, forensic imaging in Denmark is not a new area in living cases but the deeper involvement in the deceased cases still has a large focus regarding expansion and further development.

Material and Methods

Over a period of time it was tested to see what a radiographer could provide of knowledge and quality improvement to forensic imaging at a Danish department of forensic medicine. All imaging was performed by forensic technicians, who by education had no prerequisites to a deeper understanding of imaging acquisition, besides the instruction from the different vendors. The radiographer's focus involved; performing conventional x-ray, creating/editing CT-protocols, assist when performing PMCTA, evaluate PMCT-scans along with performing research scans on animals, artefacts and humans.

Results

The role of the forensic radiographer expanded rapidly along with the eye for the possibilities provided by having a professional insight to the imaging equipment and the task involving working with imaging modalities. This including advanced visualization techniques, radiation protection, PACS and the expansion of external research collaborations.

Conclusion

The forensic radiographer's qualifications are of great value to forensic medicine and the development of the sub-special. This involves simple things as positioning and parameter settings to more specialized procedures when e.g. examining different and rare specimens or evaluating CT scans and performing advanced 3D visualization and segmentation.

Outline of presentation

- Forensic Radiography in Denmark, nationally and locally
- Creating a new sub-speciality for radiographers – past and future
- PMCT scan protocols and evaluations
- 3D visualization
- External collaboration partner

VII/3 The roles of the forensic radiographer in Australia

Author: Buxton Anthony¹

¹ANZ-IAFR

A brief snapshot of the forensic imaging available in Australia before elaborating on the role of the radiographers in the NSW Health Pathology Forensic Medicine service. All services are state based facilities, usually located in the capital cities.

NSW is unique in that we have 3 sites, and the primary role of the radiographer is to provide impressions of the PMCT's undertaken by the service. We do provide imaging support at the major centre in Sydney and both imaging and impressions at Newcastle, which has a smaller case load. Most cases presenting at the coronial service have a PMCT and less than 5% have radiology reports, however all PMCT's are provided with a radiographer impression.

The focus of the presentation will be the role of the radiographer in providing PMCT impressions to assist the forensic pathologists manage cases. The work we do is recognised by the National Registration Authority (MRPBA) as an expected skill capability of radiographers.

VIII/1 The roles of the forensic radiographer in the UK

Authors: Robinson Claire¹ & Lee Brookes Amy²

¹University Hospitals of Leicester NHS Trust

²IAFR

Post mortem imaging in England differs from many other countries because of the legal system. Forensic radiography, as in other countries, is part of a suspicious death investigation by the police investigation. In England and Wales, these cases constitute less than 1% of the over 80,000 people referred for a post mortem examination each year. The majority are non-suspicious deaths that have to be investigated by a coroner to determine how and why death occurred.

Post mortem imaging services were established in Leicester in 2001 and Preston in 2018 and are now replacing non-suspicious autopsy with CT scans. These services will be explained to provide an insight into post mortem imaging in England.

VIII/2 The roles of the forensic radiographer in Switzerland

Author: Dominguez Alejandro¹

¹ HESAV CURML

- Postmortem imaging in Lausanne/Geneva context
- Debut and tasks/activities of the forensic radiographer in legal medicine
- Research and trainings for bachelor students degree
- Personal opinion

VIII/3 The roles of the forensic radiographer in Japan

Author: Kobayashi Tomoya¹

¹ Ibaraki Prefectural University of Health Sciences

The number of postmortem imaging (PMI) examinations has been rapidly increasing in Japan. PMI in Japan is often utilized for screening death causes in certain situations, including for bodies arriving in emergency rooms in a state of cardiopulmonary arrest, deaths occurring during hospitalization, official police inquests into abnormal deaths, and to serve as a guide for subsequent conventional autopsy as presented at IAFR webinar 5 (October 2018). Due to growing use of the postmortem imaging examination, laws have recently been revised to facilitate death-cause detection in Japan and The Basic Law to Promote Cause-of-Death Investigations was enacted in April 2020. As PMI examinations are now widely-accepted as playing important roles in general hospitals in Japan, PMI is recognized as one of the essential jobs of a radiological technologist (RT).

I plan to discuss current roles of RTs in the processes of performing precise and accurate PMI, organizational aspects of PMI examination systems in hospitals, questionnaire survey results regarding COVID-19 prevention for PMI, and recently reported PMI studies by Japanese RTs.

