

REVIEW ARTICLE

Virtual Autopsy and Digitalization of Medico-legal Records: A Need in Covid Era

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Abstract:

Post-mortems are done as a tool in proceedings of medico-legal cases. Autopsy exposes the forensic medical practitioners to body cavities, underlying organs and biological fluids that may be major sources of contamination, especially during the pandemic era. Since death tolls have been higher during these times, to prevent spread of viral infections, post-mortem services had been completely halted. Virtual autopsy examinations were then considered by Forensic Medical experts throughout the world during the Covid outbreak and stands as an important future tool in the post-covid era too. Also, documents pertaining to medico-legal examination needs to be handled with integrity and ethics, which prompts its digitalization. This paper aims to study the risks encountered by forensic medical practitioners while conducting death investigations, techniques of virtual autopsy, its legal admissibility, online portals for maintaining reports, their current scenario and future prospects.

Keywords: Virtopsy; SARS-Covid 2019; Medico-legal reports; Digitalization.

Introduction:

During the early months of 2020, a new form of pneumonia called COVID-19 caused by the novel coronavirus SARS-CoV-2 had broken out throughout the world. India has noted millions of cases till February 2022. The death toll also has been high during the initial outbreak followed by its different variants. The World Health Organization had declared COVID-19 to be a pandemic due to its high rate of infection. Health-care personnel, who were seen as the most precious resources in such difficult moments, were extremely vulnerable to infection. In this situation, hospital management must assure that the health and interests of health-care personnel and patients are not jeopardized along with continuous maintenance of health-care services. The same can be said for competent death management and medico-legal services. However, an increase in the number of deaths, combined with a lack of experience, infrastructure, and protective equipment, will inevitably affect Forensic medical practitioners while conducting autopsies. Evidence suggested that the Covid pandemic also contributed significantly in delayed medical care of affected persons and increased suicides, drugs and alcohol associated deaths.¹ During the onset of COVID-19 the rate of Covid infected un-natural death had increased significantly and due to the lack of awareness while dealing with virus infected bodies, the Forensic medical practitioners were in a difficult situation. At first the autopsy staff doesn't know the accurate health condition and travel history of the deceased. Further, a few infected people are asymptomatic, so their examination is also doubtful. Studies have shown the survival of this virus at lower temperatures; thus, chances of contamination were higher during cryopreservation.

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Article History

DOR : 22.07.2022 DOA : 29.03.2023

During autopsy, the mortuary staff and doctors are subjected to infected body tissues, fluids, and aerosols from the bodies of SARS-CoV-2 infected diseased which is a HG-3 pathogen and causes serious threat of infection.² The Indian medical system's guideline regarding autopsy of infected deceased states that death of a person due to COVID-19 in the hospital under medical treatment would not be considered as a medico-legal case, hence autopsy would not be required. But, brought dead cases suspected to be COVID-19 positive, to the hospital has to be essentially treated as a medico-legal case as it may be suicidal, homicidal or accidental. In such cases a medicolegal autopsy is required.³ An RTI revealed that in 57% reported unnatural deaths, autopsy was not conducted during March-August 2020 in Nagpur (Maharashtra).⁴ Almost the same situation was faced in all other states of India during 2020 and 2021 and may be again faced in near future due to recent outbreak of Monkey virus.

The Italian National Institute of Health and other health institutions worldwide have advocated the limitation of body dissections in ascertained and particularly in suspected SARS-COV-2 cases to limit the risk for the operators. The high number of bodies to examine and the high risk for operators are the reasons why there is a reduction in the rates of autopsies on SARS-COV-2 infected subjects.⁵ With the ever-changing viral strains, and emergence of a new variants termed as Deltacron, which is found to be rare and similar to the Omicron strain, Monkey Pox etc. there is an increased need of virtual autopsy using minimal intervention without compromising the accuracy of diagnosis.

All aspect of modern medicine is now heavily reliant on technology. Health organizations in India have digitised medical data to save money, improve security, and, most crucially, improve access to information. Despite the fact that most branches of modern medicine have absorbed technological advancements, most departments of forensic medicine appear to be trailing behind. Many medicolegal reports, such as autopsy reports, wound certificates, age estimation reports, opinions

regarding rape or assault, requests to forward the samples to the Forensic Science Laboratory, summons to experts and witnesses for deposing evidence in courts, requisitions from police, and so on, are still written by hands and photocopies of the same are commonly submitted in a court of law. Poor writing or photocopies might make it difficult to comprehend reports, resulting in interpretation errors.⁶

