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Use of human cadavers in teaching of human anatomy in brazilian medical faculties

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ABSTRACT. The Human Anatomy is the study of human body structure and it has been related to the use of cadavers through the history. The aim of this research was to investigate the use of human cadavers in practical classes of human anatomy in Brazilian medical schools, and it was also made the identification of alternative methodologies and new technologies applied to the teaching of Anatomy. The research was conducted at the *Faculdade Integral Diferencial* from January to December of 2015. The population studied was composed by professors responsible for the Human Anatomy sector of the Brazilian medical faculties. It was addressed all the 242 medical colleges of the Brazil. It was obtained 81 answers. 96% of respondents reported make use of human corpses in its practical lessons of anatomy. It can be observed that 42% of the surveyed medical schools make use of only formaldehyde. 81% of faculties reported to face some difficulties to acquire human cadavers. 84% of medical schools make use of artificial models. 46% of faculties make use of diagnostic images. It can be concluded that human bodies, artificial models and new technologies are widely used in practical classes of anatomy in Brazil, since there is a difficulty to obtain cadavers.

Keywords: formaldehyde, glycerin, dissection.

Utilização de cadáveres humanos no ensino da anatomia humana nas faculdades de medicina do Brasil

RESUMO. A anatomia humana é o estudo da estrutura do corpo humano e tem sido relacionada com a utilização de cadáveres durante a história. O objetivo desta pesquisa foi investigar o uso de cadáveres humanos em aulas práticas de anatomia humana em escolas médicas brasileiras e foram identificadas metodologias alternativas e novas tecnologias aplicadas ao ensino de anatomia. A pesquisa foi conduzida na Faculdade Integral Diferencial, no período de janeiro a dezembro de 2015. A população estudada foi composta pelos professores responsáveis pelo setor de anatomia humana das faculdades médicas brasileiras. Foram abordadas todas as 242 faculdades de medicina do Brasil. Obtiveram-se 81 respostas. 96% dos entrevistados relataram fazer uso de cadáveres humanos em suas aulas práticas de anatomia. Observou-se que 42% das escolas médicas pesquisadas fazem uso apenas de formaldeído; 81% das faculdades relataram enfrentar dificuldades na obtenção de cadáveres humanos; 84% das escolas médicas fazem uso de modelos artificiais, 46% das faculdades fazem uso de imagens diagnósticas. Pode-se concluir que os cadáveres humanos, modelos artificiais e novas tecnologias são amplamente utilizados nas aulas práticas de anatomia no Brasil, uma vez que existe dificuldade para obter cadáveres humanos.

Palavras-chave: formaldeído, glicerina, dissecação.

Introduction

The Human Anatomy is the study of the human body structure. It is considered one of the oldest basic medical sciences, which remains present in all curriculums of medical colleges until today (Moore & Dalley, 2007).

The study of human anatomy has always been related to the use of cadavers. However, the use of human corpses has presented obstacles over time. From the sanctioning of the federal law 8501, which regulates the destination of legally unclaimed cadavers for educational and research purposes, the difficulties faced by higher education institutions to acquire them have been increasing (Melo & Pinheiro, 2010). Moreover, in recent years, the number of bodies donated to educational institutions has decreased. Thus, it becomes necessary the proper storage of human cadavers in

order to preserve their anatomical features (Hildebrandt, 2010).

The main groups of fasteners used in the preservation of human corpses are phenols, aldehydes, acids, halogenated compounds, oxidizing agents, heavy metals and its salts, sulfur, and thiosulfates. The formaldehyde in aqueous solution at 10% is the most commonly used fastener due to its low cost and its ability to rapidly penetrate the tissues (Silva, Dias, Tavares, Marques, & Furtado, 2008).

Although widely used, the formaldehyde has many disadvantages. Prolonged exposure to formaldehyde is associated with mild neurological symptoms such as headache and dizziness. The acutely exposure can determine irritation of the eyes, nasal cavity, larynx and respiratory tract, which may cause symptoms such as watery eyes, burning sensation in the eyes, nose and throat, cough, and dyspnea. Additionally, the formaldehyde is classified as carcinogenic because of its carcinogenicity in human nasal tract and genotoxicity in the human lung (Carvalho, Zavarize, Medeiros, & Bombonato, 2013; Hammer, Loffler, Feja; Bechmann, & Steinke, 2011).