IX/1 A comparison of post mortem computed tomography and external examination of the neck in suspected hanging cases

Authors: Chew Danielle¹, Cassella John², Kralt Peter³, Barkley Andrew⁴

¹ Law, Policing and Forensics , Staffordshire University , United Kingdom

² Forensic Investigation and Analytics , Sligo Institute of Technology , Ireland

³ Post-mortem Radiology , iGene , United Kingdom

⁴ Her Majesty's Coroners Service , United Kingdom

Post mortem Computed Tomography (PMCT) in the 21st century has become an integral feature in forensic medicine. Hanging is the most common method of suicide in the United Kingdom, peaking amongst those aged 45-54 years. This study examined the two methodologies at post mortem to determine if they were complimentary in identifying the cause of death in suspected hanging cases. This study examined 19 cases (mean age, 44) between January and August 2020 at the iGene CT facility in the Coroners mortuary in Stoke-on-Trent. Retrospective images produced using a 'Siemens SOMATOM go. All CT' scanner in a range of different parameters (e.g. KV, pitch, rotation time, slice thickness (mm), increment (mm), Kernel and window were evaluated. Post mortem reports from the external examinations at the Coroners mortuary were anonymised and made available for analyses in comparison to the PMCT data. Tabulated parameters of the written statements as qualitative data were generated and evaluated using descriptive statistical analyses. There are case examples where PMCT is the superior methodology in identifying and interpreting fracture of the hyoid bone where post mortem external presentation showed inconsistencies. From the data available from the 19 cases in 2020, this suggests that PMCT is complimentary to the current conventional method of the external post mortem examination to more confidently identify neck trauma in suspected hanging cases. The documentation and clinical terminology used in reporting post mortem neck trauma findings requires the development of best practice guidelines to make reporting more consistent.

IX/2 Exploring metabolic changes in post-mortem muscle tissue by in-situ magnetic resonance spectroscopy

Authors: Gascho Dominic¹, Heimer Jakob¹, Thali Michael J.¹, Zoelch Niklaus¹

¹ Zurich Institute of Forensic Medicine, University of Zurich, Winterthurerstrasse 190/52, 8057 Zurich, Switzerland

Keywords

magnetic resonance spectroscopy; time since death estimation; postmortem interval; postmortem biochemistry; virtopsy

Introduction/purpose

In situ magnetic resonance spectroscopy (MRS) is an analytic method to study metabolic changes in tissues and fluids. The purpose of exploring the metabolic changes in human muscle tissue using hydrogen MRS was of academic interest to provide a postmortem basis for further research in this field and was of practical interest to assess if this method might serve as potential measuring tool in time since death examinations.

Materials and Methods

The study population consisted of 43 decedents, who were subjected to single voxel MRS. Single voxel measurements were performed in the vastus intermedius muscles (VIM) and in the adductor magnus muscles (AMM). The ratio between trimethylammonium-containing compounds (TMA) and the methyl group of creatine (cre) served as index value for the comparison with the postmortem interval (PMI) in this study.

Results

A multiple linear regression was calculated to predict TMA/cre ratio based on PMI, age, body temperature and muscle type and orientation. A significant regression equation was found ($F(5,77)=48.47$, $p<2.2e-16$), with an R^2 of 0.76. PMI was a significant predictor of TMA/cre ($p<0.001$). The influence of temperature was marginal.

Discussion and Conclusion

The study presents a PMI-dependent alteration of metabolite concentrations in muscle tissue, which paves the way for further research. The thoroughly researched method depending on temperatures and body weight serve as basic method for PMI estimation but this method lacks precision with increasing PMI. So far, additional muscle-dependent methods serve as supplemental method only in the early PMI stage. While a MRS-based method might serve as supplemental method for the advanced PMI stage.

IX/3 Imaging findings of contraband smuggling in 2021

Author: Daly Barry¹

¹ University of Maryland, United States

Introduction/Purpose

The purpose of this paper is to describe the recent evolution of newer formulations and packaging of concealed illegal drugs or other forms of contraband and recent advances in imaging techniques for detection.

Materials and Methods

Review of current concealment techniques in body packers, pushers, and stuffers. Compare sensitivity of concentrated cocaine in liquid form on radiography and CT imaging. Compare sensitivity of newer less radio-opaque packaging on radiography and CT imaging. Evaluate detection sensitivity of imaging for synthetic opioids.

Results

The recent development of liquid forms of cocaine that simulate fecal residue on X-ray, the transportation of smaller volumes of highly potent synthetic opioids and more radio-lucent packaging have made plain radiographs increasingly insensitive for detection of concealed contraband drugs. CT continues to have a high sensitivity for detection and characterization of such contraband, especially with the use of extended window settings, 3D volume rendered or surface shaded techniques, and dual energy index measurements.

Discussion and Conclusion

Conventional detection using radiography is no longer adequate for concealed contraband in the rapidly changing setting of liquid cocaine, very concentrated synthetic opioids and thinner radiolucent packaging. CT remains a valuable tool with a high sensitivity for detection and characterization of such contraband. However its restricted availability is a major limitation and barrier to its widespread use.

Keywords

Contraband, CT imaging, Radiography

IX/4 Personal identification using post-mortem CT image corresponding to periodontal disease examination

Author: Fujimoto Hideko¹

¹ Kyoto Forensic Odontology Center, Japan

Introduction/purpose

For personal identification using post-mortem (PM)-CT image analysis, objective evaluation is essential.

