THE DEVELOPMENT AND USE OF RADIOPAQUE MARKERS FOR THE ASSESSMENT OF GASTRIC EMPTYING IN DOGS

A THESIS PRESENTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF VETERINARY SCIENCE
AT MASSEY UNIVERSITY

FRAZER JAMES ALLAN
1995

Abstract

Currently, there is no suitable technique that can be used by veterinarians in private practice to assess the rate of emptying of solids from the stomach of dogs. Radiographic studies using barium sulphate suspension are commonly employed by veterinarians to assess gastric emptying. However, these methods are qualitative and assess the gastric emptying of liquids not solids. Diseases which affect gastric emptying are more likely to affect the emptying of solids rather than liquids. The objective of this study was to develop a technique that the practising veterinarian could use to assess the rate of gastric emptying of solids in dogs.

The study was divided into two parts, the development of radiopaque markers and the development of a method utilising these radiopaque markers that could be used in veterinary practice to assess the gastric emptying of solids.

A 1.5 mm diameter (small) marker and a 5.0 mm diameter (large) marker were developed based on studies by other investigators. It was anticipated that the small marker would empty from the stomach with food and the large marker would empty with the onset of the migrating motility complex. Both markers were made from a compound containing high density polyethylene and barium sulphate.

The gastric emptying of both sizes of marker was then assessed in 20 healthy, mixed breed dogs. Studies were performed on days one, six and nine of the investigation. After a 24 hour fast, thirty small and ten large markers were placed into a standard meal comprising of canned Prescription Diet® d/d. With the dogs restrained in ventrodorsal and left lateral recumbency, radiographs were taken hourly until all, or most of, the markers had emptied from the stomach. Percent gastric emptying of the markers versus time curves (GEvT curves) were then generated from this data. The time taken to reach the point of inflection on the GEvT curve (the lag phase), and the times taken to empty 25%, 50% and 75% of the markers (T_{25}, T_{50} and T_{75} respectively) were calculated from the GEvT curves. The sex and age of the dogs and training the dogs to the radiographic procedure did not have a significant effect on the gastric emptying parameters. There was a weak but significant positive correlation between dog weight and the T_{50}.

There were no significant differences in the T_{25}, T_{50} and T_{75} between the large and small markers. Contrary to their anticipated behaviour, the large markers left the stomach during the fed motility pattern. A larger, 7 mm diameter marker, may be required to mark the onset of the MMC in dogs.

The mean GEvT curve of the small markers on day one (with 95% confidence intervals) was considered to represent the most appropriate gastric emptying reference curve for clinical use. The lag phase of the small markers on day one was 2.45 ± 2.04 hours, the T_{25} was 4.85 ± 2.15 hours, the T_{50} was 6.05 ± 2.99 hours and the T_{75} was 8.32 ± 2.72 hours. If delayed gastric emptying is suspected, taking two or three sets of radiographs at regular intervals from 6-16 hours after feeding and comparing the results with the reference curve is probably the most appropriate method of assessing gastric emptying in a patient. Conversely, if excessively rapid gastric emptying is suspected, taking two or three sets of radiographs at regular intervals from 0-5 hours after feeding and comparing the results with the reference curve is most appropriate.

In conclusion, radiopaque markers provide a simple quantitative method of evaluating the gastric emptying rate of dogs. However, the results of this study have not established that the gastric emptying of the small markers occurs at the same rate as the gastric emptying of food. In addition, the sensitivity and specificity of this diagnostic procedure still needs to be determined. These steps in the validation process are currently being carried out at the Department of Veterinary Clinical Sciences at Massey University.

Acknowledgements

I would like to thank my supervisors, Grant Guilford and Boyd Jones, for their guidance, patience and support. In particular, Boyd's constructive comments on the finer points of the English language and Grant's endless enthusiasm and optimism were of great help to me.

To Ian Robertson, thank you for your expert advice and for the many hours you spent poring over radiographs on my behalf. Special thanks also to Marge Chandler and Phillip Judge for sacrificing many nights of sleep to help me collect data through the "graveyard shift".

This thesis would not have been possible without the loving support of my wife, Rebecca, who helped me collect data, proof-read the text and encouraged me through this project.

Thank-you to Fiona Dickinson for assisting me with the graphics and the trickier aspects of word-processing. I extend my appreciation to the staff of the small animal hospital, in particular, Jill Hogan and Pauline Gordon for their expert attention to the dogs during the study. Thank-you to the radiology staff, Hilary Burbidge, Nicki Moffat and Su Jenkins for their professional advice and for sharing the radiology suite with me during the data collection.

I acknowledge the generous support of the Comparative Gastroenterology Society for funding this study, Stallion Plastics who supplied the radiopaque markers at cost price and Friskies Pet Care for providing the maintenance dog food ration.

Table of Contents

Chapter Three **Physiology of Gastric Emptying in Humans and Monogastric Animals**

Chapter Four **Techniques for Assessing the Rate of Gastric Emptying**

Chapter Five **Materials and Methods**

Phase One - Radiopaque Marker Development and Selection of the Test Meal

Chapter Six **Materials and Methods**

Phase Two- Gastric Emptying Studies Using Radiopaque Markers in Healthy Dogs

Chapter Seven **Results**

Chapter Eight **Discussion**

List of Tables

List of Figures