Veterinary Roentgenology

A discussion on the use of the X-ray*

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ROENTGENOLOGY in some phase is discussed in most issues of our current veterinary periodicals. The use of X-ray as a diagnostic agent has been, and probably will continue for a time to be, the primary subject of our writers. X-radiation as a therapeutic agent is gradually taking the attention of many advanced workers in veterinary radiology. This application has proven its worth in human therapeutics but due to the expense of equipment and lack of knowledge among practitioners it has gained very little headway in its almost fifty years of veterinary application. It is not unwise to predict that courses in roentgenographic technique and interpretation will soon be offered in our veterinary curricula.

Let us suppose that a practitioner has purchased an X-ray machine and at least the minimum accessories. He faces the problem of learning to use it in a profitable manner. The manufacturer of his machine will be glad to supply him with charts showing its characteristics and giving approximate exposure factors for X-ray pictures. A study of the recent veterinary literature and the purchase of a good basic textbook is but the logical step in the veterinarian's self-education. One such text, the "Manual of Roentgenological Technique" (1940) by L. R. Sante, M. D., is commonly used in colleges of human medicine and has found considerable favor among veterinarians.

Roentgenographic data is likely to be confusing at first. In the data is included the position the subject is in, the distance between the tube and film, the MA, milliamperes, setting, the KV, kilovoltage, setting for a given thickness of the part and the exposure time.

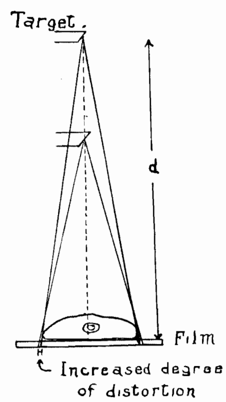

Fig. 1

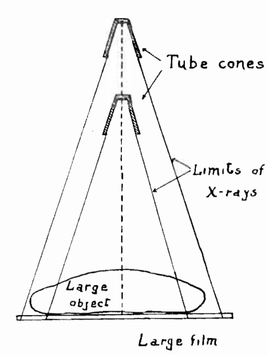

Fig. 2

The distance between the tube and film is measured from a marked point on the tube casing perpendicularly to the top of the film holder. For average work this is standardized at 30 inches. Variation of film-tube distance is done in order to preserve a reasonable degree of accuracy in the picture through perspective (Fig. 1.) and to make the limited cone of X-rays from the tube cover a large size film (Fig. 2.)

If the object radiographed is thin and small, as the leg of a toy fox terrier, the

**Editor's note: For discussions on the principles of Roentgenology and X-ray equipment see the Vet. Student. 3:19-22, 122-124.*

exposure time may be cut down to one half, if the distance is decreased from 30 inches to 21 inches. The physical law governing this is the same as for visible light, i. e., the illumination is inversely proportional to the square of the distance. For example, a picture is made at 30 inches in 4 seconds at 5 MA and 50KV. The time may be reduced without changing the MA or KV by reducing the 30 inch distance to a nearer film-tube position. If distance or "d" is changed to 25 inches, then,

$$\frac{4\text{ sec.}}{(30'')^2} = \frac{X}{(25'')^2}$$

$$30^2.X = 4\text{ sec.} \times 25^2,$$

$$900X = 2500\text{ sec.},$$

$$X = 2.8\text{ seconds exposure time.}$$

If "d" were changed to 36″, then,

$$\frac{4\text{ sec.}}{(30'')^2} = \frac{X}{(36'')^2},$$

$$X = 5.7\text{ seconds exposure time.}$$

Position of Subject

The consideration of the position of the object in relation to the film surface and to the oncoming X-rays is important. Nomenclature of position has been carried over from human technique and describes the body surfaces traversed by the X-rays before striking the film. Thus, "AP" describes an anterior-posterior position wherein the abdominal surface is considered as anterior and the lumbar surface as posterior. Lateral position is termed L, Lat., or Lateral. The rays here penetrate from side to side of the body. A dorso-ventral position is the terminology generally used to describe the position of the extremities, the rays paralleling the long axis of the body.

Securing Detail

In order to secure sharp definition of an object, it is necessary to have it in reasonably close contact with the film. Perfect contact is never achieved. Generally the part of interest, as a femur, is at least an inch from the film surface. With increasing separation the photographic image becomes larger and less distinct. The magnification is due to the radiating rays from the nearby target. The loss of sharpness or distinction is due to secondary and scattered radiation taking place between the object and the film plus distortion due to the angle of the outer rays as compared to the central ray. In order to reduce these tendencies the operator may apply pressure to force close contact and increase the film-tube distance (requiring longer exposure or greater MA).

Still another factor in position is the necessity in a thick subject of placing the suspected portion nearest to the film. The near portion radiographs as distinct and near normal size, whereas the distant part is blurred and magnified. Thus, if there was a suspected malignant growth in the frontal sinus region of a dog, a picture would be made in the AP position where the dorsum of the head would be against the film holder, or in the lateral position with the affected side against the film holder. Naturally, no more tissue should be interposed betwen film and rays than is necessary. The affected region should be isolated whenever possible.

MA and KV Variation

Milliamperage settings as indicated by the milliameter are considered in relation to the exposure time factor. Other factors remaining constant, an exposure of 2 seconds at 10 MA will produce the same density picture as one taken at 4 seconds and 5 MA. Radiographs are generally made at from 10 MA up to 100 MA or more. In fluoroscopy from 2 to 5 MA is generally used. Except in a thick dense subject this will give sufficient illumination on the screen. Higher milliamperages may be used for short periods only, due to the increased target heat with danger of ruining the tube.

