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Endometriosis and Abdominal Myofascial Pain in Adults and Adolescents

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Abstract Endometriosis and myofascial pain are common disorders with significant impact on quality of life. Increasingly, these conditions are being recognized as highly interconnected through processes that have been described for more than a century. This review is directed to this interconnection through a description of the relationships of endometriosis to proposed mechanisms of pain and chronic pain physiology; the clinical assessment of myofascial representations of this pain; and an approach to the management of these interconnected disorders.

Keywords Endometriosis · Visceral pain · Myofascial pain · Trigger point · Abdominal pain · Endometriosis · Abdominal myofascial pain · Adults · Adolescents · Botulinum toxin

Introduction

Because the span of the information required to be covered in this review is substantial, a case history that permits some focus on the interrelation of endometriosis and myofascial dysfunction is presented. This review is directed to the elaboration of this common clinical situation from a physiological and therapeutic perspective.

Case History

A 17-year-old woman presented in the emergency department with a history of increasingly severe pain in the left lower quadrant. She had undergone a laparoscopy for pelvic pain 3 months prior for an ovarian endometrioma, but the pain had persisted since that surgery. This severe flare in pain began a week earlier during an episode of heavy menstrual bleeding and became unbearable over the past 48 h. She was on no medications before coming to hospital. In the emergency department, she was found to be in excruciating pain, lying on her side with her left leg drawn up to the abdomen. She was dehydrated and exhausted. On examination, her vital signs were stable and physical abnormalities were confined to the abdominal wall; a single-digit examination of the pelvis did not indicate cervical excitation. An ultrasound was normal as were all blood indices.

The specific findings of the abdominal examination are presented in Fig. 1. An area of cutaneous allodynia is indicated by a line in the left lower quadrant. Within this area is a line of four circles that represent myofascial trigger points. Testing with an algometer calibrated to detect changes below 90 g indicated severe tenderness that reproduced her pain with a total of 20 g.

A 1% lidocaine solution was injected was into the fascia of the four circled areas and the severity of the pain dissipated after several minutes. Although this episode resulted in a reduction in the acute episode, the pain returned and became a chronic persistent pain in the left lower quadrant with a persistence of the myofascial pain.

Endometriosis

A comprehensive review of endometriosis is not possible in this review and the reader is referred to several recent reviews [1••, 2••, 3], 4••]. Those aspects of the disease that have a significant relationship to myofascial pain and its consequences will be discussed.

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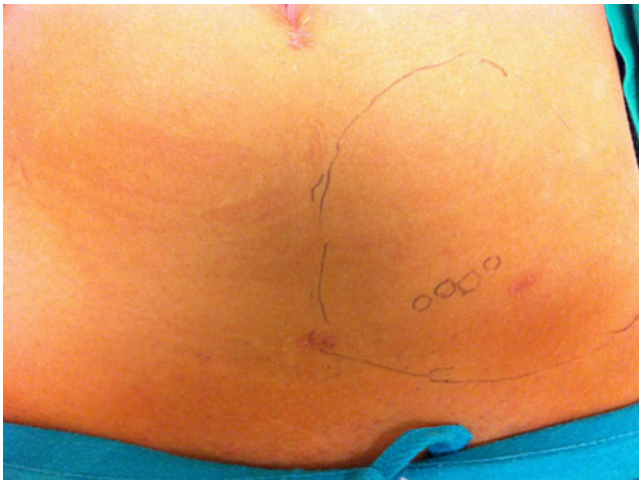

Fig. 1 Four myofascial trigger points (*small circles*) on the left lower quadrant of a woman having an acute exacerbation of chronic pain several months after an excision of a left ovarian endometrioma. The presence of cutaneous allodynia is outlined in ink. The presence of both cutaneous allodynia and myofascial trigger points significantly increases the likelihood of visceral disease

