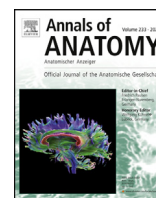




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SHORT COMMUNICATION

Human anatomy education and management of anatomic specimens during and after COVID-19 pandemic: Ethical, legal and biosafety aspects

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ABSTRACT

COVID-19 is an infection caused by the SARS-CoV-2 virus, initially identified in the city of Wuhan, China, in December 2019. Since then, the virus has spread to the continents, causing a major pandemic. The impacts of this pandemic on the education of human anatomy interfere in at least two aspects: (1) receiving and managing anatomical specimens in anatomy laboratories and (2) adaptations for classes on remote virtual teaching. Therefore, this study reviewed and discussed the legal and bioethical aspects, considering the scenario of a South American Country, aiming to stimulate the debate on these two relevant themes in the international community. Because of the COVID-19 pandemic and the impossibility of mass testing, anatomists and other workers in the field must deal with the risk of receiving bodies infected with SARS-CoV-2. In this situation, additional care measures in biosafety practices are essential to protect the staff. Such measures are: the bodies must be preserved by the perfusion of formaldehyde or other fixative solutions; embalming must be performed in ventilated rooms with a good air exhaust system; to avoid excessive manipulation of bodies and procedures such as pulmonary insufflation or craniotomy; and proper use of personal protective equipment, including lab coat, gloves and masks. As for exposure of body images in online classes, this review showed that there are no legal impediments to this end. However, anatomists must adopt measures aimed at protecting the memory of the deceased, such as using secure digital platforms with restricted access; family authorization/consent and student awareness.

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1. Introduction

Human Anatomy laboratories of Higher Education Institutions (HEIs) are important education and research environments in the areas of health and biology. They possess and use a series of didactic-pedagogical resources such as synthetic models, computers and software with digital atlases, and cadaverous pieces, allowing the study of systemic and/or topographic anatomy (Elizondo-Omaña et al., 2004; Evans and Watt, 2005; Arráez-Aybar et al., 2014).

According to the activities developed in these laboratories, it is an environment that involves risks to users (employees who perform the embalming techniques, general service staff, professors and students), due to exposure to chemical substances, pathogens

such as bacteria and fungi carried by human tissues in life or as a result of sharp materials handling and storage (Balta et al., 2015; Neto and Colombo, 2015; Fenech et al., 2016; Chappell et al., 2016). Therefore, biosafety measures are essential to maximize academic development with the safety of users, including students, professors, technicians and the cleaning staff (Neto and Colombo, 2015). Furthermore, the handling of human corpses and their parts requires ethical, legal and technical qualities from users (Elizondo-Omaña et al., 2004; Evans and Watt, 2005; Arráez-Aybar et al., 2014; Romo-Barrientos et al., 2020).

In this manuscript, the legal aspects related to the acquisition and management of human bodies in anatomy laboratories are reviewed, emphasizing the need to adopt additional biosafety measures in view of the possibility of receiving bodies potentially infected with SARS-CoV-2. Finally, legislation on the right to personality and its implications related to the exposure of images and videos of the dead human body during remote virtual classes, a common alternative in this COVID-19 pandemic, is discussed. It

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is expected that this discussion in the light of a South American country legislation will stimulate the debate on these two relevant themes by the entire international community, respecting local legal and socio-cultural aspects.

2. Anatomic specimens' admission and biosafety in human anatomy laboratories

In Brazil, most anatomic specimens used in teaching and research in human anatomy are unclaimed bodies. In this regard, Law 8.051, from November 30, 1992 (regulates the use of unclaimed anatomic specimens for purposes of scientific studies or research and provides other measures), in its second article, decides that the unclaimed corpse, within thirty days, may be sent to medical schools for teaching and scientific research. In case of unidentified corpses, the competent authority shall publish in the main newspapers of the city, (as a public utility service, for at least ten alternate days) the news of the death (article 3) and at any time, family members or legal representatives will have access to the cadaveric remains and corpse data, including identification photos, fingerprint record and necropsy results, if performed (article 5) (Brasil, 1992). In addition, each Brazilian state has its own laws that aim to guarantee the moral, ethical and legal principles regarding the admission and management of dead human bodies in anatomy laboratories.

On the other hand, a voluntary donation in life is also possible in Brazil and guaranteed by law 10.406, article 14, of January 10th, 2002, of the Civil Code. Furthermore, the disposition act can be freely revoked at any time, including by responsible family members after death of their own family member (Brasil, 2002).