Virtual autopsy: Current Scenario

The word “VIRTOPSY” was designed from two words “virtual” which was further derived from the Latin word “Virtus” meaning 'useful, efficient and good' and “autopsy” derived from the Greek word “autos-opsomei” meaning 'self-I will see'. It is a development in the field of modern Forensic Medicine, where imaging technologies and computed tomography is being used to obtain a three-dimensional view of the deceased using techniques like PM-MSCT, MRI, Radiography and so on. Virtual autopsy is defined as a non-invasive tool for conducting autopsies by sophisticated imaging technologies that can give high resolution visuals. Research also shows that virtual autopsies can depict fractures, mechanical injuries, grievousness of injury and can be used as admissible evidence in the court of law.⁷ Radiological examinations using X-rays have always been a significant visualization as well as diagnostic tool in medicine. But it was never much considered for examination of dead bodies. However radiological examination of the dead could replace conventional post mortem examinations only if it could suitably answer the cause of death, time since death sequence, nature and type of injury specifically whether it is anti-mortem injury or a post-mortem one.

Conventional radiology is accurate and non-intervening but still is able to give only two-dimensional images. Therefore, more sensitive imaging technologies have been found effective in virtual autopsies. In a first such case of sudden Covid-19 death using virtual autopsy in Indian setting a 29-year-old male was found unconscious, bleeding in his engineering hostel, and was declared dead when brought to the hospital, virtual autopsy was conducted using whole-body non-contrast PMCT.⁸ Post Mortem Multi Slice Computed Tomography is a non-intervening examination tool that has an X-ray tube and detectors placed in continuation to obtain an image of higher clarity. The images are obtained at different angles to obtain a cross-sectional view of the dead body, such that virtual images in the form of “slices” can be visualized. PM-MCT is also used for examination of the body kept within a body bag or inside a coffin. However, there are factors that affect the quality of image like radiation, motion artifacts, but still there are certain adjustments that can be made by the user. These include acquisition adjustments to be done prior to scan and reconstruction adjustments to be done post scan while studying the slice stacks. Magnetic Resonance Imaging works on the principle of combining an externally applied magnetic field and computer-generated radio waves to obtain detailed images of underlying organs and tissues within a cadaver.⁹ Once the dead body is placed within the MRI unit, the water molecules in the body are realigned by the externally applied magnetic field. The computer-generated radio waves help to generate weak signals that give a cross-sectional view of

the dead body. MRI can provide high quality visuals of soft tissue injuries and pathologies with more appropriation as compared to Computed Tomography (CT).¹⁰

Photogrammetry is defined as a method of deducing measurements from photographs and works on the principle of triangulation. It has been widely used in recording crime scenes as well as examination of dead bodies. It can generate three dimensional models of an object either in the digital format like measurement, surface and areas or in the graphical format like sketches and maps. This technique uses overlapping photos taken from varying angles which gives a three-dimensional textured appearance.¹⁰

In cases of mass fatalities and burnt cases during the pandemic, medicolegal autopsies had to be conducted as a part of the investigation procedure. Virtual autopsy had given defined results over traditional autopsies in the examination of the head and neck region especially where the dental cavity is blocked in cases of bodies in rigor mortis condition. It also serves as an indispensable tool in determining dental age for personal identification.¹¹ Virtual Autopsies not just help in examining injuries and underlying organs but also act as a diagnostic tool for evolution of medicine. A biopsy is mainly performed to extract sample cells and tissues to study their pathology and extent of any disease. Therefore, combining biopsy procedures with a non-invasive technique like post mortem guided computed tomography is subject to excellent results. Research also shows that CT guided minimally invasive needle biopsy can be conducted for collection of fluid or tissue samples for their histological examinations.¹² Post-mortem CT-guided angiography is a developmental field of Forensic Radiology for vascular imaging and soft tissue examination. It is a minimal invasive procedure unlike conventional autopsy. It includes a CT scan with an injection of a special dye that allows contrast between backgrounds for visualization of the blood vessels and the tissues.¹³

Digitalization of medico legal reports: With the growing need of technology in every sector, Forensic Medicine departments are also incorporating the use of online portals or specialized apps for storing, receiving and forwarding of all documents related to different crime scenes. Appreciable works on digitalization of medico-legal examination of sexual assault victims have been done in few African countries by Mishori and associates.¹⁴ Some Indian states like Tamil Nadu, Haryana, Madhya Pradesh have started the process of digitalization of medico-legal reports to maintain authenticity of documents. An effort has been made to provide the copy of the post-mortem (PM) report to the deceased's family member.⁶ Also, for crimes against humanity like sexual violence, abuse and assault more enhanced techniques of documentation are required to maintain confidentiality of sensitive information. This has led to the development of a specialized mobile app named Medi-Capt for ensuring proper implementation of medical, ethical and legal practices while handling documentation of victims of sexual violence. However, it is still in the processing stage and will be launched soon especially focussing in the low resource areas and regions of conflict.¹⁴

