W5: (Committee Activity) Optimising First Line Therapy for Overactive Bladder - Physiotherapy Committee (Open Session)

Workshop Chair: Rebekah Das, India
06 October 2015 09:00 - 12:00

Start	End	Topic	Speakers
09:00	09:20	Theoretical overview of rationale underpinning treatment options for OAB	Rebekah Das
09:20	09:40	Combination therapy: Pharmacological options in the management of OAB	Ruth Kirschner-Herrmanns
09:40	10:00	Introduction to the practical techniques being showcased today	Beate Carrière Rebekah Das Sonja Soeder
10:00	10:30	First practical session (3 small groups): Connective tissue massage (Speaker Beate Carriere), TENS (Speaker Sonja Soeder), Mindfulness based techniques (Speaker Rebekah Das)	Beate Carrière Rebekah Das Sonja Soeder
10:30	11:00	Break	None
11:00	11:30	Second practical session (3 small groups rotate to the next station)	Beate Carrière Rebekah Das Sonja Soeder
11:30	12:00	Third practical session (3 small groups rotate to final station)	Beate Carrière Rebekah Das Sonja Soeder

Aims of course/workshop

Developing a clear rationale for treatment choices in first-line management of overactive bladder can be difficult because causes of urgency remain poorly understood. This workshop will present a brief review of recent literature examining the causes and nature of urgency, challenging traditional views and rationale underpinning treatments such as fluid management and pelvic floor exercises. Brief practical 'snap-shots' will be offered for mindfulness, per/transcutaneous electrical nerve stimulation and connective tissue massage. Participants will be encouraged to consider established treatment choices with fresh eyes and to critically explore new options with emerging evidence as additions to their overactive bladder tool kits. Delegates a

Learning Objectives

1. Develop a critical rationale for first line behavioural therapies and pharmacotherapy for overactive bladder.

2. Apply transcutaneous electrical nerve stimulation and connective tissue massage as treatment options for overactive bladder.

3. Describe the application of mindfulness based stress reduction techniques and relaxation techniques in the treatment of urgency as an 'adverse sensation'.

Optimising first line therapy for overactive bladder

Urinary urgency is the defining symptom of the overactive bladder symptom complex. Management of overactive bladder can involve strategies directed at any of the symptoms associated with overactive bladder (urgency, urgency incontinence, frequency and nocturia). However, the focus of this workshop is to explore the nature of the sensation of urgency and to consider management strategies that focus on lessening the impact of this sensation.

What is urgency and therefore how to treat it?

Presenter: Dr Rebekah Das (PhD)

ICS definition: Urgency = the sudden compelling desire to pass urine which is difficult to defer[1].

However there has been considerable debate over the past decade regarding the adequacy of this definition and the precise ways in which 'urgency' differs from the normal desire to void.

The view that urgency reflects underlying detrusor overactivity has been revealed to be too simplistic. Urgency is now viewed as a multidimensional sensory experience of complex and uncertain aetiology[2,3]. Griffiths and colleagues have demonstrated that in patients with urgency urinary incontinence, central processing during bladder filling differs from asymptomatic counterparts[4]. DeWachter and colleagues have proposed a model whereby afferent information from the bladder is centrally modulated according to processing of wide ranging internal and external stimuli[5]. This raises the possibility that when treating urgency, a focus on addressing unhelpful cognitive and affective processes may be appropriate.

Recent research completed as part of a doctor of philosophy program demonstrated that urgency differs from the normal desire to void in multiple dimensions[6] as illustrated in **Figure 1.** The yellow squares represent the average sensation of desire to void in people without overactive bladder (light yellow = 'half' a point). The red squares represent the average profile of the sensation of urgency experienced by people with overactive bladder[6]. As with other adverse sensations such as pain and dyspnoea[7], urgency has both physical and affective dimensions.

		Does not describe my sensation at all	Describes my sensation a little bit	Describes my sensation moderately	Describes my sensation quite well	Describes my sensation very well	Describes my sensation extremely well
1	Pressure	0	1	2	3	4	5
2	Anxious	0	1	2	3	4	5
3	Urgent	0	1	2	3	4	5
4	Unpleasant	0	1	2	3	4	5
5	Intense	0	1	2	3	4	5
6	Uncomfortable	0	1	2	3	4	5
7	Sudden	0	1	2	3	4	5
8	Hard to hold on	0	1	2	3	4	5
9	Fullness	0	1	2	3	4	5
10	Annoyed	0	1	2	3	4	5

Figure 1: the sensory profile of normal 'desire to void' (yellow) as compared with urgency (red) as assessed by the University of South Australia Urinary Sensation Assessment (USA[2]).

A copy of the University of South Australia Urinary Sensation Assessment (USA[2]) is provided on page 3.

The University of South Australia Urinary Sensation Assessment (USA^2)

Instructions: Below are 10 words or phrases. Please rate **how well each word or phrase describes the sensation you feel** when you want to go to the toilet to wee.
Please consider your sensation on average over the past month and circle a response for each word or phrase.

		Does not describe my sensation at all	Describes my sensation a little bit	Describes my sensation moderately	Describes my sensation quite well	Describes my sensation very well	Describes my sensation extremely well
1	**Pressure**	0	1	2	3	4	5
2	**Anxious**	0	1	2	3	4	5
3	**Urgent**	0	1	2	3	4	5
4	**Unpleasant**	0	1	2	3	4	5
5	**Intense**	0	1	2	3	4	5
6	**Uncomfortable**	0	1	2	3	4	5
7	**Sudden**	0	1	2	3	4	5
8	**Hard to hold on**	0	1	2	3	4	5
9	**Fullness**	0	1	2	3	4	5
10	**Annoyed**	0	1	2	3	4	5

Of all the words or phrases, which one best describes your sensation?.....

Finally, please check that you have circled a response for each word or phrase.

Overactive bladder management guidelines: 'established' first line therapy

Terminology regarding first line therapy for overactive bladder varies and therefore different treatment strategies can be difficult to define. The umbrella term 'behavioural therapy' typically includes patient education, lifestyle advice, bladder training and pelvic floor muscle exercises. Clinical guidelines have been published by Gormley and colleagues[8] (AUA/SUFU: American Urological Association/Society of Urodynamics, Female Pelvic Medicine & Urogenital Reconstruction) and Yamaguchi and colleagues[9] (Japanese Urological Association). In addition guidelines developed in the UK (NICE) and Australia (RACGP) are available online. Each guideline provides a differing level of detail regarding the range of therapies included as 'first line therapy' and the underpinning rationale. **Table 1** summarises the range of treatment strategies presented in these guidelines.

Table 1: Behavioural therapies recommended for the treatment of overactive bladder in clinical guidelines.