In many countries, body donation programs were developed and most bodies in educational institutions are the result of voluntary donation (Halou et al., 2013; Alexander et al., 2014; Arráez-Aybar et al., 2014; Bajor et al., 2015). However, despite some successful experiences (Rocha et al., 2013), this modality is still incipient in our country.

In general, the anatomic specimen will only be available for use in HEIs after the death document is filled with the availability of the corpse for teaching and research, both for unclaimed bodies and for those donated in life or by family members (Melo and Pinheiro, 2010). Regarding destination of the cadaverous remains, the medical schools must communicate to the registry office when they are no longer interested in keeping the body, for the purpose of registration in the respective death document, and to the family, in the case of donated anatomic specimens (Pernambuco, 2008; Rio Grande do Norte, 2012). Family members will have a 15-day deadline to express their intention to proceed with the burial (Pernambuco, 2008; Melo and Pinheiro, 2010), and in case of no response in a timely manner, the medical schools will be able to carry out the burial or cremation according to current health legislation (Pernambuco, 2008; Rio Grande do Norte, 2012).

For long-term custody purposes in medical schools, the anatomic specimens can be chemically embalmed or cooled to -20°C , the latter being a better procedure for training surgical techniques, due to the similarity of the tissues in terms of texture and color with the living individual (Schnittler et al., 2019). However, the embalming technique is the most common in anatomy laboratories worldwide and aims to interrupt destructive biological processes and allow the use of cadaveric parts for long periods (Balta et al., 2015). The fixative substances most used in anatomy are formaldehyde, ethyl alcohol and glycerin. Despite biological risks and discussions about banning it in some countries (Fenech et al., 2016; Chappell et al., 2016), formaldehyde (37% formaldehyde solution) is still the most widely used fixing substance in Brazil (Hayashi et al., 2016). It is also the first option in Brazilian

HEIs due to its low cost and germicidal and conservation properties (Hayashi et al., 2016; Silva et al., 2016). The pieces are preserved in a 4% aqueous solution prepared with neutralizers such as monobasic sodium phosphate and dibasic sodium phosphate (Rodrigues, 2010). The working group of the Anatomische Gesellschaft on reduction of formaldehyde exposure in anatomical curricula and institutes showed that embalming of dead human bodies with intra-arterial perfusion of 4% formaldehyde and a total fluid volume of 150 mL/kg body weight is sufficient even for long-term preserving anatomic specimens (Waschke et al., 2019).

The COVID-19 pandemic, decreed by the World Health Organization (WHO) on March 11th, 2020 (Cucinotta and Vanelli, 2020) can impact the acquisition of anatomic specimens for education and research in anatomy, as well as dead human bodies handling in anatomy laboratories. On this topic, WHO published on March 24th, 2020, the guidelines for "Infection Prevention and Control for the safe management of a dead body in the context of COVID-19", which brings a series of recommendations for secure management, including:

- a) During body transportation to the morgue, autopsy or burial site, professionals must wear appropriate personal protective equipment (PPE) and, in the possibility of risks of splashing body fluids or secretions, wearing face shield and surgical mask, ensuring minimal handling of the body and that all body fluids and secretions are contained;
- b) In funeral assistance, professionals who manipulate the body must use appropriate PPE and embalming is not recommended to avoid excessive manipulation of the body;
- c) At autopsy, safety procedures must be consistent with those used for any autopsy of people who died of acute respiratory disease; in deaths occurring in the infectious period, the lungs and other organs may still contain live viruses, and to require additional respiratory protection, autopsies should be performed in rooms with adequate ventilation, with a minimum number of employees and adequate PPE, including face shield (preferably) or glasses;
- d) At burial, family members cannot touch the body, limited number of people and adults >60 years old or immunosuppressed people must not interact directly with the body (WHO, 2020a).

The Brazilian Ministry of Health, in accordance with the WHO, established on March 25, 2020, the recommendations for handling bodies in the context of the COVID-19 in Brazil (Brasil, 2020). Manipulation, funerals and burial of bodies were regulated, restricting the number of people and avoiding individuals belonging to risk groups (people aged 60 years or older, pregnant women, lactating women, those with chronic, cardiopulmonary, oncological or immunosuppressed diseases). It was recommended that the autopsy should not be performed in the event of ante-mortem confirmation of COVID-19, and that health services should avoid sending the body to the DVS. However, when this service is necessary, prior notification must be made to the service manager. In addition, it was recommended not to perform thanatopraxis by funeral agencies.