Discussion:

Since the onset of COVID-19, medico-legal examination of the dead has been a difficult task. Therefore, techniques like the above-mentioned ones have been introduced to reduce chances of contamination. Virtual autopsy is a proposed method that has been adopted by a few countries for conducting autopsies and giving practical sessions to medical students. Research shows that virtual autopsies can generate near accurate results as compared to conventional autopsies. It also looks into the aspect of dignified management of the dead. Especially in the covid era where the rate of infections in both symptomatic and asymptomatic conditions may persist, it is better to have virtual examinations rather than interventional methods. Radiological examinations can give images of bones, dental remains as well as in burnt, charred and decomposed bodies that may be COVID infected as well. It can also be used to study bullet fragments and skeletal trauma without dissection, thereby reducing chances of infection amongst the forensic practitioners. Post Mortem-Multi Slice Computed Tomography also gives a cross-sectional view of the body which is an indispensable tool in cases of road traffic accidents. A study also shows virtual autopsies in cases of infectious death, are important for public health management and accumulated virtual autopsy data is important for studying different pathological mechanisms and diagnosing COVID-19 among the deceased.¹⁵ In research, virtual autopsy is important for visualization of areas like spine, limbs and pelvis region that cannot be examined in conventional autopsy. In a recent advancement of virtual autopsy, Nuclear Magnetic Resonance has also given satisfactory results while studying the metabolomic profile of the tissues.¹⁶ Apart from these factors, reproducibility of results, reducing chances of infection, cross-contamination and also improving psychological and social notions regarding examination of the dead are distinct advantages of virtual autopsy over traditional autopsy.¹⁷ Currently, there are very few organizations who have completely switched to virtual autopsy. Most medical institutions have incorporated virtual autopsy for student demonstration or may be to compare the results generated with those of traditional autopsy. The All-India Institute of Medical Sciences (AIIMS) New Delhi, has taken up the initiative to introduce virtual autopsy measures in collaboration with the Indian Council of Medical Research (ICMR) for conducting forensic examinations in the COVID era as well as in the future.¹⁸

Along with these, there are certain limitations to virtual autopsy as well. It is unable to provide information about the status of contamination, surface texture and colour changes of the dead body. Also, presence of odour and appearance of the body are important parts of physical examination which are absent in case of virtual autopsies.¹⁷ It is also not very cost efficient, and requires thoroughly skilled technicians for handling body positioning and the imaging tools.

Digitalization of Medico-legal records is a step forward as it helps to sustain integrity of reports and also prevent manipulation. It also prevents any ambiguity that may arise while interpreting handwritten documents. Overall, it helps to ensure proper chain of custody throughout the investigation. In spite of having

several benefits, digitalization of the entire forensic network comprising police, medical experts, forensic experts and legal team, will require a lot of training, development and skilled individuals to handle such servers. Also, any default with the internet can lead to delay in processing of requests and sometimes sensitive information can be hacked also. It is also not a very cost-effective measure that can be implemented immediately.

Conclusion:

Post-mortem examinations have often been looked down as an unethical task. Many religions do not allow such examinations. Overall bringing a very prejudiced point of view for forensic medical examinations. With the onset of COVID-19 conducting such examinations became even more difficult due to its high rate of contamination. Also, subjecting trained forensic medicine practitioners to such health risks would be highly unacceptable. All these reasons prompted the use of alternative imaging techniques that would not require the medical professional to be in physical contact with the dead body. It also served as a tool for dignified management of the dead. As technology becomes more interwoven into all aspects of health care, the digitization of medicolegal services and forensics in our country is becoming extremely relevant. Though digitalization has certain drawbacks, these are surpassed by the benefits. By boosting accountability and efficiency of services given, digitalization will usher in a new age in the field of medicolegal practice in India.

For digitalization of the entire medico-legal process, an online portal should be launched throughout the country, and its access should be given to the specialized task forces within each state. Such task forces should be trained and skilled to effectively handle uploading of all documents, check entries and edits made to them, maintain their integrity and dispatch of documents till it reaches the court of law for the trials. This paper has given a review on the challenges to which the post-mortem examiners were susceptible during the pandemic, existing and developing imaging techniques and diagnostic tools. Also, the feasibility of virtual autopsy and digitalization of medico-legal records has been critically reviewed along with its scope during COVID and its future prospects.

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