	AUA/SUFU	JUA	NICE*	RACGP**
Patient education	√		√	
Bladder training	√	√	√	√
Bladder control strategies	√	√		√
Pelvic floor muscle training (PFMT)	√	√	√	√
Biofeedback (adjunct to PFMT)		√		√
Lifestyle advice				
• Fluid management				
○ Volume reduction	√	√	√	√
○ Volume increase			√	√
○ Caffeine reduction	√	√	√	
○ Alcohol reduction				√
○ Carbonated beverage reduction				√
• Constipation advice/healthy eating			√	√
• Weight loss	√		√	√
• Smoking cessation			√	
• Exercise			√	
• Toileting assistance (for elderly)		√		
Intravaginal oestrogens			√	

*NICE guidelines available at: http://www.nottsapc.nhs.uk/attachments/article/3/overactive%20bladder%20clinical%20guidance.pdf

**RACGP guidelines available at: http://www.racgp.org.au/afp/2012/november/overactive-bladder-syndrome/

Some research evidence is reported in published guidelines to support first line therapies including bladder training, pelvic floor muscle training, fluid volume reduction and weight loss[8,10]. However, other frequently recommended strategies rely largely on 'accepted wisdom'.

Re-thinking the rationale underpinning first line therapy

Historical views of urgency as a manifestation of underlying detrusor overactivity or 'irritation' have underpinned much of the rationale presented for first line therapies. However, with a broader view of urgency that includes aspects of sensory processing, the rationale underpinning treatment choices can be expanded. Some examples follow.

Rationale for pelvic floor muscle training

Reflex detrusor inhibition is commonly cited as the main rationale behind prescribing pelvic floor muscle training (PFMT) for patients with overactive bladder and urgency urinary incontinence in particular[11-15]. Even with this rationale in mind, is a strength training program, similar to that which might be prescribed for stress urinary incontinence, the most appropriate exercise dosage? In a systematic review by Greer and colleagues in 2012, assessment of strength changes in the pelvic floor was reported in a number of studies, but without justification[14]. In addition to inhibiting detrusor contractions, others have suggested that PFMT may be about 'training the will and mind.'[12,16] With a broader view of the symptom of urgency as a multidimensional sensory experience, there might be other reasons why PFMT could be prescribed and the underpinning rationale should guide exercise dosage.

Consider the following purposes for pelvic floor muscle exercise prescription. What might be the most appropriate exercise dosage and explanation to patients in order to achieve each of these aims?

Improved control and awareness of urethral closure

- **Coordination:** do some patients with overactive bladder demonstrate poor coordination of their pelvic floor muscles or poor differentiation from other muscles (for example breath holding, raising shoulders, excessive co-contraction of abdominal or adductor muscles?)
- **Endurance:** do some patients with overactive bladder demonstrate poor endurance of their pelvic floor muscles, making it difficult for them to 'hold on'?
- **Awareness:** do some patients with overactive bladder demonstrate poor awareness of whether their pelvic floor muscles are contracted or relaxed and therefore have impaired ability to 'hold on' or be confident that they are 'holding on'?

Improve circulation: evidence is increasing that impaired circulation to the detrusor might form part of the aetiology of urgency[17-20]. Exercise can improve local circulation. Might this form part of the rationale for prescribing pelvic floor muscle exercises? If so, what would be an appropriate dose?

Improve sensory awareness in the pelvic floor region generally. Exercise not only has effects on muscle fibres and circulation but also on neural networks peripherally and centrally. The sensory and motor homunculi change with exercise, with greater cortical representation of exercised areas[21]. Butler and colleagues of the Neuro-orthoapedic Institute talk of 'homuncular refreshment' which involves the use of movement to improve representation of body areas within the brain as a treatment for chronic pain. Might pelvic floor muscle training improve general awareness in the pelvic region and if so what dosage of exercise would be most effective?

Encourage confidence: Urgency has an affective component where sensation is perceived as anxiety provoking, annoying and unpleasant[2]. In addition, one of the most marked features of urgency as distinct from a normal desire to void is that it feels 'hard to hold on'[22]. Does pelvic floor muscle training ultimately enhance confidence and decrease anxiety as patients are taught to be aware of and employ their pelvic floor muscles for the purpose of effective 'holding on'?

Rationale for 'bladder training' and other behavioural therapies

The traditional aim of bladder training has been to improve bladder capacity and reduce frequency. In order for bladder training to succeed, patients need to achieve **'urge suppression'** when they feel the need to go to the toilet outside of their scheduled toileting times. Even outside of formal bladder training programs, health professionals sometimes teach **urge suppression** techniques in order to break the behavioural cycle of rushing to the toilet as an automatic reaction to the feeling of urgency. Anxiety and annoyance have been demonstrated to be part of the experience of urgency[2]. Stress in itself can perpetuate urgency or abnormal bladder sensation[23], via a number of mechanisms including impairment of urothelial protection and repair mechanisms [24].

The question therefore arises – should **stress management** play a role in 'bladder training' or other behavioural therapies?

Consider the following possibilities for behavioural therapies:

Mindful awareness of sensation rather than urge suppression: might unsuccessful attempts at urge suppression make some patients more anxious? Could patients instead be taught to re-evaluate their sensation and learn to respond to it differently? The end result may be the same – learning not to rush to the toilet but without the idea of 'suppression'. Catastrophising in the context of chronic pain is known to be an important predictor of poor

quality of life[25]. Catastrophising thoughts about urgency may similarly add to the burden of overactive bladder. The aim of non-judgemental awareness in mindfulness based training may positively reduce catastrophising tendencies.

Relaxation techniques: if stress perpetuates urgency and is part of the urgency experience (anxiety, annoyance), regular relaxation practice may be therapeutic. This could include mindfulness body scans, physiological relaxation techniques (such as progressive muscular relaxation techniques or 'autogenic training') or mental imagery. Relaxation techniques to apply specifically during urgency episodes may also be useful. Some examples of techniques that can be practiced during urgency episodes include;

- Breathing techniques ('centering', avoiding breath holding)
- Mental imagery of a closed urethra (water-tight seal, lifted bladder)
- Mental imagery of a comfortable, soft bladder
- 'Stop' practice: recognising and avoiding panic
- Brief body scan

'Myth-busting' as therapy: could myths/unhelpful beliefs about bladder function play a role in the perpetuation of stress and urgency? Consider some of the following myths:

- Drink at least 2 litres of water a day: better advice is to drink when thirsty.
- Tea and coffee do not count as fluid: all fluid counts.
- You should never go 'just in case': actually going just in case has been shown to be normal behaviour[26]. It might better to reduce obsessive behaviour but not apply unrealistic rules about 'never' going just in case.

Cognitive behavioural therapy: a 'cognitive approach' described by Marti and colleagues in 2015[27] is a structured analysis of situations or circumstances in which urgency is aggravated and the accompanying emotions, thoughts and behaviours. Behavioural change is prompted by reconsidering the thoughts that accompany the emotions and by negotiating behavioural change. The suggested process is:

1. Identify circumstances which provoke urgency
2. Analyse behaviour during these circumstances
3. Discuss reasons for behaviour
4. Define objectives for behaviour change

Neurophysiological education and cognitive behavioural therapy have also been described as treatment techniques for chronic pain and dyspnoea[28-30]. Conceptualisation of each of these adverse sensations as multidimensional sensory experiences with affective as well as physical dimensions underpins these cognitively focussed treatment approaches.

