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Character and cholinergic control of myoelectric activity in ovine duodenal bulb: relationships to adjacent regions

Krzysztof Waldemar Romański*

Department of Animal Physiology, Faculty of Veterinary Medicine, Wrocław Agriculture University, Wrocław, Poland

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ABSTRACT

The distinctive motor activity of duodenal bulb is incompletely understood. Thus, in six conscious sheep the myoelectric activity of pyloric antrum, duodenal bulb and distal duodenum were continuously recorded in order to assess the myoelectric patterns of duodenal bulb and the relationships to adjacent regions before and after feeding or cholinergic drug administration. It was found that in duodenal bulb slow waves are not always absent. Two main types of the spike burst, of high and low amplitude, were detected. Duration of bulbar spike bursts was shorter than in pyloric antrum and longer than in distal duodenum. Unlike in pyloric antrum and distal duodenum these spike bursts arrived in duodenal bulb at irregular intervals. They participated in the formation of phases of migrating myoelectric complex, minute rhythm and feed pattern. Cholinergic antagonists completely blocked these spike bursts in duodenal bulb and in distal duodenum, but not in pyloric antrum. Low amplitude spike bursts arrived occasionally, and they were not inhibited by atropine administration. They were not observed following hexamethonium administration. It is concluded that the character of myoelectric activity in ovine duodenal bulb is distinct from that in pyloric antrum and distal duodenum and remaining partially independent, is fairly well correlated with neighbouring regions.

Key words: sheep, duodenal bulb, myoelectric activity, cholinergic control

* Contact address:
Dr hab. Krzysztof Waldemar Romański, Deptartment of Animal Physiology, Faculty of Veterinary Medicine, Wrocław Agriculture University, Norwida 31, 50-375 Wrocław, Poland, Phone: +48 71 3205 422; E-mail: romanski@ozi.ar.wroc.pl

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Introduction

The duodenal bulb is the initial part of the small intestine and its function appears to be distinguishable from the remaining part of duodenum. The gastric content empties directly into the duodenal bulb. Thus, this part of the small intestine participates in gastroduodenal coordination (SCHUURKES and VAN NUETEN, 1984; 1990). In spite of its important role in digesta transport, little is known regarding the detailed character of duodenal bulb motor activity in various animal species. Since the duodenal bulb is localized near the gastric antrum and the pylorus it might be expected that its motor function is, at least in part, coordinated with gastric motility (MEYER, 1987). In ruminants, this part seems to be even more distinct and important than in other species because of the continuous flow of digesta. Thus, in cattle about 50 percent of spike bursts pass from abomasal antrum to the proximal duodenum (OOMS and OYAERT, 1978). As was reported by RUCKEBUSCH and PAIRET (1984), in sheep this region is deprived of the slow waves, which implies that the spike burst character may also differ from the adjacent regions. This is in contrast with monogastric animals, in which slow waves are present in duodenal bulb (BASS et al., 1961; DUTHIE et al., 1972). Interdigestive bulbar motility is correlated with that of ovine pyloric antrum, since during the early duodenal phase 3 of the migrating motor complex (MMC), antral motility is periodically hampered. Despite this, it was suggested that duodenal bulb functions as an independent unit. The MMC pattern seems to be present in ovine bulb (RUCKEBUSCH and BUENO, 1977; GREGORY et al., 1984). It was recently reported that the minute rhythm may also be present and traverse throughout this region (ROMAŃSKI, 2002). It also seems likely that the motility of duodenal bulb may be coordinated with the stomach and distal duodenum during feeding also (McCOY and BASS, 1963; ROMAŃSKI, 2002; RUCKEBUSCH and PAIRET, 1984; WHITE et al., 1983). Thus, the motility patterns of duodenal bulb in sheep have not been precisely described.

Cholinergic control of duodenal bulb motility is also not fully recognized. It appears that cholinergic drugs may affect bulbar motility (BUENO and RUCKEBUSCH, 1978; DANIEL, 1966; SCHUURKES et al., 1986; SCHUURKES and VAN NUETEN, 1990) while the role of vagus nerves is even more controversial (GREGORY et al., 1984; MALBERT and RUCKEBUSCH, 1989).