Endometriosis is considered an estrogen-dependent inflammatory condition of women in the reproductive years [1••]. The condition is common, particularly since the advent of laparoscopy. In general gynecology practice, pain of one cause or another is estimated to represent one third of all consultations. The American College of Obstetricians and Gynecologists has estimated that 15% to 20% of women in reproductive age have experienced pain for more than 1-year duration [5]. There are limited data in relation to adolescents. In Ontario, a self-reported estimate of 6% was identified among 495 children (ages 9 to 13 years) [6]. A Netherlands study of children and adolescents (up to 18 years old) showed that about 50% had experienced pain in the preceding 3 months, that one quarter had chronic pain (defined as recurrent or continuous pain for more than 3 months), and that the prevalence was greater for girls and the incidence rose appreciably at 12 to 14 years [6]. There is evidence that pain present in childhood does persist into adulthood [7]. It causes substantial disability in relation to occupation and social distress [8, 9]. It is associated with significant visits to emergency care, as well as high rates of various surgical conditions [10–12]. Comorbidities include interstitial cystitis, irritable bowel syndrome, depression, and chronic pelvic pain [8].

The condition is responsible for two main symptoms, infertility and pain. The etiology of endometriosis is unknown, although the most common explanation is retrograde menstruation of normal endometrium through the Fallopian tubes and subsequent implantation on susceptible tissues. Other explanations include vascular and lymphatic migration from the uterus and metaplastic changes. None of these can explain all of the varied presentations of the disease that can present rarely in distant organs such as the diaphragm, lung, heart, and brain.

The pathology of the disease is defined as the presence of endometrial tissue located in ectopic locations, usually on the pelvic peritoneum, ovaries, and Fallopian tubes. These deposits, like normal endometrium, tend to be exquisitely hormonally responsive and, therefore, can cause bleeding at the site of ectopic deposition [13].

The current pathological classification of the disease includes four groups of lesions [14]. Superficial peritoneal lesions are most common, located throughout the pelvis, attracting neovascular activity, and differing in presentation from a clear vesicle appearance to red, blue, and black plaques [15]. The different colors are based upon the variable iron content. Endometriomas are ovarian cyst-like lesions that appear to develop from implantation of the endometrial tissue from the Fallopian tubes into the defects of the surface of the ovary after ovulation [16]. They are actually considered pseudocysts because they lack a true cyst-wall lining. Catamenial (monthly) bleeding permits the progressive growth of these cysts that can reach a very large size. Rupture is common and frequently results in an acute episode of severe pelvic pain. Deeply infiltrative endometriosis is located primarily below the peritoneal lining, is often surrounded by a mass of fibrous tissue, and is commonly associated with ovarian endometriomas [17]. Adenomyosis is a condition where the endometrial lining is located in the muscular wall of the uterus and causes severe dysmenorrhea and deep dyspareunia as menstruation progresses [18].

The pathological processes involved with the progression of endometriosis are thought to be repetitive hemorrhage, inflammation, and the release of cytokines from the hemorrhagic implants [1••, 19–21]. The pain is thought by many to be a consequence of inflammation associated with the recurrent hemorrhage from the ectopic deposits of endometrial tissue [15, 17]. Although the existence of pain from the viscera initially was disputed, the presence of visceral-derived pain and the existence of visceral nociceptors are now accepted [22]. There appears to be two classes of nociceptive activity; high-threshold receptors that are active when stimulated in the noxious range of stimulation and intensity-encoding receptors that have a low threshold to natural non-noxious mechanical stimuli. Another theory is that afferent innervation is comprised of fibers that are only functional in the presence of inflammation, the so-called silent nociceptors [23, 24]. It has been suggested this form of afferent stimulation also may be an important contributor to the development of a chronic pain state as a consequence of visceral pain. Because the stimulation from visceral nociceptors is usually minimal, the activation of the

central nervous system by way of inflammation has been suggested as greater in magnitude and duration than that associated with acute pain. This could explain the persistence after the initial injury is repaired [25].

Although the presence of the endometriotic implants has been considered to be the cause of the pelvic pain, there are certain aspects that have raised questions among some investigators: anti-inflammatory medication does not always provide complete or even partial benefit; excision of endometriosis does not always reduce pain; and reduction in estrogen stimulation of ectopic implants similarly does not always reduce pain [26, 27]. An additional explanation of the processes associated with the development of pain also has been offered. Ectopic endometrial tissue in both experimental animals and humans has been shown to be innervated with new neural sprouts [28, 29]. It has been suggested that the way the sensory and autonomic nerve activity develop from new neural sprouts from adjacent tissues affect the neural activity of the spinal cord and brain [1••]. These authors advocate for a direction of research that moves beyond the lesions to how the condition is associated with the emerging understanding associated with chronic pain, such as the role that peripheral nerves have in the region of the lesions [1••].