'Second line' therapy or 'combination therapy' of OAB: pharmacotherapy

Presenter: Professor Ruth Kirschner-Hermanns.

Background: Due to epidemiological changes numbers of patients with overactive bladder are increasing. Risk factors for developing overactive bladder are aging as well as several neurological diseases such as diabetes mellitus, multiple sclerosis and different forms of Parkinson's disease. In addition some women with prolapse and some men with benign prostate enlargement (BPE) develop overactive bladder symptoms.

Bladder dysfunction at various levels may result in bladder control disorders, which roughly can be classified as disturbances of filling/storage or disturbances of voiding/emptying. Failure to store urine may lead to various forms of incontinence (mainly urgency and stress incontinence), and failure to empty can lead to urinary retention, which may result in overflow incontinence. A disturbed filling or storage function can be improved by agents decreasing detrusor activity, increasing bladder capacity, and/or increasing outlet resistance The common view is that in overactive bladder/detrusor overactivity, the drugs act by blocking the muscarinic receptors on the detrusor muscle, which are stimulated by acetylcholine (Ach), released from activated cholinergic (parasympathetic) nerves. Thereby, they decrease the ability of the bladder to contract. Pharmacological treatment has been shown to be a useful addition for those patients with no obvious intravesical obstruction after first line treatment such as behavioural training, bladder training, pelvic floor rehabilitation, specialized physiotherapy, life style changes or other forms of conservative treatment have not led to a satisfactory result.

Session overview: Newly developed drugs, intravesical use of Botulinumtoxin or neuromodulation might be valuable options for those patients in whom first line therapy has failed, or where side effects override benefits. The goal of this course is not only to give an overview of pharmacological treatment in patients with overactive bladder but also to provide an overview of limitations of pharmacological short and long term treatment in different patient groups. We will further discuss surgical options such as instillation of Onabotulinum A toxin, neuromodulation and prolapse surgery.

Suggested Readings:

Boettcher et al 2012, Overactive Bladder Syndrome (OAB) – An Underestimated Long term Problem after Treatment of Patients with Localised Prostate Cancer.[31]

Staat et al 2012, New measurement to compare soft tissue anchoring systems in pelvic floor surgery.[32]

Kirschner-Hermanns et al 2012, Does diabetes mellitus-induced bladder remodelling affect lower urinary tract function? International Consultation on Incontinence - Research Society (ICI-RS) report.[20]

Practical snapshot 1: Mindfulness based stress reduction

Presenter: Dr Rebekah Das (PhD), PT, MAPA.

In 2014 Baker and colleagues[33] published a comparison of a mindfulness based stress reduction program and a yoga program for the treatment of urge urinary incontinence with the former showing promising results. The rationale for choosing mindfulness based techniques included the demonstrated benefit in the treatment of irritable bowel syndrome (IBS) and the known differences in brain activation during bladder filling for people with urgency urinary incontinence.

Some basic tenets of mindfulness based techniques include:

- non-judgemental awareness of bodily sensations
- interpreting sensations simply as sensations and thoughts simply as thoughts
- separation of symptoms and suffering
- responding versus reacting to sensation

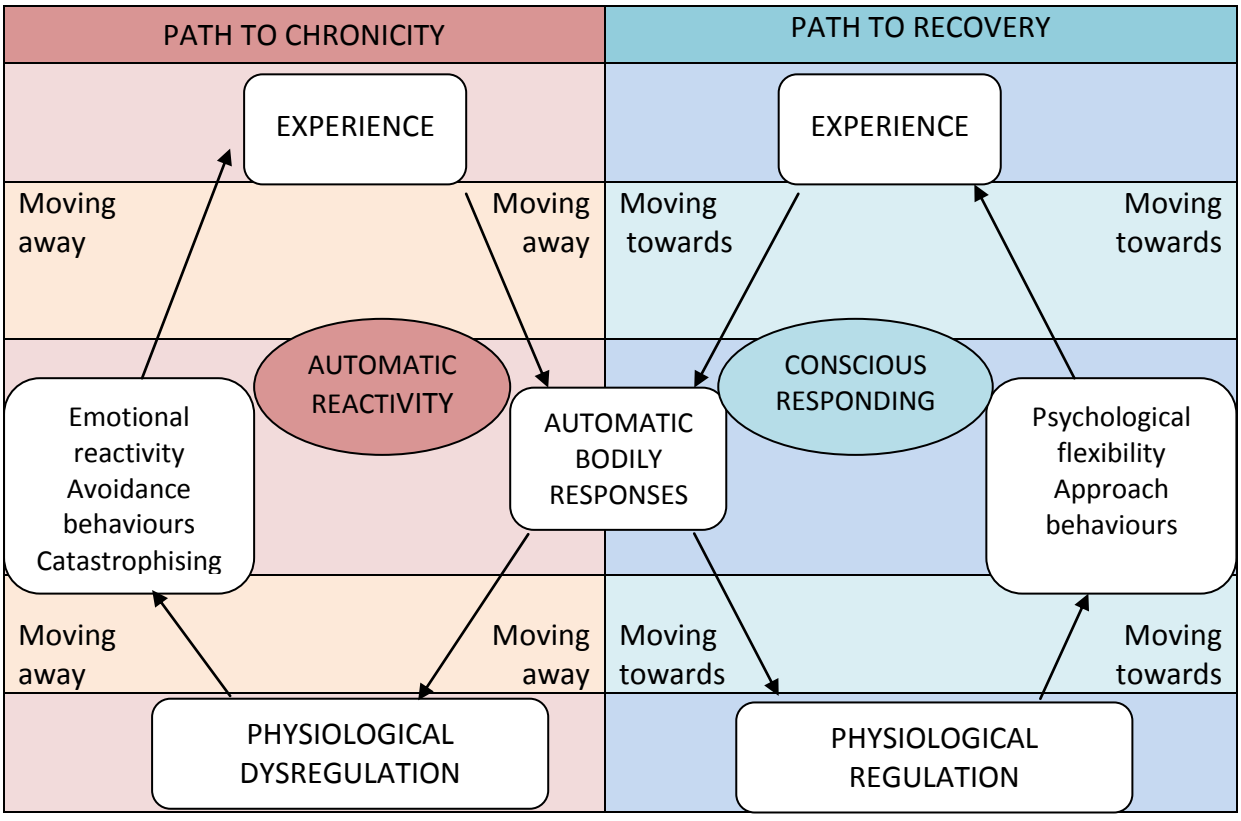


Figure 2: an illustration of responding versus reacting. *Adapted from illustration drawn by Georgie Davidson, Mindful Movement Physiotherapy.

Food for thought: how do the tenets of non-judgemental awareness of sensation and responding versus reacting relate to ideas of 'urge suppression techniques'?

Recent research has revealed that **distraction techniques** may impair external urethral sphincter function in terms of increased reaction time and decreased maximum EMG activity[34]. Could mindful attention be more useful than distraction?

Consider related techniques: progressive muscular relaxation, diaphragmatic breathing, imagery.

