

Academy of Physical Medicine: Autonomic Imbalance in Infants

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Autonomic dysfunction often begins prenatally

- parental health status
- maternal stress responses
- maternal microbiome
- structural health

All can contribute to autonomic dysregulation

Maternal Ante-Natal Health

• An increase in firing of the maternal sympathetic nervous system and increased stress hormones may have significant effects on intelligence and behaviour

Melillo and Leisman Neurobehavioural Disorders of Childhood. 2004 Springer, New York

• Oxidative stress, nutritional deficiencies, environmental toxins, drugs and alcohol also can have a direct effect on the foetus and the development of its nervous system

• Higher maternal adverse childhood experiences-ACE scores significantly predicted shorter placental telomere length and greater respiratory sinus arrythmia-RSA suppression in infants

Jones et al Psychoneuroendocrinology. 2019 Aug;106:20-27.

Maternal Physiological Stress

• "Prenatal maternal stress affects the coupling between maternal and fetal heart rate detectable non-invasively a month prior to birth" *Lobmaier et al Arch Gynecol Obstet. 2020 Feb;301(2):405-414*

• "Antenatal maternal psychological distress is common and was found to be associated with key psychosocial measures during pregnancy, as well as with adverse birth outcomes"

McGinty RP et al Compr Psychiatry. 2020 Jan;96:152128

• "Results implicate maternal prenatal stress as a source of epigenetic mechanisms that affect fetal brain development and program risk for emotional dysregulation and mental disorders over a lifetime and across generations" DeSocio JE Arch Psychiatr Nurs 2018 Dec 32;(6: 901-906



Caesarean Section

• C-section deliveries make up 30% of UK births (14%elective, 16% emergency)

https://digital.nhs.uk/data-andinformation/publications/statistical/mate rnity-servicesmonthly-statistics/january-2019#key-facts

In the USA they vary between 22% in Utah to 38% in Mississippi



. https://www.cdc.gov/nchs/pressroom/so smap/cesarean_births/cesareans.htm

• HRV analysis revealed higher cardiovagal modulation in spontaneously born new-borns without analgesia compared to infants born by C-section

Kozar et al BMC Pregnancy Childbirth 2018 Jun 27;18(1):264

Structural Health-Pelvic Torque











Uterosacral and Round Ligaments

• Anteriority of one side of the sacrum will slacken one and tighten the other uterosacral ligament

• Torque will transfer through the uterus

• Any PI-AS rotation of the pelvis will tension the round ligaments adding to the uterine torque



Female Pelvis Section-Showing Ligaments



Diaphragm Release Pelvic Floor Balancing





Sacral Correction- Posterior Side



<u>Birth Trauma</u>

- Birth trauma is any condition that effects the foetus adversely during delivery Hughes et al Arch Otolaryngol Head Neck Surg. 1999 Feb;125(2):193-9
- Perinatal morbidity predicted health at age 12
 Miller et al Journal of Pediatric Nursing Volume 24, Issue 2 ,2009 Apr;101-114
- Up to 73% of infants had one or more asymmetries at birth 61% head, 42% face and 16% torticollis

Miller et al British J Midwifery 2013 Oct 21;10:736

• "Birth trauma is an under-publicised and therefore under-treated problem" Gottlieb MS J Manipulative Physiol Ther. 1993 Oct;16(8):537-43

Birth Trauma-Predisposing Factors

- Oxytocin use
- Malpresentation
- Multiple pregnancy
- Prolonged labour
- Prolonged 2nd stage
- Epidural anaesthesia
- Forceps delivery
- Shoulder dystocia
- Macrosmia

Perlow et al J Reprod Med. 1996 Oct;41(10):754-60.