The guidelines of the Brazilian Ministry of Health, however, do not mention cases of corpses of unidentified people or unclaimed bodies, thus, the impact on the admission of corpses determined by Decree 61.573/2018 is uncertain. In addition, bodies of clinical death of unknown cause are not necropsied and do not undergo an analysis for the viruses that cause COVID-19, hepatitis and AIDS, before being assigned to HEIs. Thus, every anatomic specimen, in the absence of specific tests and diagnoses, should be considered potentially infectious (IFAA, 2020a; WHO, 2020a).

Another important aspect is the underreporting of COVID-19 cases in Brazil (Prado et al., 2020), which may contribute for bodies

to reach IFM and DVS without having been tested for SARS-CoV-2. This highlights the situation of social vulnerability in which the population of many states in Brazil live. Since approximately 20% of the population are below the poverty line (Sawaya et al., 2003; Lavinias, 2010), it takes time for family members to provide the funeral service for their relatives as soon as possible, thus increasing the time that the corpse remains in the hospital, DVS or IFM, causing the bodies to accumulate in the cold rooms of these services. Regarding the donated corpses, anatomists must also deal with the possibility of the donor being positive for COVID-19. Although the risk of infection from an infected donor is unknown, testing and investigating donors is recommended (Ravi, 2020).

These issues have a direct impact on the anatomy laboratories of HEIs as they may be at risk of receiving bodies infected with SARS-CoV-2 and other viruses. There are few studies that have evaluated the time and capacity for postmortem transmission of viruses in frozen anatomic specimens. A study evaluated several organs of anatomic specimens from patients diagnosed with severe acute respiratory syndrome (SARS) caused by SARS-CoV, and demonstrated that the infectious agent was detected in lung and small intestine samples within 180 h post-mortem (Tang et al., 2007). Another study revealed that SARS-CoV-2 can persist on inanimate surfaces for up to nine days (Kampf et al., 2020). In this context, indirect transmission through contact with contaminated surfaces or aerial transmission, caused by the spread of infectious active agents in droplets (aerosols) suspended in the air for long distances have been recognized as important routes of transmission of SARS-CoV-2 (WHO, 2020b).

Thus, in view of the contamination risks, it is suggested that anatomic specimens' donors or those not claimed, in the impossibility of testing for COVID-19, should not be preserved through cooling by HEIs schools (Schnittler et al., 2019). However, several studies have revealed that most chemical agents routinely used in anatomy laboratories for embalming anatomic specimens such as alcohol, acetone, glutaraldehyde and formaldehyde are effective to inactivate SARS-CoV depending on temperature conditions and time period (Darnell et al., 2004; Rabenau et al., 2005; Kariwa et al., 2006; Kampf et al., 2020).

Considering that the used chemical agents are also effective in inactivating SARS-CoV-2, the embalming procedures of anatomic specimens can be maintained in HEIs during and after the COVID-19 pandemic, however, the anatomic specimen manipulation, since its arrival until the act of infusing chemical substances requires additional care and reinforcement of biosafety procedures in anatomy laboratories (IFAA, 2020a).

Therefore, it is essential that all people who work handling the corpses comply with the rules and routines, because only in this way can barriers be created to minimize or cancel the risks. It is noteworthy that the exposure to physical, chemical and biological agents for students occurs for a short period, therefore, it does not necessarily imply a risk to the health of users, since contact is for a short time and on alternate days according to the schedule of practical classes. The accumulated effect is more frequently observed in workers, who are entitled to compensation for health problems (Zeller et al., 2011; Costa et al., 2015; Ladeira et al., 2011).

For adequate embalming control and anatomical techniques in HEIs, we recommend the following measures, adapted from the protocol for cleaning and disinfection of environmental surfaces in the context of COVID-19 by WHO (2020a), the Brazilian Ministry of Health (Brasil, 2020) and the best practice guidelines for body donation programmes during the COVID-19 pandemic of the International Federation of Associations of Anatomists (2020a):