The glycerin conservation is an effective technique for storage of cadaveric parts. This technique has the advantage of presenting best aesthetic and morphological results, be odorless, and be easy to handle by professors and students (Silva et al., 2008; Carvalho et al., 2013).

The plastination is a technique that replaces water molecules of the body by a polymer while keeping the original structure and characteristics of the piece. This technique has the advantage of obtaining parts odorless, dry, and with easy maintenance. However, the cost is high and it requires a longer preparation time, which can take several months to finish the procedure (Riviera et al., 2006).

Alternative methods of teaching human anatomy have gained importance, such as the use of artificial parts and software development. The technology has been applied in order to effectively contribute to the quality of education by making it more interesting and dynamic (Fornaziero & Gil, 2003).

It is important to note that only the cadaverous parts include structural details and anatomical variations that are essential for the academic formation of students of health area, especially academics of Medicine.

The aim of this study was to investigate the use of human cadavers in practical classes of human anatomy in Brazilian medical schools. In addition, it was made the identification of alternative methodologies and new technologies applied to the teaching of this discipline.

Material and methods

This study it is an applied research with descriptive character and quantitative approach. In accordance with the resolution 466/12 from the National Health Council, this project was submitted to the Research Ethics Committee (REC) of the *Faculdade Integral Diferencial* - FACID/DeVry. It was also registered in the Platform Brazil with the number of authorization CAAE 39683714.7.0000.5211.

The study was conducted at the *Faculdade Integral Diferencial* - FACID/DeVry, from January to December of 2015. The population studied was composed by professors responsible for the Human Anatomy sector of the Brazilian medical faculties. In this study, it was addressed all the 242 public and private medical colleges of the Brazil.

The data were collected through a standardized questionnaire, which was sent via email to the professors. The free and informed consent term (IC), a document that presents all information about the research, was sent along with the standardized questionnaire.

The online questionnaire was sent between the months of March to May 2015. For those who did not respond during this period, the questionnaire was sent back during the month of June 2015. It was obtained a total of 81 answers.

The questionnaire had the identification and characterization of the institution where the research would be conducted. The questionnaire consisted of questions about the use of cadavers in practical classes of Anatomy, preservation methods of human corpses, difficulties in obtaining the corpses, and use of artificial parts and other technologies.

The collected answers were digitized in spreadsheets of the program Microsoft Office Excel 2010 for Windows®. After that, the data were organized in tables and graphs.

Results and discussion

The questionnaire was sent online to 242 Brazilian medical schools. Of this total, 81 institutions sent responses. The questionnaire contains the answers about the use of human corpses in practical lessons of anatomy. It can be observed that 96% of respondents reported make use of human corpses in its practical lessons of anatomy, while 4% do not make use of them.

It is noted that the use of human cadavers is a method widely used in the teaching of human

anatomy in Brazil. This data is important, since the knowledge gained through cadavers is essential to the formation of good health care professionals, who will deal with the human body during their work life. Moreover, only parts of cadavers have structural details and essential anatomical variations for a good academic training (Costa & Lins, 2012).

The use of cadavers in practical classes of human anatomy can be made from the dissection or prosection (Fazan, 2011). The information obtained from a dissected tissue may not match what is seen *in vivo*. This happens because the death and the fixing process can significantly alter the color and texture of human tissue. Another problem is the preservation and storage of cadavers that sometimes is performed improperly (Hildebrandt, 2010).

The word prosection is used informally by anatomists to refer the technique that uses previously dissected cadavers (Fazan, 2011). Nowadays, it can be observed a decrease in the workload of health care courses and an increase in the number of students per classroom. This way, the prosection has advantages over the dissection, since the use and handling of previously dissected pieces' demand much less time and complexity (Rizollo & Stewart, 2006).

The Figure 1 shows the main methods of conservation for cadavers. It can be observed that 42% of surveyed medical schools make use of only formaldehyde, 37% make use of formaldehyde and glycerine, 15% make use of only glycerin, 4% adopt three or more methods, 1% makes use of only plastination, and 1% did not inform.

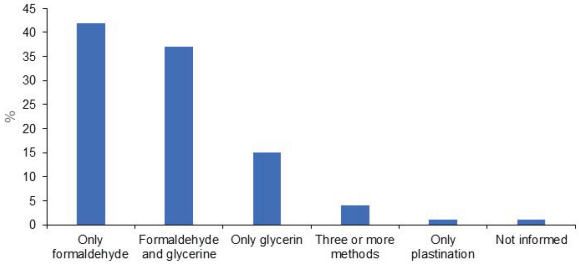

Figure 1. Distribution of answers on the main methods of conservation for cadavers in Brazilian medicine faculties, 2015.