Therefore, the aim of this work was to provide novel data concerning the character of myoelectric activity of duodenal bulb in fasting and feeding conditions and correlations with adjacent regions, as well as to assess the role of cholinergic mechanisms in this function.

Materials and methods

Six adult Polish Merino rams weighing 38-42 kg each were used in the study. Animals were fed normally with good quality hay – standard meadow grass mixture (1 kg per animal per day) supplemented with standard grain mixture (3-5 g/kg of body mass) and they were fasted 24 h prior to surgery. Drinking water was not limited. The mid-right laparotomy (up to 18 cm incision) 2 cm beyond the last rib was performed following general and local anaesthesia. Anaesthetical procedure: preanesthesia – Combelen (Bayer) 0.1 mg/kg of body mass divided 1:1 (intramuscular : intravenous); then, general anaesthesia 25% ethyl alcohol 3.0-3.5 ml/kg of body mass to achieve deep anaesthesia (no reflexes) and finally, local anesthesia – 1% Polocainum hydrochloricum (Biowet, Pulawy) 40 ml intramuscularly and subfascially, around the incision, especially above the incision area. Three bipolar platinum electrodes (ROMAŃSKI and KURYSZKO, 1995) were implanted onto the antral (4 cm before pyloric ring), bulbar (6 cm beyond the pyloric ring) and duodenal (26 cm - in two animals and 50 cm beyond the pyloric ring - in all six animals) serosa. Additional (jejunal) bipolar electrode was implanted 250 cm below the pylorus in all animals studied to ensure MMC and identification of other patterns. Distances were measured during surgery. The marked wires were exteriorized 4-6 cm beside the mid-lateral incision, soldered to a plug and fixed to the skin and wool. 7-10 days were allowed for recovery. Just after surgery the animals were fed with increasing rates of hay. The standard grain mixture was added when the animals returned to a similar appetite as observed prior to surgery and the amount of hay given to the animals became normal.

A total of 214 experiments were performed in fasted (48 h) or non-fasted animals. All animals were habituated to the experiments. At the beginning of every experiment, a thin polyethylene catheter was inserted into the iugular vein for i.v. NaCl or drug administration. Myoelectric activity

was continuously recorded throughout the experiment using an encephalograph (Reega Duplex TR XVI, Alvar Electronic, Montreuil, Paris). Time constant was 0.01 s, speed of paper 2.5 mm/s and maximal filter position was utilized. The longer control experiments (without feeding or drugs) lasted 3-5 h each and were performed on non-fasted animals (with, n = 6, or without 0.15 M NaCl i.v., n = 6) and on fasted animals (n = 6) until at least two consecutive phases 3 were recorded. Before feeding (n = 6) or drug administration (n = 184), control recordings were also performed. These experiments lasted 4-6 h each on the whole. During the control part of these experiments, lasting 1-2 h, at least one normal phase 3 MMC was recorded. Then, 0.15 M NaCl i.v. (during phase 2a or 2b MMC), standard feeding (250 g of the grain mixture during phase 2b MMC) or anticholinergic drug i.v. administration were designed in random order. The following drugs and doses were used in non-fasted animals. As an antinicotinic drug, hexamethonium bromide (Hx, Sigma) at doses of 1.0, 2.0 and 5.0 mg/kg were introduced i.v. (within 1, 2 or 5 min, respectively) during phase 2b MMC. Antimuscarinic drugs, atropine sulfate (Atr, Polfa) at doses of 0.002, 0.02, 0.1 and 0.5 mg/kg i.v. and pirenzepine dihydrochloride (Pir, Sigma) at doses of 0.02, 0.1 and 0.5 mg/kg i.v. were administered within 0.5, 1 and 2 min for the given doses, respectively. At least one-two day intervals were allowed between the experiments when anticholinergic drugs were given. MMC phases were identified in the duodenum according to the criteria proposed by CODE and MARLETT (1975) and phases 2a and 2b were distinguished according to DENT et al. (1983) and ROMAŃSKI (2002). It was not possible to identify phases 2a and 2b in duodenal bulb. The myoelectric activity of duodenal bulb including types of spike burst and myoelectric patterns (MMC, minute rhythm, fed pattern, rebound excitation) were visually characterized and slow wave frequency and amplitude, as well as spike burst amplitude, frequency, regularity and duration were measured in antrum, duodenal bulb and duodenum. Duration of spike burst inhibition by anticholinergic drugs was measured from the end of drug administration until the arrival of the first spike burst, including observed rebound excitation.

