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2. SUMMARY

Introduction:

The field of large animal trunk radiography is relatively new in veterinary medicine. Veterinary radiology has been mainly confined to the examination of the lower parts of the extremities and of the head. This is explained by the absence of powerful enough clinical x-ray units.

Although constant improvement of radiological equipment and availability of powerful x-ray units for veterinary medicine in the last few years have resulted in research and clinical reports in large animal radiography, the digestive tract of the horse has remained a neglected subject.

The purpose of this thesis is to make a contribution to the radiology of the equine digestive system.

Equipment and methods:

The project was accomplished by the use of the x-ray machine of the Department of Surgery of the Faculty of Veterinary Science, University of Pretoria. This is a triplex optinatic 1023, made by Elema Schönander AB of Stockholm, Sweden. It has an output of 100 KV at 640 MAS or 200 KV at 320 MAS.

All exposures were done through a grid. The animals studied were four grown and mature horses. Studies were made in standing position. Every procedure was repeated twice on each horse, and when results varied, repeated studies were made until conclusions were arrived at.

In the studies made, special attention was given to locate and define the external area of exposure to demonstrate each part of the digestive tract, and to the correct exposure data.

In the report - discussion of the anatomy, histology and physiology of each section of the tract proceeds the description of the technique and exposure data. The findings are discussed fully in each section.

Oesophagus:

For the purpose of study, the oesophagus was divided into three parts: cervical, thoracic and abdominal parts.

a) Cervical oesophagus:

The technique which proved to demonstrate this section best was voluntary intake of contrast medium in a form of barium sulphate paste. Some of the findings of this section were;

- i) Longitudinal folds of the oesophageal mucosa were demonstrated.
- ii) An apparent physiological sphincter was seen at cranial end of the oesophagus.
- iii) The normal curve of the oesophagus was well demonstrated.

b) Thoracic oesophagus:

The technique which was found to demonstrate this section best was barium meal drench. Some of the findings were:

- i) Barium accumulated at the lowest point of the thoracic oesophagus, i.e. the thoracic inlet.
- ii) A complete filling effect of the oesophagus in this section has shown an indentation at the level of the aortic arch.

c) Abdominal oesophagus:

Technically it was possible to demonstrate this section by insertion of a stomach tube full of barium suspension.

The most important finding was the fact that this section has a very steep decline into the cardia. A

Stomach:

Technically it was found that the dorso-ventral projection with contrast media is the preferred method for study of the stomach. The stomach could, however, be demonstrated also by lateral projection for which air insufflation and barium meal were necessary.

Some of the findings were:

- i) The size and shape of the stomach varied with the amount of its contents.
- ii) Expansion of the stomach occurs towards the cranial part of the abdomen.
- iii) The position of the stomach was not permanent. It varied between individual horses and even in the same horse.
- iv) The pylorus is usually to the left of the midline.
- v) Food leaves the stomach as early as 10 minutes after the meal.
- vi) Gastric emptying time varied with the type of food consumed.

Duodenum:

Technically the dorso-ventral projection was found to be the only way to demonstrate the identifiable parts of the duodenum.

Some of the findings were:

- i) Contrast medium was essential.
- ii) It was possible to demonstrate the pyloro-duodenal junction.
- iii) Only the first part of the duodenum was well identified in the radiographs.
- iv) The sigmoid section of the first part was clearly defined only within the first ten minutes after the barium drench.

Ileo-jejunum:

Technically the lateral projection was found most suitable to demonstrate this section.

The most important finding was the fact that it was not possible to interpret fully the radiographs of the small intestines.

Caecum:

Technically it was found that the horse must be cast down and anaesthetized for radiography of the caecum. The best radiographs were produced by long exposures of low MA.

Some of the findings were:

- i) It was possible to demonstrate well the base and apex of the caecum.
- ii) Accumulation of most of the barium in the caecum takes place about four to five hours after the barium drench.

Colon:

It was considered to be impractical to examine the colon radiographically, due to its large caliber. Only the pelvic flexure of the colon was studied.

Technically it was found that only lateral projection could be used in studies of the pelvic flexure.