- a) The room for anatomical techniques must always be kept clean and ventilated, and must present an exhaust system for air changes;
- b) Adequate lighting of the work environments;
- c) Easily disinfected surfaces and materials;
- d) To avoid procedures that may generate aerosols, such as lungs insufflation and craniotomy;
- e) Technical personnel must wear appropriate (PPE), including lab coat, gloves, FFP2 and FFP3 masks or similar, caps and eye protection. A facial shield is necessary in situations where aerosols are produced;
- f) The instruments used must be cleaned and disinfected immediately after the procedures;
- g) The environmental surfaces, where the body was prepared, must first be cleaned with soap and water or a commercially prepared detergent solution;
- h) After cleaning, a disinfectant with a minimum concentration of 0.1% (1000 ppm) of sodium hypochlorite (bleach) or 70% ethanol should be placed on the surfaces for at least 1 m;
- i) Items classified as garbage must be handled and disposed properly, in accordance with legal requirements;
- j) Non-disposable items must be sent for cleaning and disinfection/sterilization, according to the service routine and in accordance with the regulations;
- k) Sharps instruments must be disposed in rigid, perforation-proof and leak-proof containers, with the infectious waste symbol;
- l) Cleaning staff professionals, responsible for the laboratory's hygiene, must wear proper PPE;
- m) Training of all professionals, including technicians, professors and cleaning staff, may be necessary to raise risk awareness and adopt appropriate biosafety measures.

3. Teaching anatomy and using images of human anatomic specimens

The SARS-CoV-2 pandemic and the consequent schools and higher education institutions shutdowns in many countries accelerated the process of inserting technology in human anatomy teaching and learning. Several anatomists had to re-orient themselves and change their teaching practices, such as participating in online theoretical classes and working with virtual atlases, 3D applications and other digital tools (Byrnes et al., 2020; Longhurst et al., 2020; Pather et al., 2020).

In this paper we do not aim to discuss the best teaching methods in anatomy, but to discuss the ethical and legal aspects related to the exposure of images and videos of human anatomic specimens during online classes.

The Brazilian Civil Code, in its Art. 6, defines that the existence of the natural person ends with death (Brasil, 2002). Therefore, it is presumed that, after death, the rights of the human person would be finalized. However, it is widely known that the corpse has legal protection, proven by the existence of several laws, and some of them will be discussed below.

Law 5.250, of February 9, 1967, which regulates the freedom of expression of thought and information, defines in Art. 24 that they are punishable, in the terms of articles 20–22, slander, defamation and injury against the memory of the dead (Brasil, 1967). Following this understanding, the Civil Code, in Art. 12, states that the spouse or any relative in a straight line, up to the fourth degree of a dead person, is entitled to request or demand that the threat or injury to the right to personal identity to be ceased and claim losses and damages (Brasil, 2002). In other words, relatives can legally demand compliance with the law in cases of violation of the right to personal identity of the dead, including intimacy, honor and image (Brasil, 1988). It is important to highlight that the right to personal identity

refers to the guarantee of human dignity, internationally recognized by the Universal Declaration of Human Rights ([UN General Assembly, 1948](#)).

The Brazilian Penal Code considers four crimes against respect for the dead, as an ethical-social value:

- a) Art. 209–To prevent or disturb burial or funeral ceremony. Penalty of detention, from one month to one year, or fine. Sole paragraph: If violence is used, the penalty is increased by one third, without prejudice to that corresponding to violence;
- b) Art. 210–To violate or desecrate a grave or a funerary urn. Penalty of imprisonment, from one to three years, and fine;
- c) Art. 211–To destroy, subtract or hide a corpse or part of it. Penalty of imprisonment, from one to three years, and fine;
- d) Article 212–To vilify corpse or its ashes. Penalty of imprisonment, from one to three years, and fine ([Brasil, 1940](#)).

To vilify is the action of outraging, disrespecting or violating the lifeless human being and his/her memory. The consummation of this crime is therefore intimately linked to the right to personal identity, regarding the right to image and privacy. Not related to the dead person, but to his/her family and friends ([Duarte, 2016](#)).

[Duarte \(2016\)](#) argues that the crime of vilifying an anatomic specimen leaves doubts about its consummation, especially related to the conduct performed by the subject and its purpose. However, depending on the way in which the information is disseminated (images, videos, etc.), the anatomic specimen's exposure can be characterized as a crime of vilification, for violating personal identity rights, regardless of family members and friends of the deceased. In this case, it is understood that the reproduction of the image on digital media such as Facebook®, Instagram®, Whatsapp® or any other app from virtual social networks can constitute an affront to this right provided by the Brazilian Federal Constitution ([Brasil, 1988](#); [Duarte, 2016](#); [Machado and Manso, 2017](#)).

According to the several laws applied to the protection of the corpse, offending morals/memory, using images or removing any part of it, constitute an affront to the right to personal identity ([Duarte, 2016](#); [Teixeira, 2019](#)).

