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## ► To cite this version:

D. A. Titchen. THE NATURE AND CONTROL OF GASTRIC MOTILITY IN RUMINANTS. Annales de Recherches Vétérinaires, 1976, 7 (2), pp.165-168. hal-00900885

**HAL Id: hal-00900885**

**<https://hal.science/hal-00900885>**

Submitted on 11 May 2020

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## THE NATURE AND CONTROL OF GASTRIC MOTILITY IN RUMINANTS

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Three forms of movement of the more cranial divisions of the ruminant stomach which have been stimulated as reflex responses in decerebrate preparations are :

### I. — RETICULAR GROOVE CONTRACTIONS

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Earlier evidence on the reflex stimulation of the *sulcus reticuli* reticular and rumen contractions and their form have been reviewed [1, 2]. The groove has an efferent postganglionic atropine-sensitive vagal innervation which has been demonstrated to be effective by the 110th day of gestation judged by groove contraction observed in the sucking foetal lamb [3]. It has been stimulated to contract as a reflex response to afferent superior laryngeal nerve stimulation and the introduction of water into the posterior mouth cavity in decerebrate preparations of lambs and calves [4] in which basic characters of reflexes, such as reflex latency, summation of individually inadequate stimuli and various peripheral origins of central inhibition were demonstrated. When the reticular groove is stimulated to contract in conscious animals reticular contractions are inhibited to a varying degree and may cease completely during sucking [5]. Two components of this inhibition have been postulated, one temporally associated with the initiation of reticular groove contractions, the other related to the inhibition arising from abomasal distension (an inhibition by abomasal stretch was demonstrated in decerebrate preparations [4].)

The contraction of the reticular groove is one part of a series of reactions contributing to the direct passage to the abomasum of suckled liquid. Other components which have been identified by still radiographic [6], cineradiographic [7] and/or electromyographic observations (NEWHOOK and TITCHEN, unpublished) are (i) particular forms of contraction of the caudal thoracic oesophagus and (ii) an opening of the reticulo-omasal orifice. The importance of these associated reactions is

indicated by the continued passage of much of the sucked liquid to the abomasum after contraction of the groove was blocked by atropine which prevents neither vagally stimulated opening of the reticulo-omasal orifice nor striated muscle activity of the oesophagus.

Higher central control of the reticular groove and of the reticulo-omasal orifice is indicated by the observations that the former may contract and the latter dilate when lambs are shown, but not allowed to suck from, a bottle from which they have been accustomed to drink [6]. These reactions may be important in attempts to use the reticular groove to direct food substances or drugs to the abomasum. The importance of taste stimulation of contraction of the reticular groove contraction has been recognized [8] but still remains to be investigated in detail. Species differences, in particular, require attention. Taste probably remains important in arousal of the reticular groove mechanism despite demonstrations of its stimulation primarily as a behavioural response.

## 2. — RETICULAR AND ASSOCIATED RUMEN CONTRACTIONS

Earlier definitive studies on reflex stimulation of contractions of the adult ruminant stomach on the production of contractions of the reticulum have been reviewed [2]. These observations were made in decerebrate preparations and anesthetized animals in which reticular contractions were stimulated by its distension or afferent vagal stimulation. Reticular contractions have been obtained in response to buccal, oesophageal and other gastric stimuli [2]. Acid stimulation of abomasal receptors, tactile and stretch stimulation have all been shown to be important in reflex and concurrent vagal efferent and afferent recording studies [16].

Reticular contractions rarely if ever occur naturally, isolated from associated ruminal contractions and opening of the reticulo-omasal orifice (ROO). The stimulation of ruminal contractions spreading caudally over the rumen to follow reticular contractions, was identified as a specific response to stretch of the rumino-reticular fold. The reflex factors which contribute to stimulation of closure or opening of the ROO have not been identified. Its effector sensitivity to  $\alpha$  and  $\beta$  adrenergic closure and opening mechanisms [9] and atropine sensitive closure, and resistant opening vagal mechanisms have however been shown [10]. This complex effector sensitivity is probably representative of the sensitivity of the ruminant stomach generally.

## 3. — RUMINAL CONTRACTIONS INDEPENDENT OF THOSE OF THE RETICULUM

Eructation cycles or rumen contraction have been stimulated in decerebrate preparations by gaseous distension of the rumen. In decerebrate preparations they have been shown to be specially susceptible to inhibition, which in the case of these

reflex visceral responses may be mediated by afferents taking a course in the vagus or splanchnic nerves [2, 13].