The obtained values were expressed as means ± SE. To find the differences among means the statistical significances were calculated using Student t-test for paired or unpaired values, where appropriate. This

calculation was preceded by analysis of variance. The p values smaller than 5% were considered significant. Three degrees of significance were distinguished: $P<0.05$, $P<0.01$ and $P<0.001$.

Results

Slow waves, permanently observed in antrum and duodenum, were observed in duodenal bulb only in 8.9 % of the experiments performed (n = 214). They were clearly measurable during duodenal phase 2a MMC in duodenal bulb in five of six animals studied and their frequency was 20.1 ± 0.4 (n = 5) vs. 21.6 ± 0.5 cycles per minute, cpm (n = 6), N.S. in duodenal bulb and in the duodenum, respectively. During duodenal phase 2b MMC

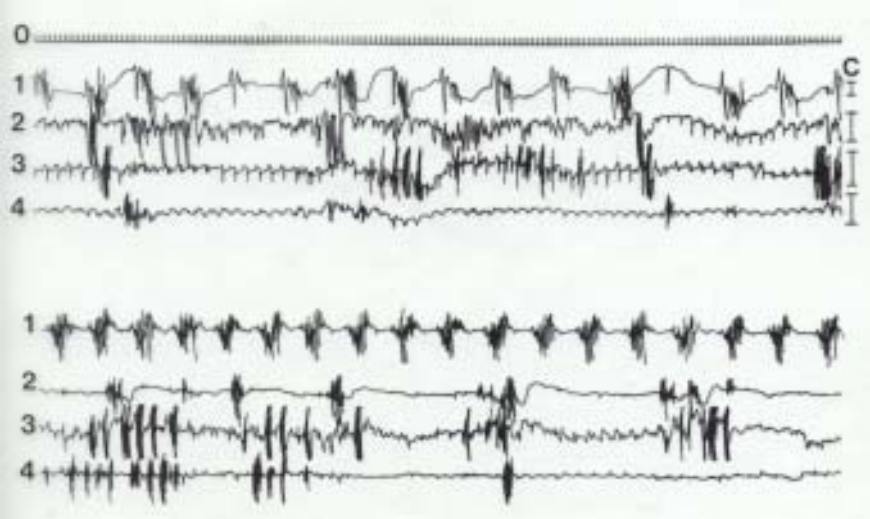

Fig. 1. Comparison of ovine myoelectric activity of ovine antrum (electrode 1), duodenal bulb (electrode 2), duodenum (electrode 3) and jejunum (electrode 4) during phase 2b MMC and during feeding. Upper panel: the minute rhythm originating from antrum during phase 2b MMC in fasted sheep. Note occurrence of slow waves in right side of bulbar recording.
Lower panel: the migrating and non-migrating spike bursts in antrum and duodeno-jejunum during feeding in non-fasted sheep. Note the maximal spiking activity in antrum. In lower panel calibration as in panel A, Fig. 2. 0 - time in seconds, c - calibration 50 μV. Further explanations: see section Materials and methods.