In this perspective, one might question whether the use of anatomic specimens by the HEIs and the techniques of dissection or prosection, that are routine in human anatomy laboratories, constitute a crime of vilification. [Teixeira \(2019\)](#) argues that the use of anatomic specimens by the HEIs for teaching and research does not characterize a crime of vilification, because besides the legal authorization (law 8.501/92 and law 10.406/02), this procedure does not fit in the typification of the crime, which requires a conscious will to outrage the corpse.

Therefore, clearly there is no legal impediment to the use of images or videos of anatomic specimens for exclusively didactic and research purposes. However, this pandemic caused by SARS-CoV-2 has demanded changes that needs to be discussed regarding moral and ethical values in the teaching of human anatomy ([Champney, 2011](#)).

Organizations such as the American Association of Anatomists (AAA), American Association of Clinical Anatomists (AACA) and the International Federation of Associations of Anatomists (IFAA) have developed policies and guidelines with ethical recommendations for the management of body donation and anatomic specimen handling programs ([AAA, 2009](#); [AACA, 2017](#); [IFAA, 2020b](#)). Regarding the use of images, AACA reaffirms that videos and images of anatomical specimens of donated bodies are valuable resources in medical education and research, and that body donation programs should create policies for the elaboration of these media. However, it raises the need for donor consent/authorization, including information on the distribution of derived images and possible cir-

ulation sites ([AACA, 2020](#)). IFAA adds that the donor should not be identified in the published images ([IFAA, 2020a, b](#)).

These guidelines and policies reinforce the ethical conduct of respect for the anatomic specimen; however, they do not specifically address the cases of images and videos of unclaimed ones. For these cases, there is no possibility of authorization from family members, who in most cases are not identified. In addition, as previously discussed, the right to personal identity continues after death, as it can be claimed by family and friends. In this case, the following question arises: if there are no known relatives or friends, would the unclaimed corpse be without rights? Could consent be waived? These questions demand great ethical discussion by anatomists from all over the world, and a deep reflection needs to be carried out.

It is known that the study of human anatomy provides knowledge about the structure of the human body, but it also allows the development of skills such as feelings of gratitude, respect for death and ethical awareness for students. These are fundamental ideas in their future professions. ([Kissler et al., 2016](#); [Flack and Nicholson, 2018](#); [Thompson et al., 2019](#)). It is noteworthy that much of what is followed by students is due to the professors' posture and attitudes, especially in practical classes ([Hildebrandt, 2019](#)). Therefore, anatomists are expected to have an ethical stance of respect for the corpse, regardless of national and global socioeconomic situations, as in the COVID-19 pandemic.

We reiterate that, in cases of need for practical online classes, with the exhibition of images or videos of anatomic specimens, some measures must be adopted, aiming at the preservation of human dignity, as follows:

- a) Use of secure digital platforms with restricted access only to students and professors of the course;
- b) Authorization/consent from the anatomy sector/department, and from family members in cases of donated bodies;
- c) Awareness of students about the legislation related to the protection of the corpse and;
- d) Adoption of an ethical stance of respect for the corpse, regardless of its origin and condition.

4. Conclusion

In this study, we describe the legal processes for obtaining corpses for education and research in higher education institutions. This human material, despite recent technological advances, remains the main teaching and learning method in human anatomy ([Elizondo-Omaña et al., 2004](#); [Evans and Watt, 2005](#); [Arráez-Aybar et al., 2014](#)). However, several precautions must be adopted in the anatomy laboratories due to the risk of exposure to several agents potentially causing diseases and/or accidents.

The need for new strategies for the proper and safe management of anatomic specimens that tested positive or suspect for COVID-19 is evident in the absence of specific studies on the effectiveness of biosafety standards in this condition ([Yaacoub et al., 2020](#)). Therefore, these rules must be rethought and expanded, aiming at the safety of all users, especially the technical professionals and professors responsible for embalming new corpses.

Besides, we instigate the debate on the legal and ethical aspects of the exhibition of images of human anatomic specimens and their parts, guided by the Brazilian legislation. We encourage an in-depth discussion on the topic and the adoption of some practices to guarantee ethical principles of respect for the corpse, when its exposure is inevitable.

The adoption of routines, sequences, protocols and standards must be pursued by everyone; and their proper implementation

will depend on the individual and collective effort of students, professors, technicians and the cleaning staff.

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Ethical statement

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