An example mindfulness based stress reduction program

The following program is reproduced with permission from Jan Baker, lead author of the research referred to in this handout. This is the program used in their research and was derived from programs developed by Dr Kabat-Zinn at the Massachusetts University Medical Centre. More information can be found at the web-site: http://www.mindfullivingprograms.com/whatMBSR.php

The program illustrates the graduated learning process involved in a typical mindfulness based stress reduction program designed for groups. Note that there are no specific references to bladder symptoms, but consider where these might be incorporated.

Class 1: The course began with personal introductions to create group cohesion, an overview of the coming eight weeks, and a discussion of attitudes that support mindfulness. Participants were led through an experiential exercise of mindful eating of a raisin that focuses on the physical sensations of smell, feel, touch sight, and taste. They were encouraged to take this practice home and practice mindful eating with other food. They were introduced to diaphragmatic breathing and body scan exercise to facilitate non-judgmental awareness of bodily sensations.

Class 2: Participants were guided through a body scan exercise at the beginning of class. Time was given to share and discuss their experiences during the preceding week, particularly with regard to home practice. Participants were introduced to sitting meditation with awareness of breathing as the primary object of attention, to develop concentration. Home practice this week included being aware (mindful) of a pleasant events and of a routine daily activity.

Class 3: Gentle mindful yoga movements were introduced as a way of alleviating physical symptoms of stress and bringing awareness to subtle movements of the body. Discussions included the power of being mindful in the present moment and the objective observation of thoughts as *merely thoughts*, rather than as facts or events. Home practice this week included being aware (mindful) of unpleasant events.

Class 4: The practice of sitting meditation was expanded to emphasize the perception of body sensations *as simply sensations* (as opposed to interpretations and thoughts *about*

sensations, e.g. catastrophizing). Walking meditation was also introduced. The psychophysiology of the stress response was presented. Recommended home practice was to become aware of their personal stress reactions.

Class 5: There was acknowledgment of the halfway point in the course. Time was given for participants to discuss their commitment to daily practice and their experiences of the effects of the program so far. Sitting meditation was expanded to include awareness of thoughts arising and passing away, followed by a discussion of the role of mindfulness in responding to stress in everyday life. The concept of emotional intelligence was introduced. For home practice, participants are encouraged to begin experimenting with combinations of practices previously introduced that fit their needs, including body scan, gentle yoga, walking meditation, and sitting meditation. Home practice included identifying a difficult communication experience and become aware of the distinction between everyday reacting (without choice) and responding (with choice).

Class 6: Sitting meditation was expanded to a longer session and the use of metaphors that explore qualities of mindfulness were used. The topic of working with emotions continued from the previous class, to expand the inner resources for emotional resilience. In addition to the home practices suggested previously, participants are asked to be aware of and label their emotions for the next week.

Class 7: The practice of *choice less awareness* was introduced during the sitting meditation. Choice less awareness is a state in which one is fully aware of the moment, yet mindfulness is not focused on any physical or mental image or object. Topics of discussion included gaining confidence in the practice and results of mindfulness and awareness as related to food and eating. In addition to the home practices suggested previously, attention was drawn to awareness of how we nourish our bodies, and how that relates to emotional intelligence.

Class 8: The last class began with a body scan, followed by sitting meditation. The discussion focused on a brief review of the course, acknowledging where the participants were at this point in their personal practices, and cultivating resources for continued practice.

Example body scan and other mindfulness scripts can be accessed at:

http://mindfulnesshamilton.ca/meditation-scripts

Suggested readings:

Kerr et al 2013, Mindfulness starts with the body: somatosensory attention and top-down modulation of cortical alpha rhythms in mindfulness meditation.[35]

Carslson 2012, Mindfulness-based interventions for physical conditions: a narrative review evaluating levels of evidence.[36]

Practical snapshot 2: Transcutaneous electrical nerve stimulation

Presenter: Sonja Soeder, PT

Overview

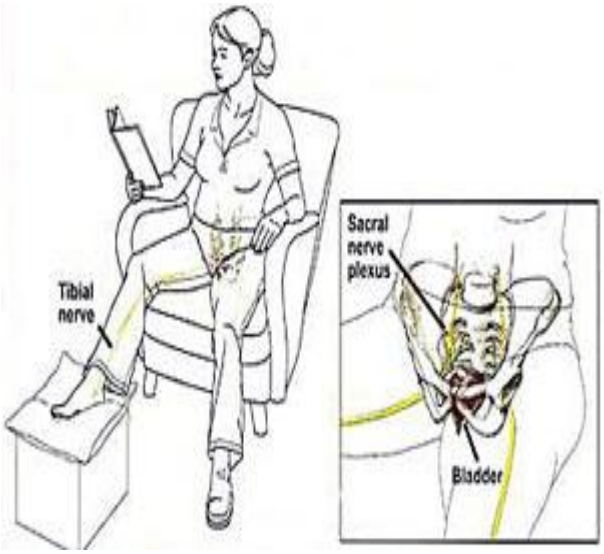
Electrical stimulation for the purposes of reducing overactive bladder symptoms in both adults and children have included pelvic floor stimulation (vaginal electrodes, e.g. Wang and colleagues[37]), sacral neuromodulation[38], pudendal nerve stimulation[39], percutaneous tibial nerve stimulation[40,41] and transcutaneous electrical nerve stimulation (TENS) targeting the tibial nerve at the ankle[42], sacral dermatomes[43] or vaginal/anal/genital stimulation[44].

Sacral neuromodulation (SNS) involves surgical implantation of an electrode (a thin wire) near the S3 nerve root either uni or bi-laterally, which is connected to a pulse generator (implantable neurostimulatior) providing continuous stimulation. The patient has a hand-held programmer which enables them to adjust the intensity and to turn the stimulator on or off. The pulse generator is approximately 2.5 x 2.5 cm and is implanted in the gluteal fascia. It is an invasive procedure and therefore is considered third line therapy for OAB. Prior to implantation a trial period of 10 days to 4 weeks is commonly offered. This is reversible, allowing patients and clinicians to decide if SNS is an appropriate treatment choice. SNS has been used since 1994. Proposed mechanisms include activation of spinal inhibition via afferent S3 nerve fibres or detrusor inhibition via activation of the pelvic floor[45]. The parameters of the Interstim-II device are: F= 10-14 Hz, pulse width=180-240 µseconds. The sensation invoked by stimulation is of a light tingling, tapping or pulling and is not meant to be painful. Follow-up after surgery involves several appointments over the first 2-4 months followed by annual review. With a stimulator implanted, any kind of diathermy to the body is contraindicated, even if the device is switched off.

Pudendal nerve stimulation also involves surgical implantation of a pulse generator but targeting the pudendal nerve via a transgluteal or ischial-rectal approach[39]. The same device used for SNS is used (parameters typically 200 µseconds, 16 Hz). It has been suggested, though, that transcutaneous stimulation may be considered[46].