The rumen contractions of eructation differ from those associated with mixing of digesta. Recordings from exteriorizations, cineradiographic and electromyographic studies revealed an early contraction of the dorsal part of the caudal ventral blind sac and then sequentially caudal and more cranial regions of the dorsal rumen [2, 11, 12]. The cycle is completed after an eructation with a contraction of the ventral sac of the rumen [2]. The factors involved in the production of the different direction of contraction of the dorsal sac have not been defined. It is however possible with different parameters of vagal efferent stimulation to produce different forms of ruminant contraction [13], as well as to produce them reflexly [13].

### THE CENTRAL, NEURAL, MECHANISMS

Reflex centres concerned in these responses are in the medulla oblongata. Evidence for this includes the demonstration of the responses in decerebrate preparations. Responses of decerebrate preparations with the spinal cord also cut, strengthen the contention that the responses are vago-vagal reflexes. Further evidence in support of the medullary location of the reflex centres has come from studies on intramedullary stimulation, medullary lesions and examinations of retrograde medullary degeneration after gastric branches of the vagus were cut. Reference to literature on these topics was made in a report of the use of the technique of intramedullary neurone recording concurrently with recording gastric motility [14]. In decerebrate preparations it is necessary to apply a stimulus to maintain reflex contractions of the reticulum and rumen and rhythmic activity in medullary motor neurones causally associated with reticular contractions cease when the vagus nerves are cut. This is presumably due to withdrawal, by vagotomy, of excitatory afferent vagal inputs. However continued rhythmic electrical activity in 'gastric centres' after bilateral vagotomy suggests that there is a cyclical activity due to an input to the medullary centres from higher levels in the nervous system [14]. The respective contributions of peripheral and central influences to regulation of the rate and form of reticular and rumen contractions requires more complete analysis than have been achieved to date. This is specially evident in the case of eructation cycles of rumen contractions.

### GASTRO-INTESTINAL HORMONES

Since the report [15] that the gastric pentapeptide, pentagastrin, reduces the frequency and force of reticular and rumen contractions the importance of gastro-intestinal hormones in the modification of gastric motility in ruminants has been increasingly studied. The relative importance of these hormonal and neural effects in modifications of the motility of the more cranial divisions of the stomach following changes in conditions in the small intestine remain to be defined, as do the inter-relations between neural and hormonal factors.

## REFERENCES

- [1] SELLERS A. F., STEVENS C. E., 1966. *Physiol. Rev.*, **46**, 634-661.
  - [2] TITCHEN D. A., 1968. In *Handbook of Physiology*. Section 6 : Alimentary Canal, Vol. 5, Ch. 12, (C. F. Code, ed.), Washington, D. C., American Physiological Society.
  - [3] DUNCAN D. L., PHILLIPSON A. T., 1951. *J. exp. Biol.*, **28**, 32-40.
  - [4] COMLINE R. S., TITCHEN D. A., 1951. *J. Physiol.*, **115**, 210-226.
  - [5] KAY R. N. B., RUCKEBUSCH Y., 1971. *Br. J. Nutr.*, **26**, 301-309.
  - [6] NEWHOOK J. C., TITCHEN D. A., 1974. *J. Physiol.*, **237**, 415-430.
  - [7] NEWHOOK J. C., TITCHEN D. A., 1975. In *Proceedings IV International Symposium Ruminant Physiology* (I. W. McDonald ed) Armidale, New England University Press.
  - [8] WATSON R. H., JARRETT I. G., 1944. *Bull. Council scient. ind. Res. Melb.*, **180**, 95-126.
  - [9] TITCHEN D. A., NEWHOOK J. C., 1968. *J. Pharm. Pharmacol.*, **20**, 947-8.
  - [10] NEWHOOK J. C., TITCHEN D. A., 1972. *J. Physiol.*, **222**, 407-418.
  - [11] AKESTER A. R., TITCHEN D. A., 1969. *J. Anat.*, **104**, 137-151.
  - [12] RUCKEBUSCH Y., KAY R. N. B., 1970. *Ann. Rech. vétér.*, **2**, 99-136.
  - [13] REID C. S. W., TITCHEN D. A., 1965. *J. Physiol.*, **181**, 432-448.
  - [14] HARDING R., LEEK B. F., 1971. *J. Physiol.*, **219**, 587-610.
  - [15] CARR D. H., MCLEAY L. M., TITCHEN D. A., 1970. In *Physiology of Digestion and Metabolism in the Ruminant* (A. T. Phillipson ed) Newcastle upon Tyne : Oriel.
  - [16] IGGO A., LEEK B. F., 1967. *J. Physiol.*, **193**, 95-119.
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