

Alterations of neurochemical expression of the coeliac-superior mesenteric ganglion complex (CSMG) neurons supplying the prepyloric region of the porcine stomach following partial stomach resection.



Katarzyna Palus*, Jarosław Całka

Department of Clinical Physiology, Faculty of Veterinary Medicine, University of Warmia and Mazury in Olsztyn, Oczapowskiego Str. 13, 10- 718 Olsztyn, Poland

ARTICLE INFO

Article history:

Received 23 November 2015
Received in revised form 21 December 2015
Accepted 22 December 2015
Available online 28 December 2015

Keywords:

Coeliac-superior mesenteric ganglion complex
Gastric innervation
Immunohistochemistry
Neuroactive substances

ABSTRACT

The purpose of the present study was to determine the response of the porcine coeliac-superior mesenteric ganglion complex (CSMG) neurons projecting to the prepyloric area of the porcine stomach to peripheral neuronal damage following partial stomach resection. To identify the sympathetic neurons innervating the studied area of stomach, the neuronal retrograde tracer Fast Blue (FB) was applied to control and partial stomach resection (RES) groups. On the 22nd day after FB injection, following laparotomy, the partial resection of the previously FB-injected stomach prepyloric area was performed in animals of RES group. On the 28th day, all animals were re-anaesthetized and euthanized. The CSMG complex was then collected and processed for double-labeling immunofluorescence. In control animals, retrograde-labelled perikarya were immunoreactive to tyrosine hydroxylase (TH), dopamine β -hydroxylase (DBH), neuropeptide Y (NPY) and galanin (GAL). Partial stomach resection decreased the numbers of FB-positive neurons immunopositive for TH and DBH. However, the strong increase of NPY and GAL expression, as well as de novo-synthesis of neuronal nitric oxide synthase (nNOS) and leu5-Enkephalin (LENK) was noted in studied neurons. Furthermore, FB-positive neurons in all pigs were surrounded by a network of cocaine- and amphetamine-regulated transcript peptide (CART)-, calcitonin gene-related peptide (CGRP)-, and substance P (SP)-, vasoactive intestinal peptide (VIP)-, LENK- and nNOS-immunoreactive nerve fibers. This may suggest neuroprotective contribution of these neurotransmitters in traumatic responses of sympathetic neurons to peripheral axonal damage.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

The prevertebral sympathetic ganglia are considered to be regulatory neural structures involved in the control of digestive tract motility, secretion and absorption (Miolan and Niel, 1996). Previous studies have shown that the major source of postganglionic sympathetic nerve fibers supplying the stomach and duodenum originate from the coeliac-superior mesenteric

ganglion complex (CSMG) compared with only single perikarya located within sympathetic chain ganglia (SChG) (Ekblad et al., 2000; Skobowiat et al., 2011; Trudrung et al., 1994).

Sympathetic neurons and other peripheral neurons are capable of extensive regeneration following axonal injury. Alterations in neuropeptide phenotype and activation of gene expression are the main cell body responses of adult sympathetic neurons to neuronal damage (Boeshore et al., 2004; Sun and Zigmund, 1996). It has been

Abbreviations: CART, cocaine- and amphetamine- regulated transcript peptide; CGRP, calcitonin gene-related peptide; CNS, central nervous system; CSMG, the coeliac-superior mesenteric ganglion complex; DBH, - dopamine hydroxylase; DRG, dorsal root ganglion; ENS, enteric nervous system; FB, Fast Blue; GAL, galanin; IMG, inferior mesenteric ganglion; IL-1 β , interleukin 1 β ; IR, immunoreactive; IL-6, interleukin 6; LENK, leu 5-enkephalin; NGF, nerve growth factor; LIF, leukemia inhibitory factor; NO, nitric oxide; nNOS, neuronal nitric oxide synthase; NPY, neuropeptide Y; PACAP, pituitary adenylate cyclase activating polypeptide; PBS, phosphate-buffered saline; RES, partial stomach resection; SCG, superior cervical ganglion; SChG, sympathetic chain ganglia; SOM, somatostatin; SP, substance P; TH, tyrosine hydroxylase; TGF- β , transforming growth factor- β ; TNF- α , tumor necrosis factor- α ; VIP, vasoactive intestinal peptide.

* Corresponding author.

E-mail addresses: katarzyna.palus@uwm.edu.pl (K. Palus), calkaj@uwm.edu.pl (J. Całka).

Table 1

List of primary and secondary antibodies used in the study.