Percutaneuous tibial nerve stimulation (PTNS) involves insertion of a needle electrode to stimulate the tibial nerve just superior to the medial malleolus **(Figure 3)**. It was developed initially based on the bladder/pelvic floor acupuncture point and the observation that hind-leg stimulation in animals inhibited the detrusor. The tibial nerve is a sensory-motor nerve with afferent pathway to the lumbosacral roots L4-S3. The parasympathetic nerve supply, which is responsible for the detrusor contractions and thus for the voiding, rises in sacral spinal cord from S2-S3. The PTNS effect is to stimulate indirectly the sympathetic nervous system to inhibit contractions during the bladder filling phase[47]. The whole mechanism is controlled by complex interactions within the peripheral and central nervous system.

Parameters are a continuous or intermittent, square wave form, pulse width = 200 µseconds, F = 20 Hz. Intensity = maximum tolerated by patient. Most common dosage is weekly 30 minutes sessions for approximately 10-12 weeks[48]. Increasing the number of sessions per week does not appear to increase the effect.



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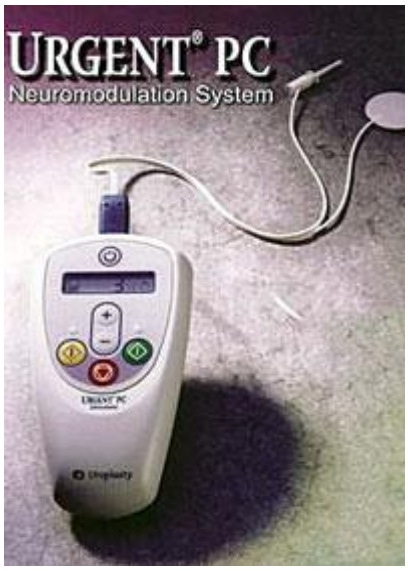

Firma Uroplasty: Urgent PC Neuromodulation System

Figure 3: PTNS suggested patient position and device.

TENS (various application sites of surface electrodes): rationale is that it is less invasive but it remains unclear whether it is equally effective. It is also unclear whether the same parameters as for SNS or PTNS should be chosen. Treatment can target S3 (placed over the sacrum), hypogastric nerves (electrodes placed suprapubically) or the tibial nerve with electrodes placed to mimic electrode placement in PTNS. TENS can also be used to directly stimulate pelvic floor muscles in support of behavioural or biofeedback training to enhance pelvic floor muscle training (using vaginal or anal probes)[49,50]. Some examples of electrode placement and vaginal/anal electrodes are provided in **Figure 4**.

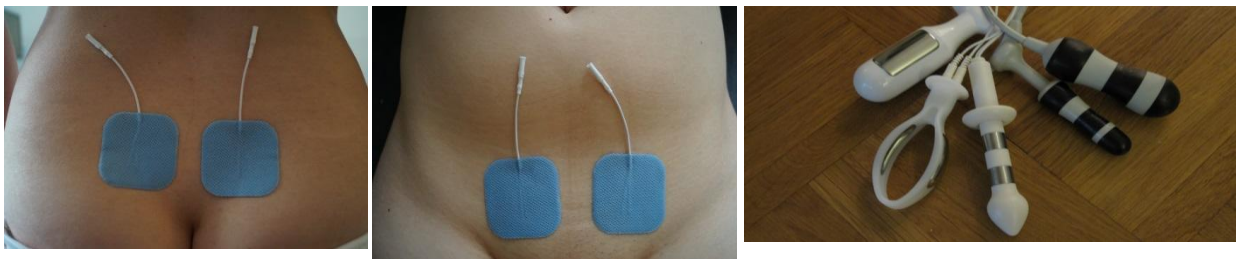

Figure 4: examples of electrode placement and vaginal/anal electrodes.

Considerations for parameter choice:

Skin resistance is greater with surface electrodes than with a needle electrode. To reduce skin resistance it is important to clean skin, possibly shave hair and to make sure there is good contact between electrodes and the skin. Self adhesive electrodes should have adequate adhesive gel and re-usable electrodes should either have an adequate layer of gel or be applied using damp electrode covers and bandaged securely. The depth of the target nerves should be considered, or alternatively, dermatomes to be targeted can be considered. Amplitude may need to be greater than with a needle electrode. Skin resistance is greatest to low frequency currents so where practical it may be useful to consider techniques such as modulated medium frequency where a low beat frequency is achieved by modulating two medium 'carrier' frequencies. However, standard TENS machines which patients can take home are most commonly low frequency machines.

Which nerves/nerve fibre types to target and therefore which parameters to choose? There is little research evidence to guide parameter choice. Nerve depth and fibre types need to be considered. Superficial nerves will be stimulated more readily than deeply placed nerves. Large diameter, myelinated fibres are more readily stimulated than small diameter and unmyelinated fibres which require greater current density[51]. Gajewski and colleagues hypothesise that the stimulation targets for OAB 'wet' (i.e. with incontinence) may be different to those for OAB dry[46]. They propose that stimulation of nociceptive fibres (small, unmyelinated C-fibres, therefore requiring higher amplitude stimulation) may be beneficial for OAB dry if this subtype of OAB is assumed to have more to do with sensory processing; C-fibres project to the thalamus and insula and therefore targeting these nerves may influence central processing. Conversely, targeting A-delta fibres (larger, myelinated fibres requiring lower amplitude stimulation) may modulate overactive voiding reflexes.

However, **amplitude** is not the only parameter to influence the types of never fibres stimulated and the outcomes. **Frequencies** greater than 20 Hz may stimulate detrusor contractions whereas lower frequencies (5-10 Hz) seem to inhibit the detrusor[46]. However the mechanisms behind these effects remain obscure.

The strength-duration curve in **Figure 5** demonstrates that **pulse durations** at less than 0.1 milliseconds (100 µsecs) large diameter (and more superficially placed) sensory fibres are differentially stimulated and much higher current amplitude is required to stimulate either motor or pain (A delta or C) fibres. Note that where motor nerves (largest diameter) are superficial, a motor response may be elicited without sensory nerves being stimulated.