The technique of fixation and conservation through formaldehyde is the most used in Brazil, probably due to its low cost, rapid tissue penetration, and long durability. The formaldehyde is used diluted between 3 and 10% in water or alcohol. This substance reduces tissue degradation by preventing the proliferation of microorganisms and the break of lysosomal walls, which could cause autolysis of the cells.

Although widely used, the formaldehyde has many drawbacks, mainly due its toxicity. Most authors report that formaldehyde can cause headache, dizziness, irritation of the mucous membranes, coughing and dyspnea, besides its carcinogenic potential (Hammer et al., 2011; Oliveira & Zaiat, 2005).

Another method widely used in the preservation of human corpses is the glycerin conservation. Glycerin is a liquid clear, colorless, and viscous, which has the ability to dehydrate the cells without change its ionic concentration, what keeps the integrity of the cells (Rodrigues, 2010).

The glycerin has a much higher cost than formaldehyde. However, its use ensures better working conditions for technical, professors, and students. As it is a biodegradable preservative, it is important to assist in the preservation of the environment (Costa, 2011). The glycerinated preparations are easily handled, lighter and have not unpleasant odor. This provides space savings to store them or keep them outdoors for a long time (Carvalho et al., 2013; Hammer et al., 2011).

As observed in Figure 1, the plastination technique is rarely used in Brazil, mainly due to its high cost. In this technique, tissue fluids and part of the lipids are replaced by polymers under vacuum. The result is the creation of parts clean, dry, and odorless, which can be handled without the use of gloves. The parts remain preserved for longer time and do not cause irritation, which is very advantageous when compared to formalized parts (Riviera et al., 2006).

The questionnaire also brings the distribution of responses about the difficulty of obtaining human cadavers for teaching anatomy. 81% of faculties reported to face some difficulties to acquire human cadavers; while 19% said have no problem with that.

Traditionally in Brazil, most of the cadavers used for study and research come from unclaimed bodies. With the homologation of the Federal Law 8.501/92, which refers to the allocation of unclaimed corpse, the routing of these bodies to medical schools has become an unusual practice, since the process must comply with the legal procedures laid down in this law.

The Figure 2 shows the main answers obtained by our research on the difficulties faced in obtaining human cadavers for teaching. As shown in the Figure 4, the bureaucracy was the main difficulty reported by 21% of responses. 20% of the faculties reported to face difficulties with the donations of cadavers, 11% cited a lack of paupers, 9% reported lack of service of death verification (SDV), 12% reported other responses, and 27% gave no answers.

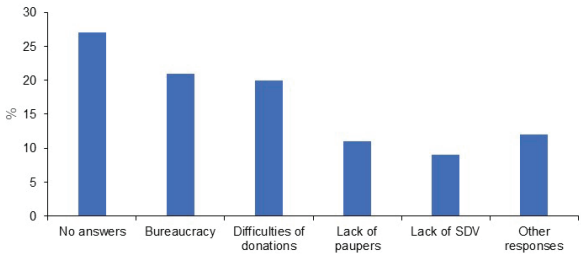

Figure 2. Distribution of answers about the difficulties of obtaining human cadavers, 2015.

According to the literature, obtaining corpses in the past used to be not so much bureaucratic. The corpses could be obtained through the compulsory allocation of bodies of executed criminals in capital punishment, corpses unclaimed by families, and bodies of indigents. The cadavers used to be sent by oral tradition without many formalities during many years in the past (Barros, 2010; Melo & Pinheiro, 2010).

With the sanction of the Law 8.501 (Brasil, 1992), the automatic forwarding of bodies to the colleges started to suffer contestations, which led to a decrease in the number of cadavers sent to practical classes of anatomy (Barros, 2010).

Another way to obtain human corpse is made by donation of the body. This act is supported by the article 14 of the Law 10.406 (Brasil, 2002, chapter 2) of the Brazilian civil code, which states that: It is valid with scientific or altruistic goal, the free disposal of the body, in whole or in part, after death.

However, the number of bodies donated is reduced in our country, what becomes a difficulty faced by educational institutions. This is mainly due to cultural and religious questions. Furthermore, in Brazil, the funeral is valued and respected, unlike other countries, where the number of bodies donated for teaching and research is higher (Barros, 2010). Furthermore, it is believed that the development of bioethics and legal consciousness more elevated about the human being contributed to the reduction of obtaining of cadavers for educational purposes (Barros, 2010).