- Induction of labour at term is associated with adverse outcomes
 Grivel et al Acta Obstet Scand 2012 Feb;91(2):198-203
- Trauma to the bony / cartilaginous skeleton i.e. skull fractures, nasal trauma
- Trauma to vascular tissue / fluid dynamics i.e. cephalhaematomas, retinal haemorrhages, intra cranial haemorrhage, hydrocephalus
- Trauma to nervous tissue i.e. Erbs palsy, BPI, ocular injuries
- Trauma to soft tissues i.e. torticollis



Asphyxia due to anoxia or injudicious anaesthetic use.
 Phillips (1997) ch.10 Pediatric chiropractic Anrig and Plaugher Eds

Parasympathetic Innervation

- Parasympathetic input is primarily through the vagus
- The heart, lungs, oesophagus, stomach, gallbladder, small intestine and proximal colon are supplied via the vagus
- Parasympathetic fibres from the sacrum supply the remainder of the gut maybe sympathetic?

Espinosa-Medina I et al Clin Auton Res. 2018; 28(1): 13–21

· Sympathetic innervation arises from the thoracic and upper lumbar cord

Autonomics

- Parasympathetic stimulation increases peristalsis and secretory activity and slows heart rate
- Sympathetic stimulation slows gut motility and digestive function and increases heart rate
- The enteric nervous system modulates the activity of the other two systems
- As the infant's sleep cycle lengthens so does the cycle of peristalsis, providing more time for digestion and absorption

Vagus Nerve Entrapment points

- Skull base
- Sub-clavicular
- Diaphragm



<u>Asynclitism</u>





Jugular Foramen Compression

• If a foetus's head is fixed in an asynclistic position during the birth process sub occipital and cranial tissues maybe strained creating jugular foramen compression *Carreiro JE An Osteopathic Approach to Children. 2003 Churchill Livingstone Edinburgh*



- Heart rate and breathing issues
- Difficulty in swallowing or choking while feeding
- Functional Gastrointestinal Disorders -straining, constipation, reflux, colic
- Increased sympathetic tone
- Torticollis

Proton Pump Inhibitors-Effects

- The specific adverse effects associated with PPIs were necrotising enterocolitis, late onset sepsis in premature infants, clostridium difficile infection, asthma, obesity and small intestine bacterial overgrowth in young children
- PPIs create dysbiosis of the microbiome in the mouth, gut and lungs in the paediatric population

Levy et al Acta Pediatrica 2020 feb 6

Infant Microbiome

- Colonisation begins before birth
 Jiminez Res Microb 2008;159:187, Satokari Lett Appl Microb 2009;48:8
- Infants delivered by C-Section have a different microbiota to those delivered vaginally which will impact their health

Collado Gut Microbes 2014 01;5(2):271

• C-section is associated with higher levels of the metabolic syndrome, type-1 diabetes and asthma

Hyde and Modi Early Hum Dev 2012 Dec;88(12):943

More than 200 bacterial species identified in breast milk
 Eerodez et al Cell Mol Biol 2012 Nov 2:50(1):21

Fernadez et al Cell Mol Biol 2013 Nov 3;59(1):31

• Breast milk is a source of commensal bacteria which further enhance infant health by preventing pathogen adhesion and promoting gut colonisation of beneficial microbes

Lyons et al Nutrients. 2020 Apr 9;12(4).



Bidirectional Microbe-Brain Communication

Gut-brain communication primarily occurs via interactions between the gut microbes and established psychoneuroimmunologic (PNI) pathways, including immunological (cytokines), endocrine (hypothalamicpituitary-adrenal [HPA]), and neural (vagus) pathways *Yang et al Nurs Res. 2016 Jan-Feb; 65(1): 76–88.*

Microbiome-Immunological Effects

• The gut microbiome contributes to the systemic inflammatory milieu of the host

• Lactobacillus secretes lactic acid which inhibits colonisation by infammatory microbes

Haarman & Knol Appl Environ Microbiol. 2006 Apr; 72(4):2359-65

• Enterobacteriaceae and Pseudomonadaceae are likely to stimulate a robust systemic inflammatory response

Bengmark S Pharmacol Res. 2013 Mar; 69(1):87-113

Colonization with Staphylococcus aureus has been associated with elevated cytokine levels

Johannson et alv PLoS One. 2012; 7(11):e49315

• Inflammatory cytokines exert effects on the CNS, shaping mood, stress response, and illness behaviour

