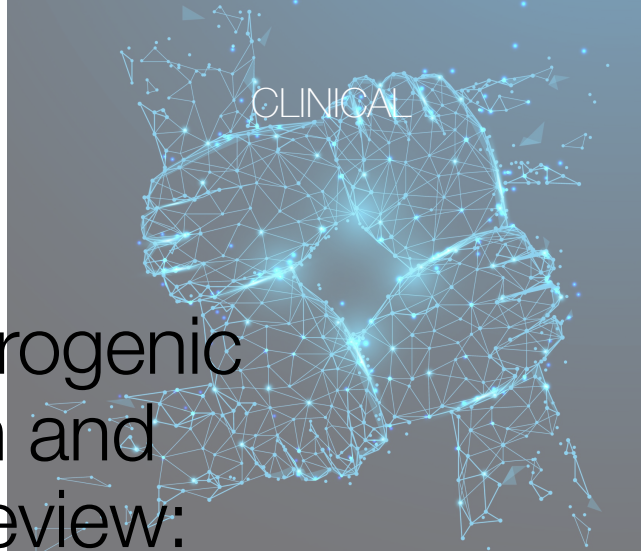
Asia-Pacific Chiropractic Journal



Neurodynamics of vertebrogenic somatosensory activation and Autonomic Reflexes - a review:

Part 12 General considerations

Peter Rome and John Waterhouse

Abstract: Given the volume of available evidence, it would be remiss to dismiss the concept of a somatosensory-ANS-visceral reflex model of pathophysiology. This phenomenon is offered as one of the models contributing to the documented clinical focus of a manual therapeutic influence. The rationale for manipulative intervention explicates the necessity to remove or modify noxious somatic input upon the physiological function of related innervated structures. While it may be a factor in a number of clinical conditions, this vertebral Somatic Autonomic Visceral Complex (SAVC) is not claimed to provide all ætiological answers or be a panacea. However, as an integral component of a subluxation the complex may be indicated by the presence of associated signs and symptoms.

Indexing terms: Vertebral subluxation; Neurophysiology; Somatosensory; Autonomic nervous system.

Introduction

The evidence reviewed here would also suggest that to discount or overlook the somatovisceral connotations of the vertebral subluxation is to dismiss some fundamental principles of somato-autonomic reflex neurophysiology. This observation is made notwithstanding the contradictory dichotomy in attitudes towards spinal manipulation within allopathy which by comparison appears well-supported by European medical doctors who do recognise the physiological phenomenon. (Part 5 of this series) (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

> *...The presentation of this evidence may point towards expanding the understanding of the ramifications of the somatic vertebral subluxation model, its impact on human and animal neural physiology, and consequently the degree in which it may influence other aspects of visceral physiological function'*

It would then follow that in particular cases a conservative opportunity could exist to modify specific SAVCs as contributory factors. The rationale for this is to normalise an associated noxious neurovertebral (somatic) impact with the potential to alleviate a range of patient conditions. It is suggested that the opportunity also exists for in-depth comparative efficacy studies of similar conditions with traditional interventions.

In essence and as sought to portray in this series, the studies by Sato, Schmidt, (1) Jänig, Haavik, Cramer, King and others has augmented the somatosensory research related to the pathoneurophysiology phenomena.

An extensive 2012 literature review by Vernon explored the correlation of spinal pain with its neuroanatomical and neurophysiological features. He noted that spinal pain produced different features from pain originating from

peripheral structures. In addition he discussed this influence on visceral and autonomic reflexes as also noted by Cramer and Darby. (11, 12)

In an earlier 1989 study, Jinkins and colleagues confirmed that the '*vertebrogenic symptom complex includes (1) local and referred pain and (2) autonomic reflex dysfunction*' (13)

Additionally, Jinkins noted that somatic pain has a '*direct afferent somatosensory inflow into the CNS via respective somatic spinal nerves*' and differentiates spondylogenic pain from articulogenic pain and other spinal structures. (14) A feature also noted by Sekine et al. (15)

