A study to elaborate a technical manual of veterinary radioprotection

CHS Sousa1,2, ET Nascimento1,2, LG Padilha2, GS Araújo2, JGP Peixoto2

1Universidade Estácio de Sá
2Fundação Técnico-Educatacional Souza Marques
3Instituto de Radioproteção e Dosimetria

E-mail: chenrique@ird.gov.br

Abstract. ANVISA Ordinance 453/98 reports the importance of radiological protection, in its fundamental principles, for the protection of patients, workers and the public in the medical and dental radiology sector. However, health surveillance has failed to control veterinary medical radiodiagnosis. Due to the peculiarity of working with animals, the veterinarian has been overexposed to ionizing radiation. This work is quantitative and observational carried out with some clinics, veterinary radiologists and data from personal files, internet and literature. Thirty people were included in the study, where 60% assumed the position of technical manager, 66.7% the radiological protection supervisor, 13% have updated radioprotection training, 66.7% do not carry out quality tests and maintenance of equipment and 76.7% have doubts about radioprotection standards. It was found that a significant proportion of veterinary radiologists are unaware of radioprotection standards, or have doubts about the matter, exposing themselves unnecessarily to ionizing radiation putting their health and that of others at risk.

Keywords: radioprotection; veterinary imaging diagnosis; veterinary radiodiagnosis

1. Introduction

Historically it is known that soon after Wilhelm Conrad Röentgen discovered X-rays on November 8, 1895, the first harmful effects on humans began to appear. The basic principles of radiation protection provide basic guidelines for operating activities using ionizing radiation. They are: Justification, Optimization, and Dose Limitation, all based on the fundamental principle known as the "ALARA" acronym for "As Low As Reasonable Achievable" [1, 2, 3].

From the emergence of the harmful effects of prolonged exposure to X-rays in the early twentieth century, radioprotection forms based on exposure time, distance from the radiation source, and shielding were developed to minimize the harmful effects of radiation. radiation [1, 2].

Veterinary radiology is an excellent diagnostic support tool [4]. Veterinary radiology works mainly for the radiological study of small and large animals, as a complementary diagnostic exam or as a therapeutic intervention method [5]. Radiological study is indispensable in the clinical routine of veterinary medicine due to its simplicity and speed in elucidating clinical cases [6]. Their employment has become increasingly accessible to the population [7].
In veterinary radiology, radiologists find it difficult to use personal protective equipment, such as lead gloves. Patients may be very small or very agitated, not allowing the radiologist to be able to properly contain the exam using gloves, forcing himself to perform the exam without using them [8].

For professionals working in veterinary radiology, knowledge of radioprotection is extremely important, due to the peculiarity of working with animals that need containment [1, 2]. In some cases, radioprotection has been neglected and veterinarians are unnecessarily exposing themselves to X-rays. They are subject to the risks, emergence of unwanted biological effects such as cataracts, leukemia and other cancers inherent in this work activity which is exposure to ionizing radiation [5].

2. Material and Method
The present work is quantitative and observational and was based on collecting personal information, images from the internet and also collecting data from the literature, that is, performing a bibliographic search of articles, norms, ordinances, among others, as regards respect to radiological protection from 07/2018 to 06/2019, using the keywords “radioprotection”, “veterinary radioprotection”, “veterinary radiodiagnosis” and “veterinary imaging diagnosis”.

3. Results and discussion
Radiological protection or radioprotection is the set of measures or actions aimed at protecting human beings and their descendants against possible unwanted effects caused by ionizing radiation [9]. The National Health Surveillance Agency - ANVISA, through Ordinance 453/98, established the basic guidelines for radiological protection in medical radiodiagnosis, however, it neglected to cite veterinary radiodiagnosis services [7].

According to Rosa et al., 2017, the immobilization of animals, in X-ray examinations in veterinary medicine are performed by the veterinarians themselves, making them close to the primary beam, exposing the hands mainly. In 1930, damage to the hands of veterinarians working with fluoroscopy could be observed, and in 1970 radio-induced lesions were common in veterinarians performing X-ray examinations [4].

In 2018, a research on radioprotection in veterinary medicine was conducted using Google Docs®, where questions were directed to veterinarians from all over the country who work directly with ionizing radiation (X-rays) [8].

In a total of 30 answers, 43.3% have a “Lato Sensu” postgraduate degree in diagnostic imaging, 26.7% residency in diagnostic imaging, 16.7% have no specialization, 3.32% doctorate in diagnostic imaging, 6.4% extension course in image diagnosis, 3.32% intensive course in image diagnosis, 3.32% specialization in image diagnosis, not linked to ECM.