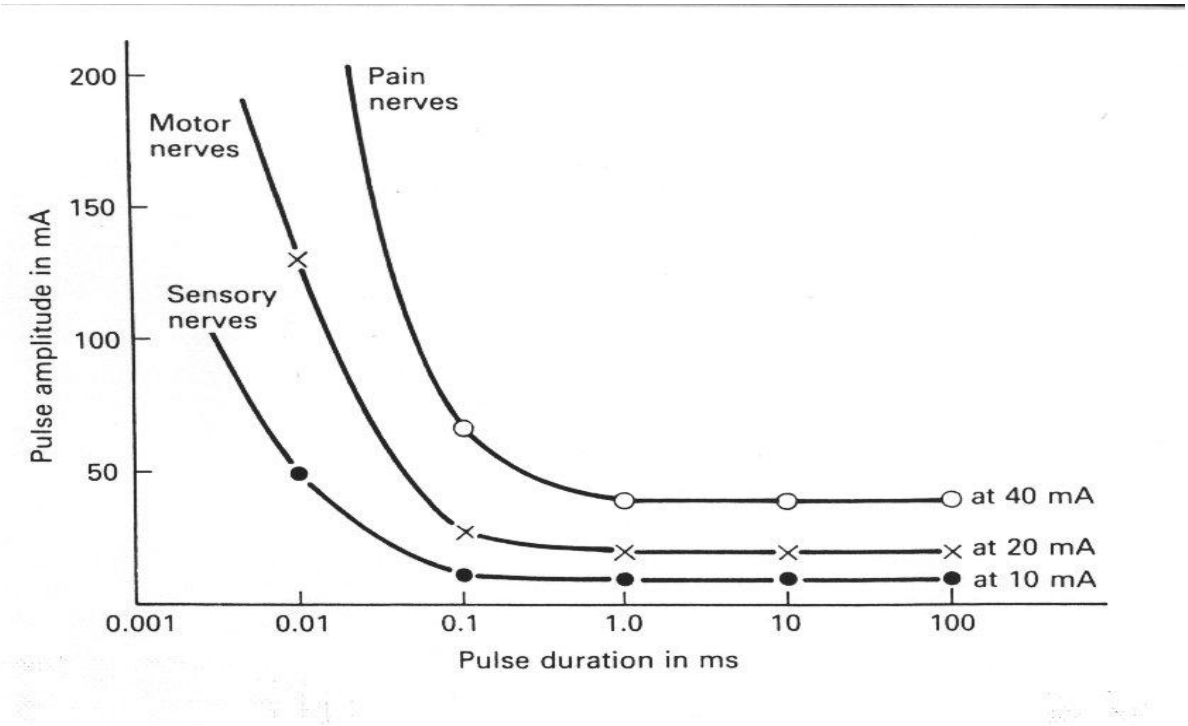

Figure 5: strength duration curve demonstrating the relationship between pulse duration and amplitude for the stimulation of different nerve types. Adapted from Robertson et al 2006, pg 61.[51]

As the pulse duration increases, the differentiation between nerve fibre types becomes less and C-fibres are more easily targeted. Longer pulse durations equate to lower frequencies as per the formula below:

$$F = \frac{1000}{PD+PI}$$

(where F = frequency (Hz), PD = pulse duration and PI = pulse interval in milliseconds)

Gajewski and colleagues[46] did not discuss the relevance of pulse duration in their review of electrical stimulation parameters and it is not always reported in studies of the clinical effectiveness of stimulation (see Table 2). However, TENS used in the treatment of pain can be either low pulse duration high frequency or high pulse duration and low frequency, with different pain control mechanisms being targeted by each of these combinations.[51,52] Further research may elucidate the relevance of different parameter choices for the treatment of OAB.

Suggested reading regarding the history of different types of electrical stimulation with a discussion on parameter choice:

Van Balken et al 2004, The use of electrical devices for the treatment of bladder dysfunction; a review of methods.[53]

Possible nerve targets for electrical stimulation:

Sympathetic nerve fibres (detrusor relaxation, internal sphincter tone)

- Preganglionic T10-L2 . Small diameter fibres. Or large diameter mechanoreceptors (Aβ) in same dermatome.
- Postganglionic via hypogastric (T10 – L2) and pelvic nerves (S2-4 and travels to walls of rectum). Small diameter, deeply placed.

Motor neurons to pelvic floor muscle, external urethral sphincter

- Pelvic nerves S2-4. Large diameter α fibres.

Parasympathetic nerve fibres (detrusor contraction, internal sphincter relaxation)

- S2-4. Small diameter fibres.

Afferent fibres from the bladder

- Via S2-4 Small diameter A δ or C fibres

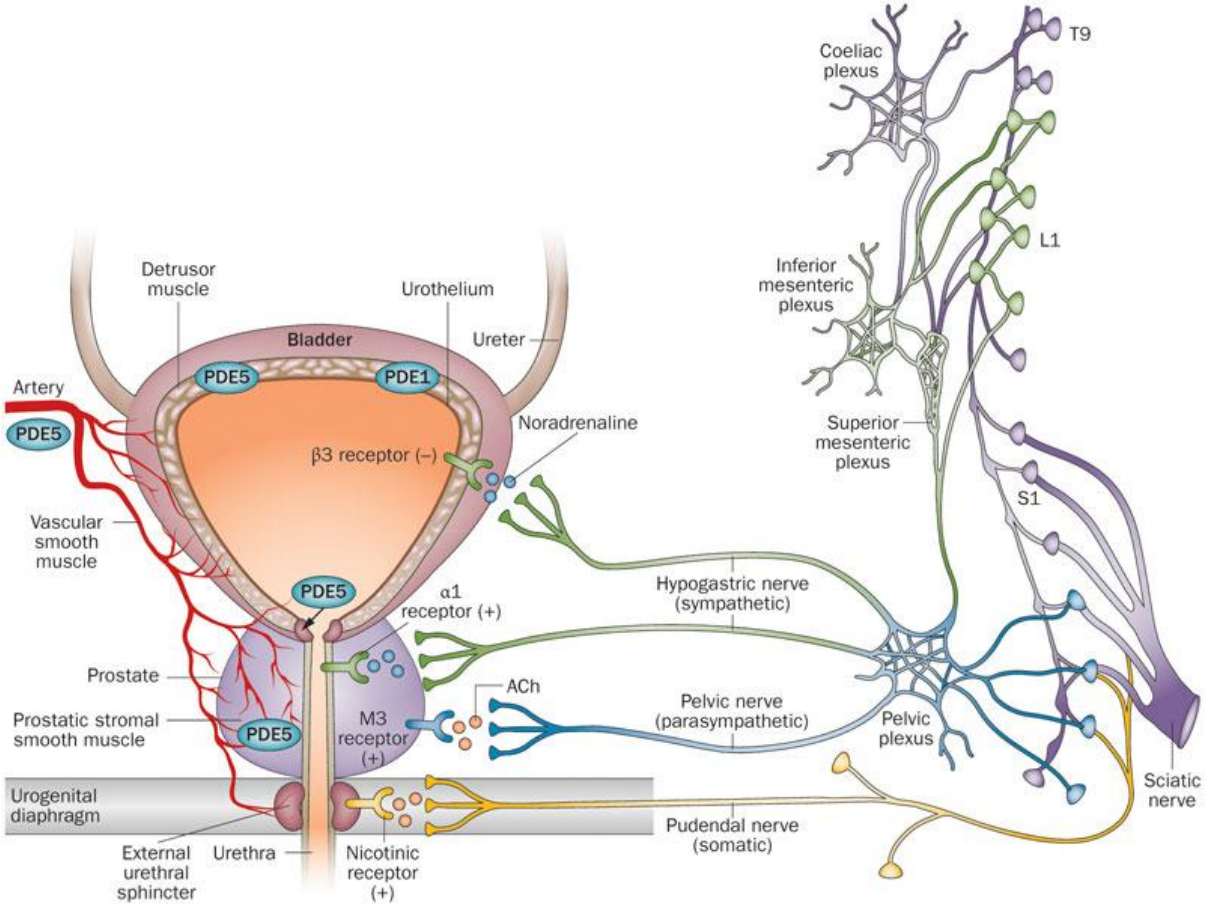

Figure 6: Neural targets for stimulation. Picture obtained from http://www.nature.com/nrurol/journal/v10/n7/fig_tab/nrurol.2013.101_F3.html, (accessed 2/5/2015), Rahnama'i et al 2013[54].