Jinkins also noted that '*Anatomic data suggests that somatic and visceral autonomic afferents may have the same or some of the same central connections at the level of the spinal cord.*' He designated the convergence theory involving the '*visceral and somatic afferent autonomic systems.*' While the somatic afferent inputs terminate in laminae II, III, IV of the dorsal horn, the visceral afferents terminate in laminae I and V. However, he also noted that there is a '*third population of cells located intermediately between these two groups' called' viscerosomatic spinal cord neurons*'. (14)

While Jinkins study was focussed on referred pain, he noted a *'sophisticated and accurate linkage of signs and symptoms with specific pathoanatomical alteration*' at segmental levels (14)

In further support of the role of the ANS, Patterson stated in 1997 that '*The evidence is becoming overwhelming for the view that somatic inputs alter not only visceral activity, but brain activity and function as well. In addition, it is now evident that the sympathetic nervous system innervates and controls much more than was previously recognized. For example, sympathetic neurons even innervate bone marrow where they control production of various blood cells.*' (16)

In addition to the text by Sato et al, three texts with similar titles embrace the theme of the series, the integrative action of the autonomic nervous system. These volumes were published some 100 years apart. The SAVC concept suggests a remedial portal in clinically applying a rationale for manual intervention, in order to influence the ANS and neutralise the influence of aberrant somatic-autonomic-visceral afference. (17, 18, 19)

The presence of a physical or mechanical element which has initiated noxious autonomic sensory reflexes would seem to be a natural and appropriate therapeutic avenue for a remedial option. The intent of this intervention would be to neutralise noxious neural stimuli which may have resulted in signs and symptoms of pathophysiology. Considering the somato-autonomic and somatovisceral ramifications, this focus would be anticipated to assist in the restoration and/or the maintenance of physiological homeostasis. As Hendry and Hsiao state, '*the somatosensory system uses different tactics and strategies to achieve the goals of perception, homeostasis and sensory guidance of movement.*' (20, 21, 22, 23)

Extensive research on animal subjects by Sato and colleagues suggests somato-autonomic control and regulation. (24) Homeostasis implies that with normalised somatovisceral reflex activity, even the prevention of some disorders may also be possible in the early stage of the process. (25, 26)

Given that the somatosensory reflex input has such a major influence upon the autonomic nervous system, Jänig opined further that '*The body's motor activity and behaviour are only possible when its internal milieu is controlled to keep the component cells, tissues and organs (including the brain and skeletal muscles) maintained in an optimal environment for their function.*' (26)

Somatosensory pain or tenderness associated with disturbed or subluxated intervertebral facet joints would be indicative of the noxious firing of free nerve ending mechanoreceptors. The stimuli would then register centrally through to the spinal cord's *medial lemniscus* and *thalamus*. It is then interpreted in the brain and returned down the spinal cord to complete the SAV reflex.

Other noxious insults may result from mechanoreceptors being activated by inflammatory response, hypertonicity of intrinsic muscles, and localised vascular changes. These would have the potential to exacerbate a *somatovisceral reflex arc*. (27, 28)

Neural control may influence the stimulation, suppression or inhibition of target structures' function, be they organs, muscles, glands, sphincters, smooth muscle, or other innervated objectives. Research consideration would be welcome as to the types, duration and strengths of subluxations as noted factors and whether an activated somatosensory reflex may suppress or stimulate properties of a target organ's function. Further research would be expected to expose how particular vertebrogenic noxious sensory bombardment may differentially initiate stimulatory or suppressive influence on innervated structures. Such studies may also differentiate the effects of subliminal somatosensory irritation compared to both overt or the more subtle subluxated vertebrae.

A further goal would be identifying the difference in target tissue response when initiated from articular sensory stimulation associated with the irritation from a different somatic disturbance. Nociceptive responses could be compared to the sensory input from a hypermobile segment or from inflamed or arthritic articular facets which registers conscious awareness in the patient.