Dantzer and Kelley Brain Behav Immun. 2007 Feb; 21(2):153-6

Microbiome-HPA Axis

• The composition of the microbiome influences the hypothalamic-pituitaryadrenal (HPA) axis by influencing cortisol secretion Sudo The microbiota-gut-brain axis in health and disease. New York, NY: Springer; 2014. pp. 177–194

• Chronic stress reduces the diversity of the microbiome and affects the relative abundance of various types of resident bacteria in a manner that correlates with increases in pro-inflammatory cytokines, including interleukin-6 (IL-6) and tumour necrosis factor-alpha (TNF-a)

Bailey et al Brain Behav Immun. 2011 Mar; 25(3):397-





Microbiome-Vagus

• Bacteria in the gut interact with cells in the gut wall to stimulate production of peptides that activate afferent endings of the vagus nerve

• Pro-inflammatory cytokines appear to activate vagal afferent fibres, with vagal transmission of inflammatory signals believed to be a key mechanism by which the brain receives information regarding systemic inflammation

• Efferent fibres of the vagus, in turn, carry anti-inflammatory signals to the periphery, via what is termed the cholinergic anti-inflammatory pathway Tracey KJ Nat Rev Immunol. 2009 Jun; 9(6):418-28 VijayaraghavanPLoS One. 2013; 8(6):e65936

Microbiota

• "Bidirectional signalling between the gastrointestinal tract and the brain, mainly through the vagus nerve, the so called "microbiota-gut-vagus-brain axis," is vital for maintaining homeostasis"

Moniel-Castro et al Front Int Neurosc Oct 2013;7:70p1

- Microbiota/vagal communication may be key in controlling feeding behaviour Cawthorne and de La Serre Brain Res. 2018 Aug 15;1693(Pt B):134-139
- The micobiome may act as a key regulator in brain development, aging and neural degeneration

Dinan and Cryan J Physiol. 2017 Jan 15;595(2):489-503

Probiotics

• Probiotic supplementation has been shown to have beneficial effects when given pre (via the mother) and post birth

Grzeskowiak et al Anaerobe 2012 Feb;18(1):7

• Probiotic supplementation during the neonatal period seems to reduce allcause mortality, NEC, and sepsis in vulnerable infants

Imdad et al Nutrients. 2020 Mar 17;12(3)

• Lactobacillus rueteri has been shown to be effective in the treatment of infant colic

Horvath A, Szajewska H World Rev Nutr Diet. 2013;108:40-8

Levels of Bifidobacterium, Clostridium, Lactobacillus, and Klebsiella predict colic severity and crying times

Loughman a et al J Dev Orig Health Dis. 2020 Apr 13:1-11



Sacrum - Assessment

- Squeeze the buttocks together and observe any deviation of the gluteal cleft
- The cleft will deviate to the anterior sacral side

Sacrum- Correction

- Contact posterior sacrum hold 5-8 seconds
 P-A pressure
- Finish with fast "flexor flick"
- Stabilise ipsilateral ileum

Balancing Sacral Respiratory Function

Flexion/extension of the sacrum is encouraged while the ASIS's are gently squeezed together to open the SIJ's

C1 Adjustment - Low Force

Diaphragm Release

Slow stretch restricted diaphragm 5-8 seconds and then use fast stretch pull apart













Occipital Decompression

• Fingers of both hands under the infant's occiput attempting to flex it, feel for side of restriction

• A facial release is performed-indirectly and very gently in the direction of "freedom



S-C J and A-C J Correction

Inferior medial clavicle



Superior lateral clavicle



Adjusting instruments to used with caution and should be infant compatible. A manual slow stretch with a fast and very shallow finish can be used

What We Can Do Now

- Stress free pregnancy
- Encourage natural birth
- Allow the umbilical cord to pulse out
- Don't wash the baby
- Feed mum and baby pre and probiotics
- Also fat soluble vitamins
- Get structural care when pregnant and for the infant soon after birth

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