

Coronavirus Pandemic

COVID-19 pandemic: a reminder to develop forensic radiology facility

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Abstract

COVID-19 outbreak has resulted in a substantial morbidity and mortality, and has put the health system under tremendous stress. A need for devising and adopting newer methods and techniques is being emphasized in the healthcare facilities to combat the effects of the SARS-CoV-2. Besides patient care, focus needs to be laid on the effective and dignified management of the deceased and medico-legal services provided by the hospitals and medical institutions during the COVID-19 pandemic. Considering the likelihood of forensic experts and autopsy personnel being exposed to SARS-CoV-2 inadvertently during the autopsy, it is recommended to resort to safer and minimally invasive techniques of postmortem examination of the dead. In this regard, employing radiological techniques for postmortem examination appears to be a promising option during the COVID-19 pandemic. An inherent advantage of postmortem radiography over conventional autopsies is the minimization of the risk of transmission of infection to the health care workers. Our correspondence highlights on the possibility of using radiological facilities as an effective replacement of high-risk conventional autopsy procedures during the COVID-19 pandemic.

Key words: SARS-CoV-2; COVID-19; pandemic; autopsy practices; forensic radiology.

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Introduction and background

The COVID-19 pandemic has brought the world virtually to a standstill, and has made each one to look for ways to protect oneself as well as others. Advisories have been issued to the lay public as well as the health care workers so that necessary precautions are taken, and infection prevention and control measures are followed to prevent transmission of infection. The health sector, in particular, is under tremendous stress, with the ever rising morbidity and mortality due to COVID-19, each passing day. The need for devising and adopting newer methods and techniques is being emphasized in the health systems to combat the effects of the SARS-CoV-2. In many parts of the world, hospitals have been designated to specifically deal with COVID-19 cases. Many hospitals have restricted the patients' visits to the hospital unless extremely essential and telemedicine services have been introduced to address the cause of patients.

COVID-19 outbreak by far has resulted in more than 5 million deaths globally [1]. Health care workers, who have been considered as the most vital asset in these trying times, are particularly at risk of being infected with the virus. In such a scenario, hospital administrators have a dual role to play; they have to explore new avenues so that the health care services are not compromised, and ensure that safety and interests of health care workers and the patients are well-protected. The same applies to effective management of the dead and medico-legal services provided by the hospitals and medical institutions. However, increasing number of deaths, compounded with limited expertise, infrastructure and protective equipment is bound to affect those providing medico-legal services, especially those conducting medico-legal autopsies [2].

Forensic autopsies during COVID-19 outbreak

SARS-CoV-2 is a HG-3 pathogen that poses considerable risk of infection to those carrying out

autopsies on COVID-19 confirmed and suspected deceased. The high risk of infection is owed to the fact that healthcare workers are exposed to infected body tissues, fluids, and aerosols generated during autopsy. In order to protect the health care workers, it is recommended in most set-ups to avoid medico-legal autopsies on COVID-19 cases, where ever possible [3]. The very fact that COVID-19 deaths are considered as natural deaths, justifies their exemption from forensic autopsies. However, this may not be the case always, as in umpteen number of suspicious and non-natural deaths, the deceased might be harbouring SARS-CoV-2. The laws of the land necessitate forensic autopsies in such cases, and the possibility of forensic experts and support staff being exposed to the novel coronavirus becomes inevitable. A similar situation arises in medico-legal investigations of unidentified or unclaimed deaths, with no available history of COVID-19 symptoms or test reports. Considering the likelihood of forensic experts and autopsy personnel being exposed to SARS-CoV-2 inadvertently during autopsy, it is recommended to resort to safer and minimally invasive techniques of postmortem examination of the dead. In this regard, employing radiological techniques for postmortem examination appears to be a promising option during the COVID-19 pandemic.