Some of the findings were:

- i) It was possible to demonstrate clearly the pelvic flexure.
- ii) Contrast media started to appear in the pelvic flexure about five hours after drenching the animals.
- iii) There appeared to be a physiological obstacle in this section of the bowel. One and a half hours to two hours passed from the appearance of the contrast media in the lower part of the

flexure until the complete filling of it.

Rectum:

Technically the lateral projection was the only possible method for radiography of the rectum.

Some of the findings were:

- i) By barium enema the rectum was well demonstrated.
- ii) Warm barium enema penetrated several coils of the small colon.
- iii) Barium enema was almost invariably expelled by defecation in one and a half hours time.

The report terminates with general conclusions and suggestions for further research in this subject.

F. BIBLIOGRAPHY

1. Alexander F. & Benzie D. 1951 Radiological study of the digestive tract of a foal.
Q.J.Exp.Physiol. 36:213.
2. Alexander J.E. 1967 Radiological findings in equine choke. J.Am.vet.med.Ass. 151:47.
3. Bartels J.E. 1969 Persistent right aortic arch in the horse. J.Am.vet.med.Ass. 154:406.
4. Blood D.C. & Henderson J.A. 1960 Veterinary Medicine 2nd ed. Bailliere. London.
5. Broom A.E. 1952 The future expectation of radiology in larger animals. Swest Vet. 6:42.
6. Carlson M.D. 1963 Veterinary Radiology. Bailliere, Tindall & Cox, London.
7. Dixon. 1968 Radiographic techniques in equine radiography. Vict.vet.Proc. 25:86.
8. Douglas S.W. & Williamson H.D. 1967 Principles of Veterinary Radiography. Bailliere, Tindall & Cassell, London.
9. Drury F.S., Dyce K.M. & Merlen R.H. 1954 Some practical aspects of the experimental radiology of larger domestic animals. Vet.Rec. 66:593.

10. Dukes H.H. 1955 The Physiology of Domestic Animals.
Comstock Publishing Ass. Ithaca.
11. Dyce K.M. 1956 The ileoceocol region of the horse.
Anat. Anz. 103:344.
12. Dyce K.M. 1960 Observations upon the gastro-intestinal
tract of the living foal. Br.vet.J. 116:241.
13. Elijas E. 1967 Radiography of the vertebral column
in cattle. Vet. Arch. 37:219.
14. Ellenberger W.E. & Baum H. 1897 Topographische
Anatomie des Pferdes. Paul Parey, Berlin.
15. Garnham D.L. 1968 Hip dysplasia in Hereford cattle.
J.Am.vet.med.Ass. 152:1150.
16. Geros V. 1963 X-ray diagnosis of intrathoracic compli-
cations of traumatic reticulitis in cattle.
Proc. 17th Int.vet.Cong. 2:1139.
17. Lewandowski M. 1963 X-ray techniques for reticulitis
and peritonitis in cattle. Medycyna Wet. 19:554.
18. Maximov A. & Bloom W. 1950 Textbook of Histology.
Saunders. London.
19. Mill J. 1968 Radiography in diagnosis of thoracic
diseases in large animals. Mh. Vet. Med. 23:382.
20. Muller L.F. 1951 Die Bewegungsercheinungen am Darne
des Pferdes nach Röntgen Untersuchungen
beim Pony. Inaug. Dis. Leipzig.

21. Nagel E. 1964 Radiography of the abomasum in adult cattle. Rep.3rd.Int.Cong.Dis.Cattle. 375.
22. Nagel E. 1966 Radiography of abomasum in adult cattle. Arch. Exp. Vet. Med. 20.
23. Nagel E. 1968 Radiography of oesophagus in cattle and horses. Schweizer Arch. Tierheilk. 110:320.
24. Raker C. & Sayer A. 1958 Oesophageal rupture in Standard Bred mare. J.Am.vet.med.Ass. 133:371.
25. Rapic S. 1965 Radiography of vertebral columna in horses. Vet. Arch. 35:105.
26. Roberts E.J. 1967 Some examples of use of radiography in equine surgical procedures. Proc. R. Soc. Med. 60:786.
27. Sattler H.G. 1968 Radiography of traumatic pericarditis in cattle, with particular references to techniques used. Arch.Exp. 22:443.
28. Schebitz H. 1968 Atlas der Rontgenatomie von Hund und Pferd. Verlag Paul Parey. Berlin.
29. Sisson S. & Grossman J.D. 1955 Anatomy of domestic animals. Saunders. Philadelphia.
30. Vinokhodov V.A. 1962 Radiography of heart of cattle with traumatic pericarditis. Veterinariya. Moscow. 6:53.