Also, 60% of the participating veterinarians assume the role of technician responsible (RT) in radiodiagnosis, 66.7% assume the role of radiological protection supervisor (SPR) and only 13% have radioprotection training established by Ordinance 453/98 updated. Regarding the tests of the quality program in radiodiagnosis, 66.7% reported that they do not perform or are behind schedule and 76.7% have doubts about the current norms and recommendations of radioprotection [8].

Search using Google Docs®. Safety, quality and radiological protection in veterinary radiodiagnosis [8]. In “A”, does Ordinance 453/98 - ANVISA up to date, establish the radiological protection training, 86.7 answered no. In “B”, do you have any questions about current standards and radioprotection recommendations? 76.7 answered yes (figure 1).

Performing a radiographic examination on small animals requires great skill, because due to the patient's need for content and not collaborating, sometimes veterinarians give up the use of the lead glove when performing an x-ray examination, thus, it unnecessarily exposes itself to the primary beam of radiation, and in more severe cases, it exposes the escort (figure 2). According to Ordinance 453/98 ANVISA states that no body part should be exposed to the primary X-ray beam without the use of 0.5 mm lead shielding [3].
Figure 1: Graphic A showing that 86.7 interviewers answered no establish the radiological protection training, graphic B showing that 76.7 interviewers answered yes about current standards and radioprotection recommendations.

Figure 2: Exposure to the primary X-ray beam. Source: Image of the author's personal file.
Doses in the hands of veterinarians are typically less than 0.1 mGy/exposure, but erroneous techniques, unbalanced X-ray equipment, and high flow rates may increase the risk of stochastic effects [4]. According to Nascimento et al. 2019, in a study conducted and published in Encounter X Magazine, the dosimetric evaluation resulting from radiological procedures performed without the use of the plumbiferous glove, the apron monitor dose was 15.89 mSv and the bracelet monitor dose 80.60 mSv. 15,790% higher for the apron monitor and 80,50% higher for the wristband monitor compared to <0.1% mSv / year (table 1) cited by Rosa et al., 2017 (figure 3).

Table 1: Dosimetric evaluation resulting from radiological procedures performed without the use of the plumbiferous glove and apron.

| Total Exams (approximately) | Dose mSv/year | Dose mSv/year |
|-----------------------------|---------------|---------------|
|                             | Apron Monitor | Bracelet Monitor (right hand) |
|                             | 15.89         | 80.60         |

The limits established by CNEN have not been broken, 20 mSv / year for full body and 500 mSv for shivering (table 3), but they are high for a radiodiagnosis service [10].

Table 2: Annual dose limits for public preconized on CNEN - NN 3.01 regulation.

| Greatness | Body       | IOE          | Public          |
|-----------|------------|--------------|-----------------|
| Effective dose | Whole body | 20 mSv       | 1 mSv           |
| Equivalent dose | Hands      | 500 mSv      | - - -           |

According to Nascimento et al., 2019, no x-ray equipment should be held by hand while performing the x-ray examination, the veterinarian should wear a support for the equipment and settle down 2 m using the trigger cable. The imaging plate or radiographic cassette should also not be held by hand during the examination (figure 4). The use of PPE during the exam is mandatory and IOE’s must use the dosimeters [1, 2, 3, 5, 8].

According to Rosa et al., 2017, currently the doses received by veterinarians are estimated to be < 0.1 mSv / year, which indicates the relationship with possible stochastic damage, cancer and cataract. However, it is believed that the dose received should be much higher than that described by the author [4].

There is no Resolution of the Federal Council of Veterinary Medicine CFMV or Regionals CRMV’s on the practice of veterinary radiology and ANVISA Ordinance 453/98, does not mention the veterinary radiodiagnosis sector. It is therefore important to introduce a safety culture in radiation protection in veterinary medicine to inform the class of risks of ionizing radiation and the need to strictly follow international recommendations and national standards [1, 2, 5, 7, 8].
Veterinarians should be prepared to assume the role of radiation protection supervisor, otherwise they may endanger their health and the health of others as well [8 and 11] and the responsibility for radioprotection at the clinic, hospital or diagnostic center by image belongs to the employer [3, 9, 11]. According to ANVISA Ordinance 453/98, in each radiodiagnosis service, a team member must be appointed to answer for the actions related to the radioprotection program, called the radiological radioprotection supervisor [3].

It is the responsibility of the SPR to advise the proprietor in matters relating to radioprotection, with authority to interrupt unsafe operations, and shall: prepare and keep up to date the descriptive radiological protection memorandum, verify that the facilities comply with all requirements of the regulation, certify the safety of the installations during planning, among others [2].