Although the role of the somatosensory influence upon the autonomic nervous system seems to have attracted researchers' attention, the findings do not appear to have transferred across into general clinical application, apart from the manipulative sciences. (29) It has been these clinical sciences in particular which have recognised the potential for this somato-autonomic influence to be implemented. In 2006, Jänig stated that '*Despite its enormous importance for the maintenance of normal physiology in all vertebrate species, and for its understanding of many clinical symptoms of disease, the autonomic nervous system has not, even transiently, been the centre of attention in neuroscience research internationally over the past 40 years.*' (30)

A decade later Murtagh still recognised the conservative lack of interest in the spine. In 2015, he stated that '*the importance of the spine as a source of various pain syndromes has not been emphasised in medical training.*' That observation does not appear to have changed with allopathy being focussed predominantly on the pharmaceutical model. (31)

The widely published neurophysiologist Elspeth McLachlan at the *Prince of Wales Medical Research Institute* in Sydney acknowledged the difficulty of researching human autonomic reflexes when she stated that '*pathways to the viscera are currently too hard to study in humans because they are less accessible.*' (32) However, Sato and others have extensively explored the somatosensory-somatovisceral association primarily with animal subjects, at a depth as to be particularly relevant to neurophysiology in the manipulative clinical sciences. (33)

Sato and colleagues essentially neutralised suggestions that positive results to SMT were psychosomatic. (34, 35) They stated that, '*All evidence introduced here indicates that, in anaesthetised animals in which emotional factors have been eliminated, somatic efferent nerve stimulation can regulate various visceral functions by responses that are reflex in nature …* ' (36)

In view of the available evidence, it would seem quite plausible to state that vertebral subluxations may be one of the factors in a number of symptoms, clinical signs, or physiologic changes, and that encompassing *Somato Autonomic Vertebral Complexes* (SAVC) appear to be one of the factors in a range of pathophysiological states.

However, it would be distinctly inaccurate for critics to assert that chiropractors still claim that subluxations are the cause of all disease. This paper makes no claim to such a statement whatsoever. The authors are not aware of any formal evidence in the last 100 years that would support such a claim. Indeed historically, it was a medical doctor who appears to have first made this claim back in 1827. When Harrison stated that '*When we take into account the number, the*

size, and the distribution of the spinal nerves among the viscera and muscles, we are led to conclude that scarcely a complaint can arise in which they do not participate.' (p 11) An additional statement claims that '*… these vertebral dislocations, from internal causes, may be easily removed …* ' (p 17), and further referred to vertebral subluxations (p. 11, 133, 135, 139, 173) as imperfect dislocations. (p 142) He goes on to say that '*It is very surprising that subluxations should have been so generally overlooked in modern times.*' All of these statements were made 196 years ago. (p 135) As a former president of the *Royal Medical and Royal Societies of Edinburgh*, Harrison MD, FRAS makes a number of references to an association between vertebral displacements and a broad range of conditions. His acknowledgement of both the subluxation and its neural element is noted. (37)

The orthopaedist Goodley, suggested that an association between a VSC and internal organs could be the very same relationship (as) the routes for 'referred' pain. He regards the somatovisceral hypothesis as a '*completely acceptable science*.' (38)

It is submitted that a physical-mechanical articular disturbance could not exist without physiologically impacting on neural and other integrated structures. It can be noted that even a dull ache is a noxious sensory input. As with pain, it may have a protopathic role as well. As a structural and physiological articular disturbance, a degree of physical redress or modification of that functional disruption would seem logical and cogent. The presentation of this evidence may point towards expanding the understanding of the ramifications of the somatic vertebral subluxation model, its impact on human and animal neural physiology, and consequently the degree in which it may influence other aspects of visceral physiological function.

Confirmation of the role of the SAVC comprises significant support for this hypothesis as well as a rationale for the clinical outcomes as recorded in the literature. Indeed, no evidence was found which disproved the pathophysiological basis for the role of the subluxation-related SAV Complex.

In 1997 Nelson stated that there is an 'a*bsence of any specific refutation of the theory.*' (39) That statement still holds after twenty four years. One cannot imagine evidence contradicting the extensive neurophysiological research presented by Sato, his colleagues, and other neuroscientists.

