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VAGAL DIGESTIVE DEAFFERENTATION IN SHEEP

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The vagus nerve has a double purpose. The role of the contingent of motor fibres in the transmission of motor orders to the oesophagus and the stomach is well known in the sheep. The existence of a contingent of sensitive fibres is confirmed by the appearance of the vago-vagal digestive reflexes and by the recording from the nerve of the activity of receptors located in the wall of the gut. So, we propose to evaluate the importance of the sensitive vagus nerve in the digestive function, bearing in mind that the neurons of the vagal visceral sensibility get their perikaryas gathered in the nodose ganglion.

Material and Methods

The vagal afferences were partially or completely removed, so as to study the effects of the deafferentation on gastric motility recorded by usual electromyographic and manometric techniques. Unilateral deafferentation was performed in five sheep. The animals were anaesthetized and a dissection, under surgical lens, enabled the nodose ganglion to be separated from the bundles of likely motor fibres running on its surfaces. A steel thread was looped around the cell mass and its two ends, gathered in the lumen of a catheter, protuded from the sutured wound in the skin. It was then possible to cut the afferences in the conscious animals, by moving the two ends of the thread back and forth and to observe the immediate results of the deafferentation. Total or subtotal deafferentation was performed in the same way in four other sheep, in which the upper and lower thoracic branches of the contralateral vagus, behind the cardio-pulmonary ramifications, were cut. So, the digestive afferences were as a rule interrupted and one motor vagal contingent was kept.

Results

1. Verification of the deafferentation

If we take into account the division between the motor bundles and the mass of sensitive cells of the nodose ganglion which is not always clear in the sheep, it was necessary to verify whether the unilateral deafferentation had really been performed. It is known that the stimulation of the central end of a cut vagus nerve induces a long latency reflex contraction of the reticulo-rumen (Dussardier, 1960). When we stimulated the intact vagus contralateral to the deafferentation side by iterative
shocks, we recorded a direct motor response quickly induced by the stimulation of the vagal afferences, followed 4 to 12 seconds later by the reflex contraction triggered by the centripetal stimulation of the afferent nerve contingent. On the other hand, when the supposedly deafferented vagus was stimulated under the same conditions, no late reflex response meant that the section of unilateral afferences had been correctly performed.

2. Effects of the unilateral deafferentation

The section of the right or left vagal afferences was followed by an immediate stopping of gastric contractions for 3 to 5 minutes. Recovery to the normal rate was achieved between 60 minutes and 72 hours. We verified in two other sheep that neither the section of the glossopharyngeal nerve nor that of the entire cervical vagus nerve had any effect on the rhythm of the gastric contractions. The early depressed effects were therefore specific to the section of the only digestive vagal afferences and not the consequence of stress. The unilateral lack of afferences may unbalance the normally synchronized working of both of the medullary hemicenters responsible for the motor control of stomach, which is an impaired organ.

The volume reduction of the post-diaphragmatic afferences was attested by feeding before the gastric rate was recovered. With normal sheep, a meal of 100 g of pellets increased the gastric rhythm (243% ± 122% of the pre-prandial rate). Recovery of the basic rhythm was achieved in 30 minutes (fig. 1). After the unilateral deafferentation, the increase during the same meal was not significantly different (200% ± 40%). But the frequency of gastric contractions after the meal was significantly smaller than in normal animals during the same time. It returned to its previous rate in the 5 minutes following the end of feeding (fig. 1). These results confirm that the increase in rhythm during a meal is more the consequence of the stimulation of gastric medullary centres by bucco-pharyngeal stimuli. The gastric afferences maintain the increased frequency observed after the meal.
3. Effects of the total or subtotal deafferentation

The results were clear from the feeding behaviour: animals ate little and did not ruminate obviously. We could not say whether these behaviour changes were primitive or secondary to a disorder and to a lack of swallowing. The propulsion of a 5 ml air balloon into the oesophagus was stopped or slowed down at the thoracic level, where the density of receptors was normally high. The gastric rhythm which was not disturbed by the section of a thoracic vagus (fig. 2 A, B) was always decreased by around 20% immediately after the consecutive cutting through the contralateral nodose ganglion. It increased later on and one week after the total deafferentation, reached 135 to 150% of the normal rate (fig. 2 C). The same increase was finally achieved when the nodose section was performed before the thoracic one.

In summary, the unilateral deafferentation immediately produces a short stopping then a transient decrease in gastric motility. Motor response to filling by food is depressed. A more complete deafferentation does not suppress the rhythmic activity of the medullary gastric centres which, on the contrary, seems to be released.

References