According to ANVISA Ordinance 453/98, to perform the duties of SPR in the service it is necessary to have certification of radiodiagnosis physics specialist or have the same qualification certification required by the Technical Responsible (RT) of the service [3]. A flaw or corporatist protection, because the ideal would be the deepening of the professional, doctor, dentist or veterinarian in radiology diagnosis, dosimetry and radioprotection physics. To avoid conflict between duties, it is not recommended for the veterinarian to assume / accumulate the role, be RT of the service and accumulate the role of SPR.

According to Nascimento, 2015, the role of SPR is to lead teams, supervise machines, analyze the image and follow the preliminary descriptive report to assist the radiologist in the analysis of radiographic and tomographic exams, as well as coordinate and manage teams. It has the power to stop the entire radiology service if it finds any discrepancy without the permission of the RT. Certified and qualified professionals [2] should preferably perform the role of PRS.

4. Conclusions
It has been found that a significant portion of X-ray veterinarians are unaware of or ignore radioprotection standards or have doubts about it, have not been trained, or are outdated with radioprotection training, so they are exposing themselves, unnecessarily, to ionizing radiation putting your health and others at risk.

Although the doses hardly exceed the limits established by CNEN, radioprotection should not be neglected. Doubts about radioprotection by most veterinarians may be due to the lack of a specific technician for radioprotection for the class or lack of training or lack of interest.

To assume the role of Technical Officer and Supervision of Radiological Protection requires
training and qualification. If the veterinarian is interested in assuming these duties, it is recommended that the veterinarian have in-depth knowledge of radiology and imaging diagnostics including radiation physics, quality control, dosimetry and radioprotection.

While there is no veterinary radioprotection standard, resolution or ordinance in the country, CNEN NN 3.01 / 14 and ANVISA Ordinance 453/98 should be followed by the veterinary clinic or hospital and their legal guardians, as well as by the technical responsible and supervisors. radiological protection of the facility for the safety of the veterinary radiology and diagnostic imaging service and safeguarding of veterinarians, staff, patients and the general public.

Finally, it is important to introduce a safety culture in radioprotection applied to veterinary radiodiagnosis so that veterinarians are more aware of the risks inherent in working with x-rays and to develop a specific veterinary radioprotection technical manual so that veterinarians can adequately protect.

Acknowledgment
This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) Finance Code 001.

References
[1] Nascimento, E.T.: Radiological protection of workers and the public in veterinary radiodiagnosis sectors. White House College - FACAB. White House, SP, 2015.
[2] Nascimento, E.T.: The importance of radiological protection for veterinary medicine: the role of the radiological protection supervisor in the management of teams in veterinary imaging sectors. Candido Mendes University - UCAM. Rio de Janeiro - RJ, 2015.
[3] Ordinance 453 ANVISA Ordinance 453/98. Radiological protection guidelines in medical and dental radiodiagnosis. ANVISA / MS, 1998.
[4] Rosa, P.C., Siqueira, D., Barros, F.S. Biological effects and radioprotection in veterinary radiology: a literature review. International Joint Conference RADIO 2017. 2017.
[5] Nascimento, E.T.: The physics of radiodiagnosis: the importance of radiological protection and quality control for veterinary radimdiagnosis. Souza Marques Technical-Educational Foundation - FTESM, 2018.
[6] Furquim, T.A.C., Pinto, A.C.B.C.F., Dias, M.P.T., Santos, A.C., Melo, C.S. Preliminary dose analysis for evaluation of image quality in radiographic examinations in veterinary radiology. Brazilian Journal of Medical Physics. 2010
[7] Nascimento, E.T., Pelegrineli, S.Q., Dos Santos, A.G. Brazilian regulation of radiological protection in veterinary radiodiagnosis. International Joint Conference RADIO 2017. 2017.
[8] Padilha Filho, L.G.; Borges, L.C.; Radioprotection in dentistry: analysis of the faculties of dentistry of the State of Rio de Janeiro regarding the personnel and facilities. PEN - COPPE / UFRJ. Proceedings of the 1st. Ibero-Latin American and Caribbean Congress on Medical Physics. Mexico 98. IAEA, INIS, 1998
[9] National Commission for Nuclear Energy. Basic radiological protection guidelines. (CNEN Standard NN 3.01). Rio de Janeiro, 2014.
[10] Nascimento, E.T., Vieira, L.C.G., Mazutti. M.L.C. Dosimetric evaluation of veterinary radiological procedures performed without the use of lead glove. Meeting X Magazine, 2019.
[11] Regulatory Standard 32. NR 32 - Occupational safety and health in health services. Ministry of Labor and Employment - MTE. GM Ordinance no. 1748, August 30, 2011. D.O.U. 08/31/2011.