Conclusion

The clinical evidence in the medical literature regarding a range of vertebrogenic functional conditions is substantial. It has a sound physiological base, observational studies and narrative reports. Indeed it could be deemed an oversight for this evidence to be ignored, particularly when this evidence is substantiated by the medical literature, and a travesty when considering options for patient care.

Peter Rome
DC (ret), FICC
cadaps@bigpond.net.au

John D Waterhouse
DC, FACC
Private practice, Melbourne

Cite: Rome P. Waterhouse JD. Neurodynamics of vertebrogenic somatosensory activation and Autonomic Reflexes - a review: Part 12 General considerations. Asia-Pacific Chiropr J. 2021;1.4. URL apcj.net/papers-issue-2-4/#RomeWaterhouse12General

References

1. Sato A, Sato Y, Schmidt RF. The impact of somatosensory input on autonomic functions. In: Blaustein MP, Grunicke H, Pette D, Schultz G, Schweiger M. (eds). Rev Physiol Biochem Pharmacol. Berlin: Springer;1997;130:4
2. Sato A. Neural mechanisms of autonomic responses elicited by somatic sensory stimulation. Neurosci Behav Physiol 1997;27(5):610-621
3. Sato A, Swenson RS. Sympathetic nervous system response to mechanical stress of the spinal column in rats. J Manipulative Physiol Ther. 1984;7(3):141-147
4. Sato A. Somatovisceral reflexes. J Manipulative Physiol Ther 1995;18(9):597-602
5. Budgell B, Hotta H, Sato A. Spinovisceral reflexes evoked by noxious and innocuous stimulation of thew lumbar spine. J Neuromuscul Syst 1995;3:122-131.
6. Budgell B, Sato A. Modulations of autonomic functions by somatic nociceptive inputs. In: Progress in Brain Research. Ansterdam: Elseview. 1996;13:525-539.
7. Budgell B. Autonmomic responses to spinal pain. Rigakaryoha Kagasku 2000;15(3):81-87.
8. Rome PL. Commentary: medical evidence recognising the vertebral subluxation. Chiropr J Aust. 2016;44(4):304-7
9. Rome PL. Neurovertebral influence upon the autonomic nervous system: some of the somato-autonomic evidence to date. Chiropr J Aust. 2009;39:2-17.
10. Rome PL. Neurovertebral influence on visceral and ANS function: some of the evidence to date – Part II: Somatovisceral. Chiropr J Aust. 2010;39(1):9-33.
11. Vernon H. What is different about spinal pain. Chiropr Man Ther. 2012;20(1):22. doi: 10.1186/2045-709X-20-22.
12. Cramer GD, Darby SA. Basic and clinical anatomy of the spine, spinal cord, and ANS. St Louis. Mosby; 1995:342-344.
13. Jinkins JR, Whittemore AR, Bradley WG. The anatomic basis of vertebrogenic pain and the autonomic syndrome associated with lumbar disc extrusion. Am J Roentgenol. 1989;152(6):1277-89.
14. Jinkins JR. The anatomic and physiologic basis of local referred and radiating lumbosacral pain syndromes related to diseases of the spine. J Neuroradiol. 2004;31:163-80.
15. Sekine M, Yamashita T, Takebayashi T, Sakamoto N. Mechanosensitive afferent units in the lumbar posterior longitudinal ligament. Spine. 2001;26(14):1516-21
16. Patterson MM. Concurring point of view with supporting evidence. Somatic dysfunction in osteopathic medicine. In Rosner AL. The role of subluxation in chiropractic. Des Moines: Foundation for Chiropractic Education and Research1997.25-32 http://www.chiro.org/LINKS/ABSTRACTS/The_Role_of_Subluxation_in_Chiropractic.shtml
17. Sherrington CS. The integrative action of the nervous system. New York. Chas Scribner & Sons. 1906. https://liberationchiropractic.com/wp-content/uploads/research/1906Sherrington-IntegrativeAction.pdf Ross
18. Brooks CM, Koizumi K, Sato A. (Eds), Integrative Functions of the Autonomic Nervous System: An analysis of the interrelationships and interactions of the sympathetic and parasympathetic divisions of the autonomic system in the control of body function. Tokyo, Univ of Tokyo, Press/Elsevier; 1979
19. Jänig W. The integrative action of the autonomic nervous system: Neurobiology of homeostasis. Cambridge. Cambridge University Press. 2006.
20. Orczyk JJ, Garraghty PE. Reconciling homeostatic and use-dependent plasticity in the context of somatosensory deprivation. Neural Plast 2015;2015:290819. Doi: 10.1155/2015/
21. He K, Petrus E, Gammon N, Lee HK. Distinct sensory requirements for unimodal and cross-modal homeostatic synaptic plasticity. J Neuroscience 2012;32(5):8469-8474.
22. Yin J, Yuan Q. Structural homeostasis in the nervous system: a balancing act for wiring plasticity and stability. Front Cell Neurosci 2015. https://doi.org/10.3389/fncel.2014.00439
23. Hendry S, Hsiao S. The somatosensory system. In: Fundamental neuroscience. 4th edn. 2013. Chapter 24. doi: 10.1016/B978-0-12-385870-2.00024-X
24. Sato A, Sato Y, Schmidt RF. (1. p 5, 257-262)
25. Jänig W. General aspects of integrated autonomic response. Homeostasis and allostasis In: The integrative action of the autonomic nervous system. Neurobiology and homeostasis. Cambridge: Cambridge Press. 2006:469-70