The kilovoltage is a set factor on most of the small machines. It varies from 50 to 75 KV. On larger units of the mobile and hospital sizes the thickness of the object to be radiographed is determined and the kilovoltage is increased with greater thicknesses when their unit density remains the same or increases. It has been found best to keep the kilovoltage as

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conducting a research problem on the bacterial flora of acute calf pneumonia.

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low as possible, within a reasonable exposure time, since scattered radiations are produced in soft tissue in relatively greater amounts as the kilovoltage increases.

Proper film exposure is necessary to reproduce accurately relative densities of a subject. Too long an exposure results in a very dark film with a loss in contrast or gradation. Too brief an exposure results in a film that ranges from being thin and contrasty to a blank. Modern film allows a latitude of from 50 percent to 100 percent over or under timing from the optimum while still producing a good, readable X-ray picture. X-ray machines today are supplied with conventional split second timers. To be of value, these must be accurate.

The operator of a new machine with all his data before him, unfortunately, is still not ready to produce radiographs of his patients in an economical manner. The machine must first be calibrated radiographically and any deviations from the supplied data on exposure conditions should be noted as correction factors. A practical way of doing this and at the same time becoming familiar with the actual work is to take an average subject and make a series of one or two dozen pictures. The subject could well be a thirty to forty pound dog, in normal health, which has been put under surgical anesthesia. Nembutal with its prolonged effect would be suitable. Pictures should be made of the head, thoracic region, abdominal region, pelvis, and the limbs. The first picture of any part should be made exactly according to data supplied by the manufacturer. Upon development the picture will probably show considerable deviation from normal exposure. Another film of identical subject matter is then made with a correction in either timing or milliamperage. At first any correction should be two to four times more or less than the original factors. Thus, a picture of the foot taken at 30 inches, 10MA, ¼ second could show overexposure to a noticeable degree. To reduce this exposure to one half any one of the factors could be changed as the 30 inches to 42 inches, 10MA to 5 MA, or ¼ to ⅛ second. If the problem is handled in this manner, the veterinarian will be able to produce reasonably good pictures in the majority of his first attempts on subsequent subjects. Good common sense coupled with an understanding of the fundamentals is always required. In addition to his calibration data, the veterinarian will also have collected a series of good radiographs of normal areas of the animal body. If kept available, these are often of value when compared to similar pictures concerning the pathological subject. This comparison will also help in explaining an abnormal condition to a patient's owner.

Handling and restraint of a small animal is often attended by much trouble. A frightened or hurt animal resists being held in position for X-ray examination. Whenever possible, anesthetize the patient. The barbiturates, especially those of short effect, are applicable. Morphine or ether may be used, but the latter with a shockproof machine only because of the danger of explosion. The use of small sandbags, holding a pound or two of sand, is a frequently used device in maintaining the immobility of a limb. In order to make better contact between subject and cassette and aid in immobilization, a thin strip of cloth may be put over the part to be X-rayed. Hanging weights may be attached to both ends or the operator may pull the free ends down tightly by hand while making the picture. Movements of respiration are annoying when radiographing the body cavity. These may be stopped for several seconds by pinching off the nostrils and holding the mouth shut at the same time.

A veterinarian with X-ray equipment will come to rely heavily upon it as a diagnostic aid. In large animals, especially in light horse practice, radiography is an invaluable aid in correct diagnosis of the numerous types of bone and joint pathology of the limbs. The small animal field, naturally, finds greater use for it. Fractures and dislocations with subsequent checks on reduction are conditions for which the X-ray is most generally used. X-ray examinations of the digestive tract for foreign bodies and for content of the lower bowel are helpful in making a correct diagnosis.

Before closing, a note of warning to users of X-radiation is added. Prolonged exposure to the primary tube radiation produces cellular damage in the operator or patient. Fluoroscopy often results in excessive exposure of the technician's hands. This may be manifested locally by an erythema, drying and exfoliation of the epidermis, soreness of the joints and tendons, or a pulsating sensation in the exposed part synchronized with the alternating current. More severe "burns" are seldom encountered in the veterinary field. Reflected radiation from powerful machines may do the same damage. Common sense dictates that the operator will expose the patient and himself to X-radiation no more than is absolutely necessary.

VITAMIN E *(Continued from page 29)*

Most of the work with vitamin E therapy in the larger domesticated animals has been reported by European investigators. They cite case reports in which animals, having a bad breeding history, have been restored to fertility.

The reports of Bay and Vogt-Moller (5) and Moussu (6) include large numbers of case reports, but it is difficult for the unbiased to draw conclusions from mere clinical observations when dealing with a function attended with as many variables as reproduction. Some investigators doubt if vitamin E is necessary at all in our large animal rations. Others say that due to its wide distribution in nature, its stability, and the low requirements of our animals, that practical livestock and poultry rations do not need to be supplemented with vitamin E. Such a procedure simply adds unnecessarily to the cost of rations.

It is not the purpose of this paper to discredit wheat germ oil. It is without doubt a concentrated natural source of vitamin E as well as the B complex and possibly other nutritional entities. We have simply tried to present true facts concerning the present day knowledge of vitamin E.

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compelled to. It seemed to me that while the European schools were much better supported financially than our own, our practitioners are kept more on their mettle than they are over there. If they do not deliver the service they are not employed. While no one has higher regard for the service by our Bureau of Animal Industry than I do, I would not want to see a time when our veterinary practice was on anything but a voluntary basis. State medicine may be just around the corner, but if it comes, much of the fine client-practitioner relationship will be lost. While our relation to agriculture is unique, and while both sides may have strained it at times, there is still much to be said for this cooperation. If we can serve the great livestock industry on the one hand and protect the health of the public generally on the other, our place in the American scheme will be assured and permanent.