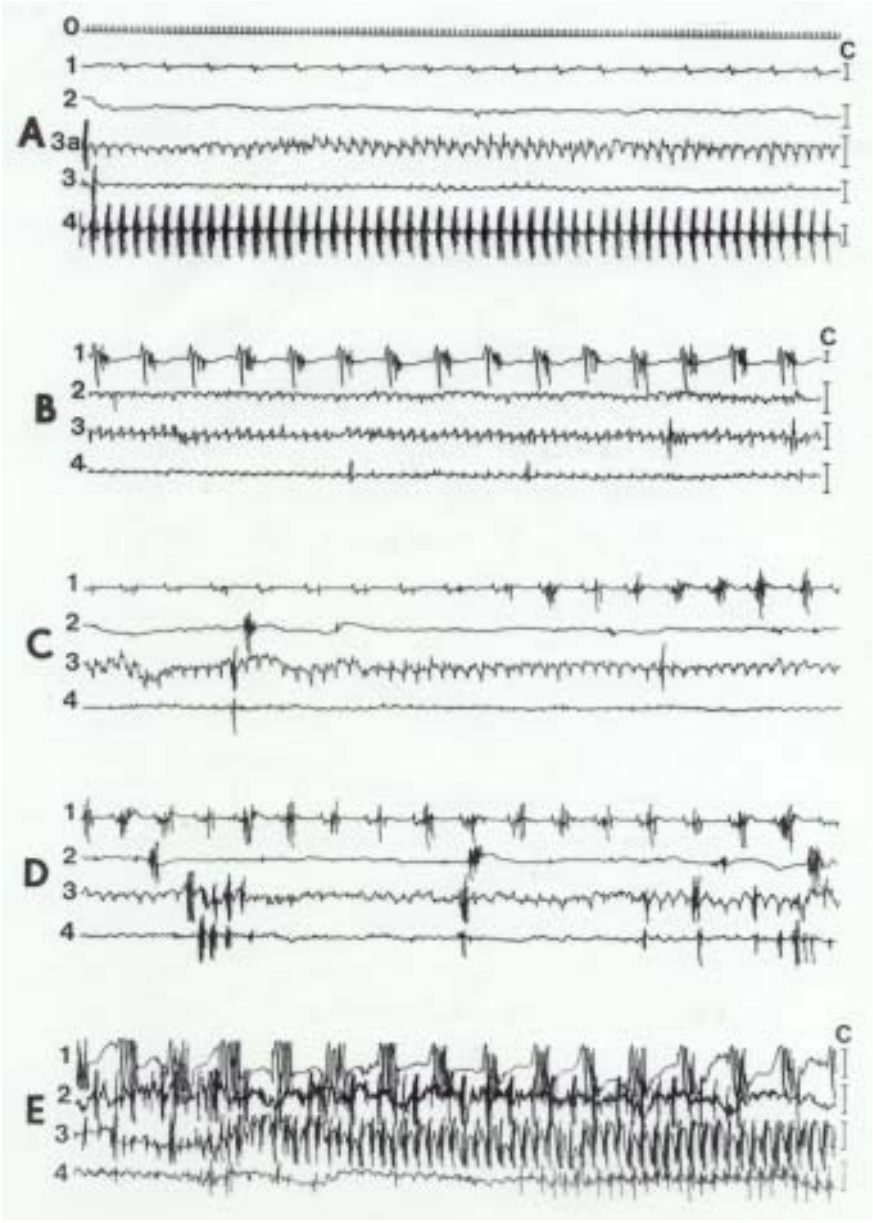
0
1
2
A
3a
3
4
C
B
C
D
E

Fig. 2. Myoelectric activity of ovine antrum (electrode 1), duodenal bulb (electrode 2), duodenum (electrodes 3a and 3) and jejunum (electrode 4) during various phases of the MMC. Panel A – antroduodenal myoelectric activity during phase 1 MMC of non-fasted sheep. Phase 3 MMC present in jejunum. Note the absence of spike bursts in antrum and lack of detectable slow waves in duodenal bulb. Panel B – myoelectric activity during phase 1 MMC of fasted sheep. Note the presence of spike bursts in antrum and the slow waves in duodenal bulb. Panel C – myoelectric activity during phase 2a MMC of non-fasted sheep. Note the presence of normal and "small" spike bursts in duodenal bulb. Panel D – myoelectric activity during phase 2b MMC in non-fasted sheep. Note the lower spike burst incidence in duodenal bulb and the presence of normal and "small" spike bursts in this region. Panel E – myoelectric activity during phase 3 MMC in antro-duodenum and phase 3 onset in jejunum in fasted sheep. Note the irregular spike burst incidence in duodenal bulb and presence of normal and "small" spike bursts in this region.
O – time in seconds. C – calibration 50 μV. In panels C and D calibration as in panel A.
Further explanations: see section Materials and methods.