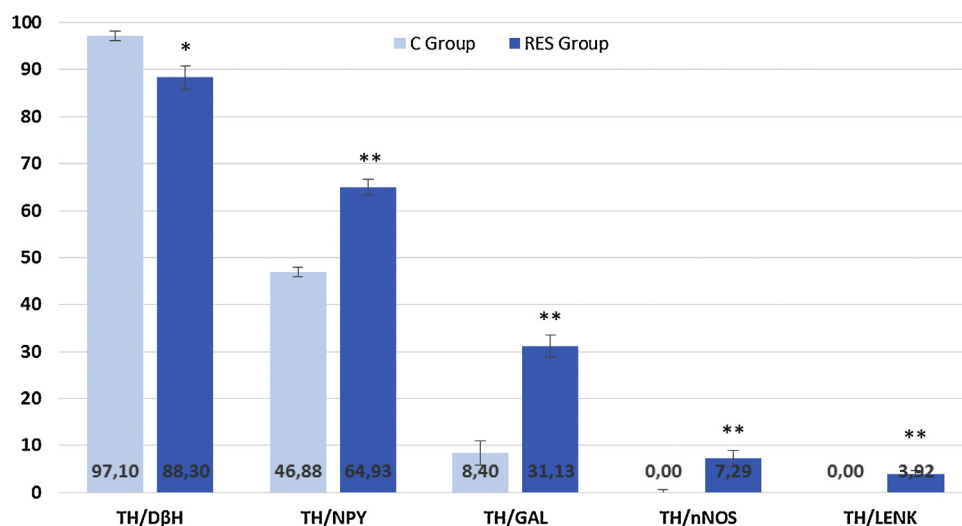
Antisera	Host species	Dilution	Code	Supplier
Primary antibodies				
TH	Mouse	1:200	MAB 318	Millipore, USA
DβH	Rabbit	1:500	AB1585	Millipore, USA
NPY	Rabbit	1:1000	NA1115	Biomol, Germany
NOS	Rabbit	1:2500	AB5380	Millipore, USA
GAL	Rabbit	1:2000	AB2233	Millipore, USA
LENK	Rabbit	1:500	4140-0355	AbD Serotec, UK
CART	Rabbit	1:15000	H-003-61	Phoenix Pharmaceuticals, USA
CGRP	Rabbit	1:1500	AB5920	Millipore, USA
SP	Rat	1:200	450-0505	AbD Serotec, UK
VIP	Rabbit	1:1500	PEPA41T	AbD Serotec, UK
Secondary antibodies				
Reagent		Dilution	Code	Supplier
Alexa Fluor 488 nm donkey anti- mouse IgG		1:1000	A21202	Invitrogen, USA
Alexa Fluor 546 nm goat anti- rabbit IgG		1:1000	A11010	Invitrogen, USA
Alexa Fluor 546 nm goat anti- rat IgG		1:1000	A11081	Invitrogen, USA

recognized that these response is also caused by both the reduction in the availability of target-derived nerve growth factor (NGF) and by the induction of the cytokine leukemia inhibitory factor (LIF). These factors may lead to an increase in mRNAs encoding various neuropeptides, such as galanin (GAL), vasoactive intestinal peptide (VIP), substance P (SP), pituitary adenylate cyclase activating polypeptide (PACAP) and cholecystokinin, with a simultaneous decrease in the activity of the catecholamine biosynthesis enzyme, tyrosine hydroxylase (TH) and dopamine β-hydroxylase (DβH) (Habecker et al., 2009; Sachs et al., 2007; Sun and Zigmond, 1996). Extensive studies focusing on possible alterations in the neurochemical expression of injured neurons found an increase in the expression of GAL, VIP, SP and neuronal nitric oxide synthase (nNOS) in neurons of the superior cervical ganglion (SCG) in rats as well as GAL, somatostatin (SOM) and Leu5-Enkephalin (LENK) in the neuronal population of porcine sympathetic neurons located in the inferior mesenteric ganglion (IMG) and sympathetic chain ganglia (SChG) (Habecker et al., 2009; Skobowiat et al., 2011; Wojtkiewicz et al., 2013). Moreover, neuronal differentiation affects the chemical phenotype of neurons located in the enteric nervous system (ENS) (Gonkowski et al., 2010; Gonkowski, 2013). This phenomenon of increased expression of certain neuropeptides may suggest their potential neuro-protective function

and may contribute to survival and repair mechanisms (Gonkowski et al., 2010; Suarez et al., 2006). However, many aspects of the possible interaction of these substances in regeneration remain unexplained and require further investigation.

Gastric disorders are among the most common diseases. Despite advances in medical treatment, in some cases (ulcers, tumors, bariatric surgeries) resection of the affected parts is necessary. The prepyloric area of the stomach is considered to be a frequent location of pathological changes, including ulcers, erosions and tumors (Fuster and Sweeny, 2011). In this respect, the selection of pig for the present experiment has been made because this species seems to be a more appropriate animal model for studies of pathological processes in the human gastrointestinal tract than rodents. Previous studies have shown that pigs share common anatomical, physiological and histological features with humans, including digestive, urinary and cardiovascular systems (Swindle et al., 2012; Verma et al., 2011). Furthermore, previous studies using the porcine model in experimentally-induced gastrointestinal disorders support the validity of this choice (Gonkowski, 2013; Wojtkiewicz et al., 2013).

To date, limited literature exists on the neuronal response to nerve injury and subsequent changes in the chemical coding of porcine CSMG neurons during partial stomach resection.

**Fig. 1.** Immunohistochemical characteristic of FB-positive neurons.

Histogram showing mean (\pm SEM) percentages of the labelled perikarya (FB- positive) immunoreactive to TH/DBH, TH/NPY, TH/GAL, TH/nNOS and TH/LENK in animals of C and RES group. The significance of differences was estimated using the Student's t test for independent samples * $P < 0.05$; ** $P < 0.001$.

Download English Version:

<https://daneshyari.com/en/article/1988752>

Download Persian Version:

<https://daneshyari.com/article/1988752>

[Daneshyari.com](https://daneshyari.com)