Forensic radiology; its current status in medico-legal investigations

Forensic radiology is a branch of radiology that utilizes the radiological services for the courts and/ or the law enforcement agencies in order to aid in the administration of justice [4]. Radiological examinations may involve the use of X-rays, fluorescent images, ultrasonography, computed tomography (CT), computed axial tomography (CAT scan), Magnetic Resonance Imaging (MRI), etc. Although the significance of forensic radiology is well-established, its use in medico-legal scenario is limited in most parts of the world, especially in the developing countries like India due to the cost, expertise, and infrastructure required to carry out the radiological procedures. As of now, the forensic radiology services are mostly utilized for age estimation, and in assessment of the severity of injuries sustained in the living in cases of trauma, child abuse, etc. Whereas, in the deceased, forensic radiological services are sought in fatalities involving firearm prior to conducting post-mortem examination to locate the projectile in the body. In the aforementioned cases too, the radiological investigations are limited to the use of X-rays. In all such medico legal cases, hospital services are utilized for forensic purposes, as

the majority of the centers do not have dedicated radiological facilities for the forensic departments.

Forensic radiology; its scope in post-mortem examinations

Autopsy on a COVID-19 confirmed deceased is considered a high-risk procedure [3]. In the conventional post mortem examination, the body cavities are opened and organs are subjected to examination. Direct exposure to the lungs, other body tissues, body fluids, and bone dust, pose a severe risk of transmission of the disease to those involved in the procedure. But with the use of post-mortem radiology, this exposure can be prevented; thereby minimizing the chances of healthcare personnel involved in autopsy from getting infected.

Virtual autopsy; comprising of computed tomography (CT) and magnetic resonance imaging (MRI) based post-mortem evaluation is considered as a valuable technique in post-mortem examinations during COVID-19 outbreak [5]. Post-mortem CT has been used to demonstrate early changes of post mortem lividity [6], as well as late changes of putrefaction [7,8]. Despite of the numerous indispensable applications and advantages of virtopsy in post-mortem examinations [7,9], it is yet to establish itself in routine practice. Probably because, virtopsy involves a complex procedure that requires dedicated on-site facilities of CT and MRI along with the expertise. While carrying out postmortem CT and MRI is a more tedious affair that requires sophisticated equipment and expertise, portable X-rays and ultrasound devices can be considered as easy to use and cost-effective alternatives during COVID-19 outbreak for forensic purposes.

Radiological investigation can be very useful during medico-legal autopsies in visualising the injuries specially the fractures, foreign bodies like the projectiles, gas embolus, as well as in assessing their severity. Even when medico-legal autopsy is mandated, full body radiology prior to autopsy, can reveal the possible areas of interest, which then can be subjected to detailed post-mortem examination. This can have wider implications during the COVID-19 outbreak. Radiology can be a valuable tool in detection of natural deaths like the pneumothorax, pneumo-peritoneum, air embolism, etc. which might even be missed during a conventional medico-legal autopsy. Ultrasonography (USG) is another useful post-mortem imaging modality that has been suggested as an adjunct to cut down the need for conventional autopsies [10]. Post-mortem USG has been shown to have a promising role in post-mortem detection of cardiac hypertrophy, aortic

aneurysm, pericardial tamponade, pleural effusions, intra-abdominal bleeding, liver pathology, bile stones, renal cysts, intracranial haemorrhage in infants, etc. [11,12]. Fluoroscopy, often termed as a live X-ray technology, is a technique similar to an X-ray wherein instead of a photographic plate, the photon beam is detected on a fluorescent screen and photocathode. Here, the images are projected on a display monitor hence allowing real time examination. Fluoroscopy is being routinely used in orthopaedic surgery, and the same might be helpful in post-mortem cases too. SARS-CoV-2 primarily affects the lungs, and CT scans are widely used during COVID-19 pandemic to diagnose the pulmonary pathology and its extent. CT scan can also be used in diagnosing cases of suspected COVID-19 to avoid chances of infection to the health care workers in the mortuary. CT scanning is always a better modality for the diagnosis for COVID-19 than the X-rays. But the use of CT scan has not been put to regular use in post-mortem cases due to the cost efficiency especially in the developing countries. In a nutshell, CT scan should be preferred to X-ray for diagnosis of COVID-19 in post-mortem cases whenever possible. Schweitzer *et al.* discussed a case where CT scan was used during post-mortem examination in a COVID-19 confirmed patient [13].