these values were 20.3 ± 0.6 (n = 3) vs. 21.7 ± 0.4 cpm (n = 6), N.S., respectively (see also Fig. 1). Here, the Student t-test for unpaired values was used. Their amplitude was usually lower, but never higher, than in

Table 1. Frequency of spike bursts in antrum, duodenal bulb and duodenum in non-fasted sheep. Means of median values derived from a series of six values (obtained from one experiment performed on every animal studied), expressed in cpm. Student t-test for paired values (preceded by analysis of variance): *P<0.05; ***P<0.001 vs. relevant value obtained during phase 3 MMC. Student t-test for paired values: [a]P<0.05; [c]P<0.001 vs. relevant value measured in the duodenum (antrum not tested). Other explanations: see chapter Materials and methods

		Antrum	Duodenal bulb	Duodenum
	n	6	6	6
Phase 2a MMC	mean ± SE	5.8 0.3	0.8*** [a] 0.1	1.3*** 0.2
Phase 2b MMC	mean ± SE	5.7 0.3	2.1*** [c] 0.2	8.5*** 0.7
Phase 3 MMC	mean ± SE	6.1 0.2	10.8[c] 0.5	21.5 0.4
Feeding	mean ± SE	5.8 0.2	3.1*** [c] 0.3	7.6*** 0.6
Rebound effect	mean ± SE	6.1 0.1	8.7* [a] 0.1	17.1 1.2

Table 2. Duration of spike bursts in antrum, duodenal bulb and duodenum in non-fasted sheep. Values (eight consecutive spike bursts from the most active period of one experiment performed on each animal studied) expressed in seconds. Student t-test for paired values (preceded by analysis of variance): *P<0.05; **P<0.01 vs. relevant value obtained during phase 3 MMC. Student t-test for paired values (preceded by analysis of variance): [b]P<0.01; [c]P<0.001 vs. relevant value measured in the duodenum. Other explanations: see chapter Materials and methods

	n	Antrum	Duodenal bulb	Duodenum
		48	48	48
Phase 2a MMC	mean	2.0** [b]	1.0	0.6**
	± SE	0.07	0.08	0.04
Phase 2b MMC	mean	2.7 b	1.4	1.0
	± SE	0.10	0.11	0.05
Phase 3 MMC	mean	3.3 [c]	1.4	1.2
	± SE	0.08	0.08	0.05
Feeding	mean	3.2	1.4	1.0
	± SE	0.08	0.08	0.05
Rebound effect	mean	2.4* [b]	1.5	1.0
	± SE	0.08	0.11	0.07

duodenum. Slow waves were also occasionally observed in duodenal bulb during phase 1 MMC, but usually they were hardly measurable. The exceptional example is shown in Fig. 2 (panel B).

The frequency of spike bursts in duodenal bulb differed from that in antrum and duodenum and was dependent upon the MMC phase and feeding procedure (Table 1). It was highest during phase 3 but was calculated during the well developed phase 3 MMC in this region (i.e., it contained 11-37 spike bursts in this study and represented 62% of all phases 3 MMC observed in duodenal bulb). This was the case when increased spike burst activity was observed in antrum, sometimes resembling phase 3 MMC in this region. When phase 3 MMC was relatively short (3-10 spike bursts observed in 38% of all phases 3) in duodenal bulb, apparently originating from this site, the frequency of spike bursts was lower (oscillating around the values obtained during phase 2b MMC, Table 1). Spike burst frequency in duodenal bulb during phase 2b MMC was measured during more active periods during the second half of this phase. This parameter was often similar during phase 2a and 2b MMC (Fig. 2, panels C and D)

and was not much higher during feeding. The relatively high standard mean error indicates that the regularity of spike burst incidence in duodenal bulb is lower than that observed in antrum and duodenum. The time lag between two consecutive spike bursts was also measured during phase 3 MMC, feeding and rebound excitation (also called post-inhibitory excitation, frequently observed after cholinergic blockade. See ROMAŃSKI, 2003). There were no marked differences between these three conditions. Thus, the overall values (i.e. during phase 3 MMC, feeding and rebound excitation) were 10.1 ± 0.1, 6.8 ± 0.7 and 3.4 ± 0.2 s in antrum, duodenal bulb and duodenum, respectively. The regularity of slow waves was 10.1 ± 0.1, 2.5 ± 0.04 and 2.7 ± 0.03 s in antrum, duodenal bulb and duodenum, respectively.