Stimulation parameters reported in published studies

A systematic review of published journal articles reporting TENS for the treatment of overactive bladder revealed 29 studies (13 reported the use of TENS on children). Table 2 summarises the range of reported parameters, giving the number of studies which report each variation in parameter choice. Surface stimulation rather than transvaginal stimulation was the focus of the review. Further studies on vaginal stimulation are available[55,56]

Table 2: TENS parameters reported in published journal articles. Grey shaded cells indicate the most common of each of the parameters.

Frequency	Pulse width	Electrode placement	Dosage*
1 Hz 1 study[57] (adult)	**100 µsec** 1 study[57] (adult)	**Sacral and perineal** 1 study[58]	**20 mins 2-3x/wk** 5 studies[43,59-62]
2 Hz 1 study[63]	**150 µsec** 1 study[63]	**Bilateral sacral** 13 studies[43,60,61,63-72] (5 adult)	**20 mins/day** 2 studies[73,74] (1 adult)
8 Hz 1 study[44] (adult)	**200 µsec** 7 studies[58,64,67-69,74,75] (5 adult)	**Tibial nerve** 6 studies[42,57,74-77] (5 adult)	**30 mins 1x/wk** 1 study[57] (adult)
10 Hz 17 studies[42,43,58-61,64,66,68,70,72,74-79] (8 adult)	**250 µsec** 1 study[42] (adult)	**Vaginal/penile** 2 studies[44,79] (both adult)	**15-20 mins 2x/day** 5 studies[44,65,66,71,79] (3 adult)
20 Hz 4 studies[67,69,73,80] (3 adult)	**300 µsec** 1 study[71]	**Anal/perianal** 2 studies[73,80] (1 adult)	**30 mins 2x/wk** 3 studies[42,75,77] (all adult)
100 Hz 2 studies[65,80] (1 adult)	**400 µsec** 1 study[44] (adult)	**Suprapubic** 2 studies[68,78] (1 adult)	**1 hr 2x/day** 1 study[78]
150 Hz 2 studies[68,78] (1 adult)	**500 µsec** 1 study[80] (adult)		**1 hr/day** 1 study[58]
	700 µsec 3 studies[43,60,61]		**90 mins 2x/day** 1 study[67] (adult)
	1000 µsec (1 msec) 2 studies[73,79]		**2 hrs daily** 2 studies[63,64]
	200 msec 3 studies[72,76,77] (all adult)		**Up to 6 hrs daily** 1 study[69] (adult)
	Unreported 5 studies[59,65,66,70,78]		

*For all studies, **amplitude** was directed by patient tolerance. In four studies, stimulation was performed during urodynamic testing rather than as a treatment course[68,72,76,80]. For three studies, full text and therefore parameters were not available[81-83].

Practical snapshot 3: Connective tissue massage

Presenter: Beate Carrière PT,CIFK, CAPP

There is some evidence that autonomic dysfunction, particularly of the sympathetic nervous system may play a part in the aetiology of urgency[84,85]. Connective tissue massage (CTM) is a manual therapy directed at manipulating subcutaneous fascial layers, thereby acting on the autonomic nervous system[86]. Recent research has demonstrated a positive therapeutic effect for constipation[87]. It may be hypothesised that CTM could also be effective in treating OAB if autonomic dysfunction is considered one of the aetiological factors.

History of CTM

CTM was first researched in Germany in the 1930s. Elisabeth Dicke, a physical therapist suffered in 1929 from severe endarteritis obliterans, an arterial obstructive disease in her right leg. While doctors considered the amputation of her right leg, she treated herself to combat her low back and leg pain, by manipulating and mobilizing her thickened connective tissue pulling with her finger tips through the tight tissue. In doing so, she felt the sensation of "sharp cutting" and tingling and warmth radiating into her leg. She extended the treatment to the region of the trochanter and lateral thigh. Within 3 months she was healed. Dicke's experience of connective tissue mobilization (CTM) was first published in a monography and in the 5th mostly unchanged edition of "Bindegewebsmassage" which was published in 1968.

In 1990, H. Teirich-Leube (1990), a physical therapist and physician and head of the Physical Therapy school in Freiburg Germany investigated Dicke's experience. Her research was supported by Heipertz (1967), who measured the improved circulation and parasympathetic effect of CTM. In 1969, Gross described a cutaneo-visceral-reflex whereby cutaneous manipulation, as in CTM, has effects on inner organs, blood vessels and nerves. Goats and Keir (1991) state that "the value of CTM lies with the capacity to induce more generalized alterations in physiological state" and that the effect of the superficial stimulation is to invoke changes in the deep tissues (such as increased blood flow and decreased pain), mediated via automonic nervous system changes. In 2011 Holey and colleagues demonstrated changes in skin temperature and diastolic blood pressure in response to CTM[88]. A review by Holey at al (2014)[86] summarises research which demonstrates physiological responses to CTM.

In 1962, physical therapists at the School of Physiotherapy in the University of Freiburg received 150 hours of training in CTM from Teirich-Leube herself and her primary teacher Ilse Schuh, whose book on CTM was published in 1992. At that time many kinds of medical conditions were treated, whenever autonomic nervous system dysfunction appeared to be part of the aetiology and when connective tissue zones (see Figure 7) were palpable and visible (such as tight bands of tissue or unusual swelling). In particular, there was

considerable emphasis on treating women with suspected hormonal imbalances and pain syndromes such as painful period. A book chapter 'Connective Tissue Manipulations' by Holey (2006)[89] provides an overview of treatment possibilities for women's health problems with supporting research evidence.

Patient evaluation for CTM

1. Careful history taking with attention to symptoms: pain, anxiety, urgency, sleep disturbance, cold feet, perspiration, visceral diffuse pain, hormonal imbalances, retention of fluid.

2. Inspection of the entire back/skin of the sitting patient (feet at a right angle hips and knees and resting on the floor). Are there areas of swelling/puffiness, tightness or indentation? Do they follow dermatomes? Manual palpation indicates if the tension is more superficial or in a deeper layer or increased tension in the muscle below.

Are there *connective tissue zones* **(Figure 7)** matching the symptoms, are they symmetrical or different right or left side?