According to the Ministry of Health, the Service of Death Verification - SDV (*Serviço de Verificação de Óbito* - SVO) is the official agency responsible for conducting autopsies on people who died without medical care or diagnosis of poorly defined disease. It is the responsibility of SDV to investigate the cause of death and issuance of death certificate in cases of natural death (Souza, 2009).

In municipalities where the SDV is not present, the death certificate is responsibility of the physician on duty in the hospital to where the body was sent; however, in case of violent death, the responsibility of issue the death certificate is of the Institute of Legal Medicine (IML). With the absence of the SDV, the sending of corpse to medical school is compromised because there is a deadlock between the responsible agencies (Souza, 2009).

The Figure 3 shows the distribution of responses about the use of artificial models in practical classes of human anatomy. It can be noted that 84% of medical schools make use of artificial models, while 16% affirmed not to use.

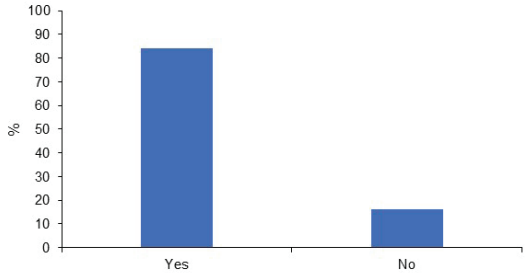

Figure 3. Distribution of answers about the use of artificial models in practical classes of human anatomy, 2015.

Due to the difficulty to obtain human cadavers for teaching anatomy, medical colleges began to truly consider the adoption of alternatives to human cadavers, such as artificial anatomical models. These models reproduce the structure of the human body and can be used in combination with cadavers. However, the artificial models have a high price and do not reproduce the human structures accurately (Hopwood, 2007).

In addition, artificial anatomical models do not show anatomical variations, texture, and consistency, which are characteristics only observed with the use of cadavers. Thus, it is believed that the artificial models can never replace absolute and satisfactorily human cadavers (Hopwood, 2007).

According to Collipal and Silva (2011), students learn more when the practical ways of learning are varied. Thus, the most interesting would be the use of human corpses and artificial anatomical models simultaneously (Collipal & Silva, 2011).

The Figure 4 shows the distribution of answers about which technologies are used in the practical lessons of human anatomy. The Figure 4 shows that 46% of faculties make use of diagnostic images, 33% make use of software, 18% make use of simulators, and 3% make use of other technologies.

In recent years, the technology has evolved considerably and arrived in the classrooms and practice laboratories in all academic areas. With the discipline of human anatomy was no different. As noted in the Figure above, the technology is already part of the anatomy teaching, which greatly favors the learning process.

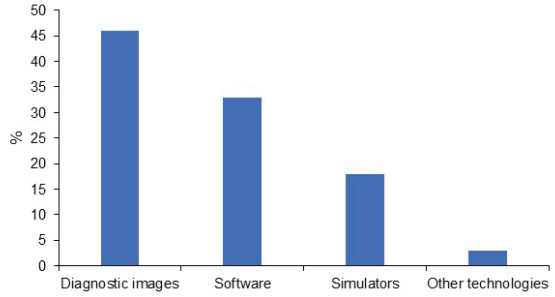

Figure 4. Distribution of answers about the use of technology in practical classes of human anatomy, 2015.

The use of new technologies in learning has proved to be increasingly effective. A resource that can be proposed is the use of software. Multimedia programs allow combining the use of text, high quality pictures, videos of clinical application, self-assessment questions, and many other features. This allows that students can learn according to their particular rhythm (Fornaziero & Gil, 2003; Klemt & Infantosi, 2000).

The diagnostic images also help the teaching of anatomy. These should be used for presenting the anatomy *in vivo* through resources as radiographs, endoscopies, CT scans, and others. Another alternative are the simulators, through which students can learn clinical anatomy with techniques and procedures as if they were using real bodies (Inzunza & Bravo, 2002).

Conclusion

Through this study it can be concluded that human bodies are widely used in practical classes of anatomy in Brazilian faculties of Medicine. It was also found that formalization still as the most used method of preservation. Currently, there is a major difficulty to obtain human cadavers. Because of that, artificial models are widely used in the teaching of anatomy, as well as new technologies such as simulators and software.

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