The duration of spike bursts in antrum and duodenum was related directly proportional to the slow wave frequency. In duodenal bulb the relation could not be found. In the small intestine it was significantly lower than in antrum (Table 2). In duodenal bulb it was less regular than in the duodenum.

Table 3. Amplitude of spike bursts in antrum, duodenal bulb and duodenum in non-fasted sheep. Values (eight consecutive spike bursts from the most active period of one experiment performed on each animal studied) expressed in mV. Student t-test for paired values (preceded by analysis of variance): *P<0.05; **P<0.01; ***P<0.001 vs. relevant value obtained during phase 3 MMC. Student t-test for paired values (preceded by analysis of variance): ^{c}P<0.001 vs. relevant value measured in the duodenum. Other explanations: see chapter Materials and methods

		Antrum	Duodenal bulb	Duodenum
	n	48	48	48
Phase 1 MMC	mean ± SE	68.9*** 3.3	-	-
Phase 2a MMC	mean ± SE	85.6** 3.8	132.3 5.8	103.2* 4.6
Phase 2b MMC	mean ± SE	130.9 4.4	148.8 5.7	146.4 3.4
Phase 3 MMC	mean ± SE	161.6 5.9	145.8 4.6	155.8 3.0
Feeding	mean ± SE	170.8 ^{c} 3.2	120.5 4.0	107.1* 2.8
Rebound effect	mean ± SE	99.3* 2.9	120.1 2.9	119.7* 1.9

There were no significant differences in the duration of spike bursts in this region during various experimental conditions. However, the smallest values were observed during phase 2a MMC.

Table 4. Duration of spike burst inhibition in duodenal bulb following administration of various doses of anticholinergic drugs in fasted and non-fasted sheep. Values (calculated from the end of drug administration until the arrival of the first spike burst) expressed in minutes. Student t-test for unpaired values (preceded by analysis of variance): *P<0.05; **P<0.01 vs. relevant fasting value. Student t-test for unpaired values (preceded by analysis of variance): [a]P<0.05 vs. the lowest dose of the same drug. T – transient, incomplete inhibition. Other explanations: see chapter Materials and methods.

		Hexamethonium			Atropine				Pirenzepine			Hx + Atr	Hx + Pir
doses mg/kg		1.0	2.0	5.0	0.002	0.02	0.1	0.5	0.02	0.1	0.5	1.0 + 0.1	1.0 + 0.1
Fast	n	6	8	6	8	6	9	7	7	7	6	6	6
	mean ± SE	14.8 2.8	17.9 3.4	29.3a 5.4	-	9.5 2.4	12.9 3.1	15.8 3.8	T	5.8 1.3	3.3 0.7	17.3 3.5	15.8 2.9
Non-fast	n	6	10	6	7	9	17	11	6	10	8	6	6
	mean ± SE	7.9* 1.5	6.1* 1.0	11.4** 1.6	-	7.0 1.3	11.1 1.4	13.3 2.3	15.2 3.6	13.7* 2.2	12.0** 1.6	14.1 1.8	12.6 1.5

The amplitude of spike bursts differed significantly in relation to MMC phase in antrum and duodenum, but not in duodenal bulb (Table 3). While this value in antrum was the highest during feeding, in duodenal bulb and in duodenum these values were the lowest during this period. Spike bursts were usually present in antrum during duodenal phase 1 MMC (Table 3) although sometimes they were not (Fig. 2, panel A). During the well developed phase 3 MMC the spike burst amplitude in duodenal bulb was relatively higher than during the shortened phase 3 MMC.

In duodenal bulb, two basic types of spike burst were observed. Classical spike bursts (amplitude 100-200 μV, sometimes much higher) were most frequently observed, and in 39.3% of experiments (n = 214), the so-called "small" spike bursts (amplitude about 20-30 μV) were observed (Fig. 1, Fig. 2, panels C – E). Their frequency and regularity was similar to other spike bursts observed in this region.