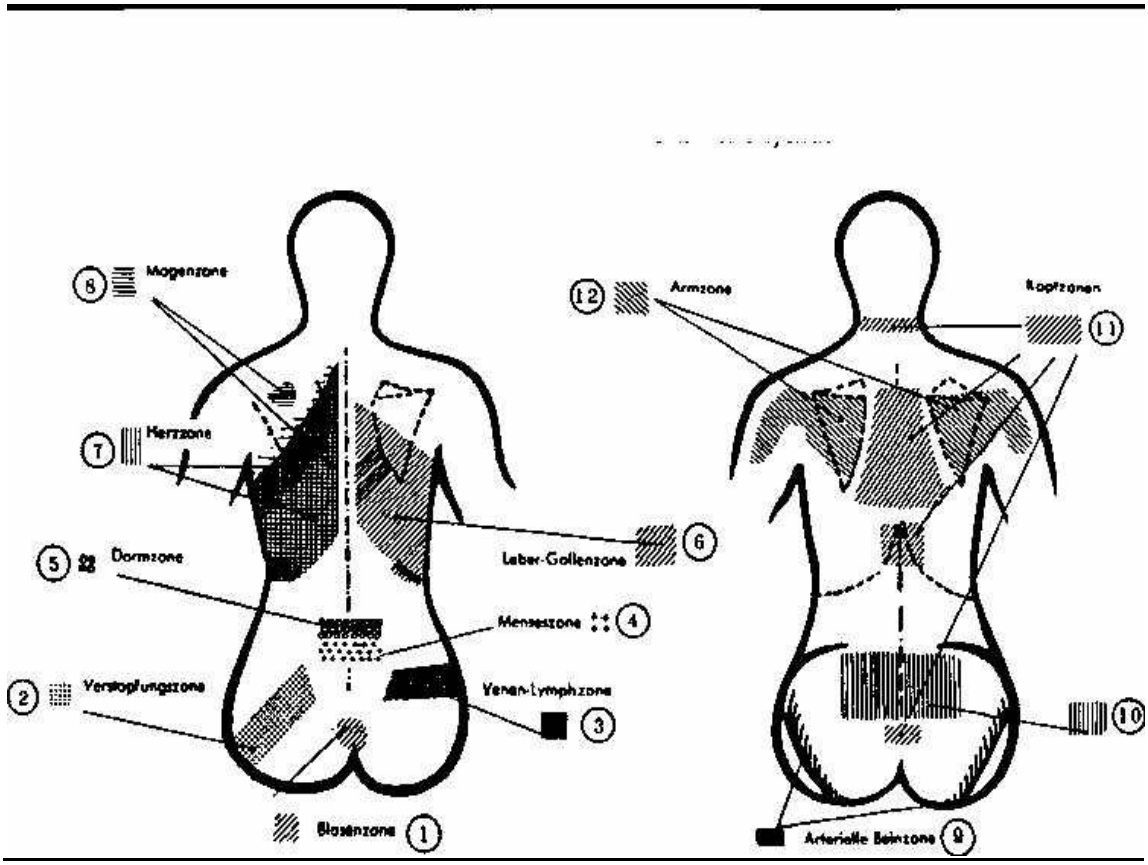

Figure 7: Connective tissue zones (from Teirich-Leube Grundriß der Bindegewebsmassage 5th ed, 1970).

CTM Treatment:

The “flächige” (from flat) technique is superficial skin rolling, which can precede the more intense CTM treatment at the fascial layer. A few treatments can relax very tight connective tissue and prepare patients for subsequent sessions of deep CTM. Skin rolling is usually done in a side-lying position, CTM at the deep layer is done in sitting, beginning at the tailbone and towards the edges of the sacrum and the pelvic rim in a caudal to cephalad direction. Directions of strokes are illustrated in **Figure 8**. It is important to stay in the layer/interface without creating a feeling of deep pressure. The cutting feeling with the skin reactions is correct. Holey and Dixon (2014) describe CTM as a *manual reflex therapy* which is applied with the pad of the longest finger or the tip of the thumb in order to reach the fascial layers within and beneath the skin.

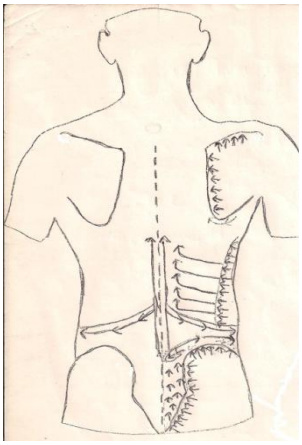

Figure 8: directions of strokes applied during CTM.

A correct stroke with the finger pad usually produces a triple response of dermographia rubra (redness of the skin), dermographia elevata (wheals/swelling in a line) sometimes there is at first a dermographia alba visible (a white line before it turns in a red line). Skin reactions are illustrated in Figure 9:

Figure 9: skin reactions evident after CTM treatment.

Other reactions to treatment:

It is important to point out to the patient the possibility of a 'humeral reaction' after the first treatment. This reaction involves an 'irresistible tiredness' and commonly occurs approximately two hours after the first treatment. Such a reaction may be expected in patients who feel a very sharp "cutting" and who have a strong skin reaction. Patients who experience this reaction should avoid driving until the reaction has abated. Occasionally the opposite reaction occurs and the patient feels overly active. Most patients feel relaxed after the treatment and they often state that they had a good night following the treatment.

Due to the possibility of these reactions, it may be helpful to give the first CTM treatments at the end of the day or the end of the morning so that the patient can rest afterwards. With the decrease of tension this reaction diminishes.

Occasionally patients can have blue marks from the strokes, which are not painful and such bleeding disappears after one or two treatments. Most commonly this type of reaction occurs in patients with rheumatoid conditions, which can cause the vessels to be more permeable.

Contra-indications and precautions:

It is understood that the treatment is not done on varicose veins (e.g. legs). The treatment for varicose veins/cramps can be done effectively at the hips and low back. Certainly, one would not treat patients with malignancies, open wounds, active infections, inflammation, or with unstable blood pressure. Pregnant women should be treated with caution, especially if they are at risk for miscarriage. Treatment during menstruation could cause heavy flow. Deep paravertebral connective tissue strokes should be avoided between the scapulae, as they may cause palpitation and fainting, especially early in a treatment program.

CTM in the treatment of OAB: special clinical considerations/reasoning

Aetiology of urgency and frequency symptoms are complex and are yet to be fully understood[90]. Where autonomic dysfunction is suspected, CTM can be an appropriate treatment choice. A through patient history, including a detailed bladder diary, will determine the likelihood of CTM being effective and the necessity of incorporating other behavioural therapies (such as fluid management or aspects of bladder training).

Some notes from my clinical experience (Beate Carriere):

Nocturia and poor sleep responds well to CTM.

Recently I treated several patients who had nocturia with 2-4 voids per night; after a single treatment they reported sleeping through the night. A further few patients with nocturia, only 3-4 hours of sleep and anxiety also started sleeping through the night, with the first void early in the morning.

Since I work in a private office and not in a research laboratory there are other factors which I consider when treating overactive bladder. I always evaluate the breathing and teach "chest-breathers" to learn diaphragmatic deep breathing, which of course also has a parasympathetic effect and supports the CTM treatment.

If swelling or retention of fluid is observed, in addition to CTM the patients may be treated once or twice with manual lymph drainage. In addition to being a relaxing treatment, this might help to improve the condition of the stressed connective tissue.

In order to improve the sensory awareness of the voiding pattern, I encourage patients to count when urinating in order to better understand whether or not the 'urgency' or bladder sensation experienced was likely to have been explained by a full bladder.

I often recommend spinal mobilisation exercises to my patients in order to promote flexibility of the connective tissues. I give exercises in all planes of motion: flexion/extension, side bending and rotation, combined with deep breathing and pelvic floor exercises to stimulate good functional activity and improved circulation in spinal and pelvic floor tissues.

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