In this time, the analysis using the alveolar bone images was proposed as a new periodontal disease examination. The purpose of this study was to examine the effect of changes in alveolar bone resorption over time on identification.

Materials and methods

Periodontal disease images data

Five patients' clinical panoramic X-ray images to examine the alveolar bone resorption were used. These were 10 images taken by each person from 19 to 26 years over time.

Control data

316 CT image data and 317 panoramic X-ray data obtained by personal identification method was used. These images have 135 pairs of the same person.

Panoramic X-ray images of patients with periodontal disease were examined by alveolar bone identification method. The effect of over time was investigated in comparison with the control data.

Results

Four persons did not change significantly, and one person changed slightly over time on alveolar bone resorption data.

All data had no effect on screening results for 135 pairs data.

Discussion and Conclusion

The CT images play a role in personal identification as well as DNA, fingerprints, and dental findings. The alveolar bone identification method is based on the top and bottom of alveolar socket. The bone resorption in periodontal disease is indicated by changes in the top position of alveolar socket.

This method contributes not only to clinical examination but also to personal identification.

Keywords

Personal identification, Periodontal disease, Bone resorption, Panoramic X-ray image, CT image,

IX/5 Anatomical variability of the maxillary sinus and their application in human identification

Authors: Dorota Lorkiewicz-Muszyńska^{1,2}, Julia Sobol¹, Filip Laskowski³

¹Department of Forensic Medicine, Collegium Medicum, Zielona Gora University

²Department of Forensic Medicine, Poznan University of Medical Sciences

³Department of Radiology, Multispeciality Hospital in Nowa Sol

Introduction

Maxillary sinus is a pyramidal pneumatized cavity in the body of the maxilla. It is anatomical structure with highly variable morphology. The size and shape of the sinus varies in different skulls and even on the two sides of the same skull. Anatomical descriptions of the maxillary sinus may be of great forensic identification importance.

Materials and Methods

The sample consisted of 124 CT scan images (248 maxillary sinuses) from a modern Polish population. 66 subjects were male and 58 subjects were female. Ages ranged from 18 to 78 years (mean age 52.5 for males and 57 for females). Three diameters were obtained: maximum transverse (horizontal) diameter called MSW, maximum vertical diameter called MSH, and maximum anteroposterior diameter (length) called MSL. 3D reconstructions of the maxillary sinus were produced using semi-manual segmentation in the 3D Slicer and the volume was calculated automatically by the software.

Results

The mean of the maximum transverse (diameter (MSW), maximum vertical diameter (MSH), as well as the volume of the right and left maxillary sinuses showed a statistically significant difference between males and females. The current study of a modern Polish sample found a mean maxillary sinus volume of 23.45 cm³ in males, ranging from 11.61 to 29.4 cm³, and a mean volume of 15.754 cm³, ranging from 5.41 to 26.42 cm³ in females. Analyses of the 3D reconstructions of the maxillary sinus disclosed high variability of their morphology in the shape and septa in different skulls.

Discussion and conclusion

The present study explores the anatomical and anthropometric variability of maxillary sinuses and their potential use in the forensic identification process. The study of morphometric characteristics is of fundamental importance to solve problems related to identification. Three-dimensional CT image analyses may provide useful information about maxillary sinus during identification process.

Keywords

Maxillary Sinus, CT, Segmentation, Human Identification

IX/6 Forensic face reconstruction based on postmortem computed tomography

Authors: Barszcz Marta^{1,2}, Woźniak Krzysztof²

¹ Department of Forensic Medicine and Doctoral School of Medical Sciences and Health Sciences, Jagiellonian University Medical College, Poland

² Department of Forensic Medicine, Jagiellonian University Medical College, Poland

Introduction

The results of forensic facial reconstruction are increasingly used not only as museum exhibits, but also for the purposes of human identification. There are two main approaches: (1) the manual method using clay or wax, which is a conventional three-dimensional method, and (2) digital facial reconstruction using a computer, which can be presented in both 3D and 2D. The database for the second method is based on the results of acquisitions using computed tomography, magnetic resonance or laser scanning.

Materials and Methods

Two cases of forensic facial reconstruction based on PMCT of previously identified bodies are presented: adults approximately 40 years old and 70 years old. Both skulls were visualized using the Volume Rendering Technique (VRT), based on an acquisition performed as part of a routine examination at the Department of Forensic Medicine using the Siemens Somatom Emotion 16 scanner. Graphic data was created using OsiriX v.5.5.1 and Gimp 2.10.22 software.

Results and Discussion

A comparison of forensic facial reconstructions with actual photos of the deceased is presented. The advantages and disadvantages of this method are discussed, including the issue of presenting the face reconstruction of the deceased with eyes closed or open.

Keywords: forensic imaging, facial reconstruction, PMCT, forensic anthropology, identification process.



[Archives of Forensic Medicine and Criminology](#)