No significant differences between experiments performed on fasted and non-fasted animals were observed.

Administration of anticholinergic drugs was able to inhibit spike bursts in all the regions studied. Hx, At and Pi at two highest doses inhibited antral spike bursts in 3-5% of the experiments performed for a period from about 10 s up to 8 min, usually for less than 1 minute. In the remaining experiments the frequency of antral spike bursts was unchanged. Hx administration in fasted animals produced a stronger (dose-dependent) effect than in non-fasted animals, while the effect of Pir was stronger in non-fasted animals (Table 4). Administration of anticholinergic drugs in combination produced an effect similar to that of Hx, and no additive effects were observed, at least in fasted sheep (Table 4). In 28% of the experiments, with the administration of moderate and higher doses of anticholinergic drugs given alone and in combination (n = 141), phase 2 MMC arrived few minutes later in duodenal bulb than in the duodenum. The "small" spike bursts observed spontaneously in duodenal bulb were not inhibited by Atr and were observed sparsely also following Pir administration. They were not detected after injection of Hx.

Discussion

Results showed that the myoelectric activity of duodenal bulb is composed in sheep. In spite of previous reports indicating the absence of slow waves in the first 8 cm of the ovine duodenum (RUCKEBUSCH and BUENO, 1977), slow waves of relatively low amplitude and frequency, similar to that in distal duodenum, were occasionally identified in duodenal bulb. Since the electrode was localized 6 cm from the pylorus it is possible that slow waves arise in this region at various distances from the pyloric ring in different animals. It is known that in monogastric animals slow waves are present in duodenal bulb (BASS et al., 1961; DUTHIE et al., 1972; BORTOFF et al., 1984) and their existence at the same frequency as in duodenum was demonstrated in pylorus (PAPASOVA et al., 1982). Thus, slow waves can be present in duodenal bulb in sheep.

The migrating myoelectric complex (MMC) was observed in duodenal bulb, although its phase 3 does not always appear in this region and is often not well developed here. This is in contrast with some previous reports

suggesting that phase 3 might be regularly present and originates from duodenal bulb in sheep (RUCKEBUSCH and BUENO, 1977; RUCKEBUSCH and PAIRET, 1984). GREGORY et al. (1984) found that phase 3 MMC originates either from duodenum or from jejunum, which is similar to the present observations. PLAZA et al. (1996a) also observed the start of phase 3 from duodenal bulb region, 10 cm from the pylorus. Since phase 3-like activity was infrequently observed in pyloric antrum and was related to the more developed phase 3 in duodenal bulb, it can be concluded that phase 3 often originates from the latter region in sheep, but it can start either from the lower intestinal segment, or occasionally also from antrum. Duodenal bulb spiking activity was less intensive than that of duodenum. Therefore, it was difficult to differentiate phase 2a from phase 2b MMC. However, either phase 1 or phase 2 MMC was clearly identified in duodenal bulb. Thus, it can be stated that bulbar MMC can comprise phases 1, 2 and also often phase 3.

Feeding affected duodenal bulb myoelectric activity but this effect was much smaller than spike burst frequency during phase 3 MMC. Feeding is known to enhance gastrointestinal motility in sheep, including the proximal duodenal region (PLAZA et al., 1996c). Thus, the obtained results are to some extent different, probably because in the present study the bulbar electrode was implanted closer to the pylorus. The clearest effect of feeding was to increase the frequency of minute rhythm that has been described in detail elsewhere (ROMAŃSKI, 2002). The minute rhythm was first demonstrated by GRIVEL and RUCKEBUSCH (1972) and in the present study usually originated from duodenal bulb, but occasionally also from antrum. Thus, the duodenal bulb can play a role in coordination of antroduodenal motility in sheep.