Besides, radiology has a well-established role in the forensic identification of the unidentified bodies and remains. With computerization of medical records, the retrieval of radiological films has become easier and hence, comparison of ante-mortem and post-mortem films can be done to ascertain the identity of missing individuals. Post-mortem radiology thus, has a role in the process of Disaster Victim Identification (DVI) too. In view of the above, forensic radiology most certainly has a promising role in medico legal investigations during COVID-19 pandemic. Forensic radiology services may be utilized in other infectious diseases such as the Ebola virus disease, rabies, etc. in future.

Conclusions

It would not be incorrect to state that, the utilization of forensic radiological facilities in medico-legal practice is grossly underutilized. An inherent advantage of postmortem radiography over conventional autopsies is the minimization of the risk of transmission of infection to the health care workers. Thus, during the COVID-19 pandemic, radiological facilities can be used as an effective replacement to high-risk conventional autopsy procedure.

Considering the immense utility of post-mortem radiological investigations, COVID-19 is certainly a

reminder to step up our approach in shifting our focus to minimally invasive and safer techniques of post-mortem examinations. It not only safeguards the health workers involved in high-risk autopsy procedure, but also ensures minimal mutilation of the dead body. COVID-19 should be considered as an opportunity to develop forensic radiology facilities as part of our preparedness for the future too.

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References

1. Worldometer (2021) Coronavirus Update. Available: <https://www.worldometers.info/coronavirus/>. Accessed: 22 June 2021.
2. Kanchan T, Saraf A, Misra S (2020) COVID-19 outbreak: a testing time for medicolegal facilities in India. *J Indian Acad Forensic Med* 42: 1-2.
3. Ministry of Health and Family Welfare, DGHS (EMR Division) (2020) COVID-19: Guidelines on dead body management. Available: https://www.mohfw.gov.in/pdf/1584423700568_COVID19GuidelinesonDeadbodymanagement.pdf. Accessed: 14 April 2021.
4. Thali MJ, Viner MD, Brogdon BG (2010) Brogdon's forensic radiology. 2nd Edition. London: CRC Press 654 p.
5. Kanchan T, Saraf A, Krishan K, Misra S (2020) The Advantages of virtopsy during the Covid-19 pandemic. *Med Leg J* 88 Suppl 1: 55-56.
6. Shiotani S, Kohno M, Ohashi N, Yamazaki K, Itai Y (2002) Postmortem intravascular high-density fluid level (hypostasis): CT findings. *J Comput Assist Tomogr* 26: 892–893.
7. Thali MJ, Yen K, Schweitzer W, Vock P, Boesch C, Ozdoba C, Schroth G, Ith M, Sonnenschein M, Doernhoefer T, Scheurer E, Plattner T, Dirnhofner R (2003) Virtopsy, a new imaging horizon in forensic pathology: virtual autopsy by postmortem multislice computed tomography (MSCT) and magnetic resonance imaging (MRI)—a feasibility study. *J Forensic Sci* 48: 386–403.
8. Thali MJ, Yen K, Schweitzer W, Vock P, Ozdoba C, Dirnhofner R (2003) Into the decomposed body—forensic digital autopsy using multislice-computed tomography. *Forensic Sci Int* 134: 109–114.
9. Dirnhofner R, Jackowski C, Vock P, Potter K, Thali MJ (2006) VIRTOPSY: minimally invasive, imaging-guided virtual autopsy. *Radiographics* 26: 1305-1333.
10. Kanchan T, Shrestha R, Krishan K (2021) Post-mortem ultrasonography: a safer alternative to autopsies in COVID-19 deaths. *J Ultrasound* 24:577-578.
11. Uchigasaki S, Oesterhelweg L, Gehl A, SPerhake JP, Puschel K, Oshida S, Nemoto N (2004) Application of compact ultrasound imaging device to postmortem diagnosis. *Forensic Sci Int* 140: 33–41.

12. Uchigasaki S (2006) Postmortem ultrasound imaging in forensic pathology. In: Tsokos M. Editor. *Forensic Pathology Reviews*. Volume 4. New Jersey: Humana Press. 405-412.
13. Schweitzer W, Ruder T, Baumeister R, Bolliger S, Thali M, Meixner E, Ampanozi G (2020) Implications for forensic death investigations from first Swiss post-mortem CT in a case of non-hospital treatment with COVID-19. *Forensic Imag* 2020: 200378.

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