31. Weaver A.D. 1969 Hip lameness in cattle. Vet. Rec.
85:504.
32. Zeskov B. 1963 Transrectal cystography in horses and
cattle. Proc. 17th Int. Vet. Cong. Vol. 2:1350.

DIE RADIOLOGIESE ONDERSOEK VAN DIE PERD
SE SPYSVERTERINGSKANAAL

deur

URI BARGAI

Promotor: Prof. Dr. C.F.B. Hofmeyr

Departement Chirurgie, Fakulteit Veeartsenykunde,
Universiteit van Pretoria.

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OPSOMMING

Inleiding:

Radiografiese ondersoek van die romp van groot huisdiere is 'n relatiewe nuwe ontwikkeling in die Veeartsenykunde. Tot dusver was die metode van ondersoek in hierdie diersoort hoofsaaklik beperk tot die kop en die laer dele van die ledemate. 'n Gebrek aan kragtige X-straal apparaat was hiervoor verantwoordelik.

Alhoewel verbeterde radiografiese toerusting en die beskikbaarwording van kragtige X-straal apparaat vir Veeartsenykundige doeleindes in die laaste aantal jare gelei het tot navorsing van, en kliniese verslae oor, radiografie van groot huisdiere is die spysverteringskanaal van die perd nie bestudeer nie.

Die doelstelling met hierdie tesis is om 'n bydrae te lewer tot die radiologie van die perd se spysverteringskanaal.

Toerusting en metodes:

Die ondersoek is gedoen met behulp van 'n Triplex Optimat 1023 X-straal apparaat, (vervaardig deur Elema Schönander AB van Stockholm, Swede), van die Departement Chirurgie, Fakulteit Veeartsenykunde, Universiteit van Pretoria. Die apparaat lewer 100 KV by 640 MAS of 200 KV by 320 MAS.

'n Weerder (GRID) is deurguans tydens beligting gebruik. Vier uitgegroeide, volwasse perde is in die staande posisie bestudeer. Elke prosedure is twee maal herhaal vir elke perd en wanneer resultate nie ooreengestem het nie is die ondersoek herhaal totdat gevolgtrekkings gemaak kon word.

Spesiale aandag is gegee tydens die ondersoeke aan die lokalisering en omskrywing van die liggaams-oppervlaktes wat oorliggend was tot die dele van die spysverteringskanaal wat ondersoek is; asook die korrekte beligtings-gegewens.

In dié verslag word n beskrywing van die tegniek en beligtings-gegevens van toepassing op elke spesifieke deel vooraf gegaan deur n bespreking van die anatomie, histologie en fisiologie van dié deel van die spysverteringskanaal wat onder bespreking is. Die bevindings word volledig in elke seksie bespreek.

Slukderm:

Vir die doel van die studie is die slukderm onderverdeel in drie dele naamlik servikale, torakale en abdominale dele.

a) Servikale slukderm:

Dié deel van die slukderm kon beste demonstreer word na die vrywillige inname van kontrasmiddel in die vorm van Barium sulfaat pasta. Sommige van die bevindings in die deel was:

- i) lengtevoue in die slymvlies is demonstreer
- ii) n klaarblyklike fisiologiese sfinkter is waargeneem by die ingang tot die slukderm
- iii) die normale kurwe van die slukderm kon goed demonstreer word.

b) Torakale slukderm:

Vir die beste demonstrasie van dié deel moes n Bariummaal toegedien word.