The occurrence of two types of spike burst in duodenal bulb may be related to the presence of two muscle layers: circular and longitudinal. The electrode wires inserted into the gut wall had contact with both these layers. The electrical and mechanical activity of the longitudinal muscle layer was demonstrated apart from circular muscle activity, its amplitude being smaller than that of circular layer motility (MENDEL et al., 1980; MORO and McLEAY, 1991; RUCKEBUSCH, 1972). In duodenal bulb, the spike burst rhythm was observed to be much less regular than in antrum and duodenum during all MMC phases and after feeding, and only some spike bursts were coordinated

with spike bursts in adjacent regions. The absence of the slow waves, or their low amplitude in duodenal bulb, may be responsible for the irregularity of spike bursts. Initiation of spike bursts in these circumstances can be more difficult and occurs at accidental intervals. This phenomenon suggests the relatively greater independence of duodenal bulb from neighbouring sites.

Administration of anticholinergic drugs often had profound effects on antroduodenal myoelectric activity. Response to these drugs was sometimes dose- dependent. Results indicate that all regions examined are sensitive to anticholinergic drugs, which further confirms the results obtained in sheep by others (BUENO and RUCKEBUSCH, 1978; BUENO and PRADDAUDE, 1979; RUCKEBUSCH et al., 1987) and in other species (SCHUURKES and VAN NUETEN, 1990). These effects were more pronounced in duodenal bulb than in duodenum despite the fact that both the duodenal bulb and duodenum are cholinergically innervated in sheep (COTTRELL and GREENHORN, 1987). In turn, antral myoelectric activity was resistant in part to the anticholinergic drugs, which contrasts with the results obtained by PLAZA et al. (1996b) and RUCKEBUSCH et al. (1987). Apparently, the authors considered the most evident examples only. Since in the present study Hx produced a longer inhibitory effect in fasted than in non- fasted animals, it appears that nicotinic receptors are more active in the fasting state. Administration of cholinergic blocking drugs inhibited both types of the spike burst observed in duodenal bulb, and it is possible that they originate from the different smooth muscle layers. It has been suggested that longitudinal layer responds by atropine-sensitive contraction, while the circular layer exhibits noradrenergic relaxations, and both layers may differ in sensitivity to cholinergic agents (CHRISTENSEN and MACAGNO, 1979). These findings could explain why "small" spike bursts arrived in duodenal bulb occasionally. The obtained results indicate that duodenal bulb may be even more sensitive to inhibition by anticholinergic drugs than the duodenum.

Finally, it can be concluded that the duodenal bulb in sheep is a separate part of the duodenum, that it partially exhibits the distinct character of motility and that it is regulated in part by other mechanisms than antrum and duodenum. Also, that it participates in antroduodenal coordination and in the control of gastrointestinal motility.

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SAŽETAK

Različita motorička aktivnost početnog dijela dvanaestnika ovce još uvijek je nedovoljno istražena. Stoga je, radi određivanja mioelektričnog modela početnog dijela dvanaestnika i njegova odnosa prema okolnim područjima, na šest ovaca mjerena mioelektrična aktivnost pilorusnog antruma te početnog i završnog dijela dvanaestnika. Mjerenja su provedena prije i poslije hranjenja ili davanja kolinergičnih lijekova. Utvrđeno je da spori valovi nisu uvijek odsutni na području početnog dijela dvanaestnika, a javljaju se dva glavna oblika valova s visokom i niskom amplitudom. Valovi početnog dijela dvanaestnika trajali su kraće od onih u antrumu pilorusa te duže nego u završnom dijelu dvanaestnika. Za razliku od dolaska u antrum pilorusa i završni dio dvanaestnika, valovi su u početni dio dvanaestnika dolazili u nepravilnim razmacima. Oni su sudjelovali u stvaranju faza migracijskog mioelektričnog kompleksa, minutnog ritma i modela hranjenja. Kolinergični antagonisti su u potpunosti zaustavili valove u početnom i završnom dijelu, ali ne i u antrumu pilorusa.Valovi malih amplituda pristizali su povremeno i nisu bili zakočeni atropinom.Također nisu bili utvrđeni nakon primjene heksametonija. Zaključuje se da je mioelektrična aktivnost u području početnog dijela dvanaestnika ovaca različita od one u pilorusnom antrumu i završnom dijelu dvanaestnika. Ona je djelomično neovisna, ali u dobroj korelaciji sa susjednim područjima.

Ključne riječi: ovca, početni dio dvanaestnika, mioelektrična aktivnost, kolinergična kontrola