26. Jänig W. (14 - p1)

27. Bendtsen L. Central sensitisation in tension-type headache – possible pathophysiological mechanisms. Cephalalgia 2000;20(5):486-508

28. Purves D, Augustine GJ, Fitzpatrick D. Eds. The major afferent pathways for mechanosensory information: the dorsal column-medial lemniscus. In: Neuroscience, 2nf edn. 2001. https://www.ncbi.nlm.nih.gov/books/NBK11142/

29. Mein EA, Richards DG, McMillin DL, McPartland JM, Nelson CD. Physiological regulation through manual therapy. In: Physical medicine and Rehabilitation: State of the Art Reviews. 2000;14(1): http://www.meridianinstitute.com/physiological-regulation/ (Citing also Kuchera ML, Kuchera WA. Osteopathic considerations in systemic dysfunction. Kirksville; MD: KCOM Press;1991.

30. Jänig W. (14 – p ix)

31. Murtagh J. Spinal dysfunction. In: General practice. 5th Edn. Chapter 25. North Ryde. McGraw-Hill 2012:222-5

32. McLachlan WM. Forward. In: Jänig W. The integrative action of the autonomic nervous system: Neurobiology of homeostasis. Cambridge. Cambridge University Press. 2006;ix-xiv.

33. Sato A, Sato Y, Schmidt RF. (1. pps1-2, 138,231,258-9)

34. Sato A. Neural mechanisms of autonomic responses elicited by somatic sensory stimulation. Neurosci Behav Physiol 1997;27(5):610-621

35. Kimura A, Sato A. Somatic regulation of autonomic functions in anesthetized animals – neural mechanisms of physical therapy including acupuncture. Jpn J Vet Res. 1997;45(3):137-145.

36. Sato A, Sato Y, Schmidt RF. (1. P 254

37. Harrison E. Pathological and practical observations on spinal diseases [electronic source]: illustrated with cases and engravings. Also, an inquiry into the origin and cure of distorted limbs. London: University College. 1827;11. https://archive.org/stream/b21288458/b21288458_djvu.txt

38. Goodley PH. Release from pain. Essentials of orthopaedic medicine. 2nd. Edn. Telz Stone. Israel. Self Published. 2005:241. (e-book). [http://drgoodley.com/goodley/live/]

39. Nelson C. The subluxation question. J Chiropr Humanit 1997;7:46-55.