Sommige van die bevindings hier was:

- i) Barium sulfaat het aangesamel by die laagste punt van die torakale slukderm naamlik by die ingang tot die borskas.
- ii) Waar die aorta boog die slukderm kruis kon met volledige vulling van die slukderm n vernouing daarin aangetoon word.

c) Abdominale slukderm:

Dit was tegnies moontlik om die deel van die slukderm te demonstreer deur n maagbuis met Barium sulfaat gevul daardeur te passeer. Die belangrikste bevinding was die baie sterk afwaartse neiging na die kardia van die maag.

Maag:

Vir bestudering van die maag is bevind dat n dorso-ventrale beligting met kontrasmiddel in die maag tegnies die beste benadering is. Die maag kon egter ook demonstreer word met n laterale beligting na insufflasie van lug en n Bariummaal.

Sommige van die bevindings was:

- i) die grootte en vorm van die maag varieer met die hoeveelheid inhoud daarvan.
- ii) Uitsetting van die maag geskied in die rigting van die kraniale gedeelte van die buik.
- iii) Die ligging van die maag was nie konstant nie. Dit het varieer tussen individuele perde en selfs in dieselfde perd.
- iv) Die pylorus is gewoonlik links van die mediane lyn geleë.
- v) Kos verlaat die maag so vroeg as 10 minute na n maaltyd.
- vi) Die tydsduur vir lediging van die maag varieer met die tipe voedsel ingeneem.

Duodenum:

Tegnies is bevind dat n dorso-ventrale beligting die enigste metode was om die uitkenbare dele van die duodenum te demonstreer.

Sommige van die bevindings was:

- i) Kontras media was absoluut essensieel
- ii) Dit was moontlik om die pyloro-duodenale aansluiting te demonstreer.
- iii) Slegs die eerste deel van die duodenum kon duidelik op die X-straalfotos uitgeken word.
- iv) Die S-vormige gedeelte van die eerste deel van die duodenum was slegs binne die eerste 10 minute na 'n Bariummaal duidelik omlin.

Ileo-jejunum:

Tegnies kon met 'n laterale beligting die mees bevredigende demonstrasie van die deel gelewer word.

Die mees belangrike bevinding was die feit dat dit nie moontlik was om uit X-straalfotos van die dunderm enige afleidings te maak nie.

Caecum:

Vir 'n radiografiese ondersoek van die caecum was dit nodig om die perde neer te trek en onder narkose te plaas. Die beste X-straalfotos is verkry deur 'n lang beligtingstyd en 'n lae MA.

Sommige van die bevindings was:

- i) Die basis en apex van die caecum kon goed demonstreer word.
- ii) Vier tot vyf uur nadat 'n Bariummaal toegedien is is meeste daarvan in die caecum versamel.

Kolon:

Vanweë sy omvang was dit nie as prakties uitvoerbaar beskou om die hele kolon te bestudeer nie. 'n Studie is slegs van sy pelviese buiging gemaak.

Tegnies is bevind dat slegs die laterale beligting in die bestudering van die pelviese buiging gebruik kon word.

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Sommige van die bevindings was:

- i) Die pelviese buiging kan duidelik demonstreeer word.
- ii) Kontrasmedia het ongeveer vyf uur na toediening hulle verskyning in die pelviese buiging begin maak.
- iii) n Fisiologiese hindernis is skynbaar in hierdie deel van die darm aanwesig. Anderhalf tot twee uur het verstryk vandat die kontrasmiddel sy verskyning in die laer deel van die buiging gemaak het totdat dit algeheel daarmee gevul was.

Rektum:

Tegnies gesproke was n laterale beligting die enigste moontlike metode vir radiografiese ondersoek van die rektum.

Sommige van die bevindings was:

- i) Die rektum kon goed demonstreeer word
- ii) Na n warm Barium lawement het n paar lusse van die klein kolon sigbaar geword.
- iii) Barium lawement is feitlik altyd binne anderhalf-uur deur ontlasting uitgeskei.

Die verslag word beëindig met algemene gevolgtrekkings en voorstelle vir verdere navorsing in die rigting.