Myofascial Dysfunction

The clinical basis for the relationship of visceral diseases, such as endometriosis, to myofascial pain has a long history. The initial medical reports were made in relation to the development of sensitized areas on the skin in specific and reproducible regions from certain visceral diseases. This representation of painful areas on the skin (cutaneous hyperalgesia) that developed as a consequence of visceral disease was first reported by Head [30] and Mackenzie [31]. Head's [30] description of the so-called Head zones was the basis for our current understanding of the dermatomes. Mackenzie [31] later complemented this work by describing his hypothetical framework for the description of the viscerosensory, visceromotor, and organic reflexes [32]. These were observational studies with additional hypothetical aspects of the role that the central nervous system must play in the cutaneous and muscular representation of visceral disease. These works are the current foundation of acute and chronic visceral pain and provide an interesting summary of the clinical approach to patients with visceral pain.

Myofascial pain syndrome is a muscle condition that has local and referred pain originating in a myofascial trigger point [33]. This term describes a nodule or band of muscle that can produce intense pain spontaneously or when stimulated. There are two aspects of the trigger point: a motor component that is palpable and a sensory component that produces pain locally and in an area of referred pain. The diagnosis of the presence of a trigger point is based on the palpation of a tender nodule or band that reproduces the patient's symptoms and can be confirmed if there is a local twitch response as a result of manipulation of the taut band [33]. When identified on the abdomen, the pain is often referred to distant locations such as the back, chest, or legs when considering pelvic trigger points. Relief of pressure causes the pain to recede immediately.

Investigations of myofascial trigger points have focused on alterations in the synaptic cleft of the neuromuscular junction, the spinal cord, and the brain response to myofascial pain [33–35]. The motor activity is based on the presence of the nodule or taut band. The area is not maintained by persistent motor activity because there are no motor action potentials present. Instead, there are a variety of altered electrical observations that can be made, including spontaneous small-voltage activity and spike discharges [36]. Recent studies have indicated that electrophysiological responses are commonly found when an electrode is placed in the trigger point for therapy [37]. There are also evoked changes in electrical activity in association with the local twitch response. These changes are not eliminated by an upper cord transaction, indicating involvement of a spinal arc in their maintenance. Spontaneous discharges from a trigger point in the rabbit can be inhibited with phentolamine, an α-blocker indicating the potential role of the sympathetic nervous system in the maintenance of these electrical discharges [38].

The sensory component of the trigger point is based on changes in the intracellular environment. There is an increased synaptic level of acetylcholine activity, local ischemia (as evidenced by biochemical changes of a lowered pH), and an increased concentration of substance P, calcitonin gene–related protein, bradykinin, serotonin, prostaglandins, and potassium [39]. These areas act to stimulate nociceptors that are present in muscle tissue. Local ischemia has been identified as the cause of pain and is a result of the metabolic crisis that occurs in these areas.

Fundamental to myofascial pain are processes of central sensitization that involve neuroplasticity in the dorsal horn of the spinal cord [40, 41].

Clinically, the studies of myofascial trigger points have focused primarily on primary or secondary causes. The primary causes are identified as single or recurrent episodes of micro—or macrotrauma or from muscle overload [42]. Overuse, postural stress, and altered mechanics can produce trigger points in the neck and back. Secondary causes have included cervical whiplash, migraine headache, temporomandibular pain, frozen shoulder, radicular pain, postlaminectomy syndrome, and viscerosomatic pain [43].

Visceral Causes of Myofascial Pain

There are a number of visceral conditions that have resulted in myofascial trigger points. Diseases of the gall bladder have produced shoulder pain and trigger points in the right upper quadrant of the abdomen [44]. Angina-like pain can be produced on the chest from cardiac ischemia and can lead to diagnostic confusion [45]. Flank pain and trigger points can be produced by ureterolithiasis [46]. One of the important characteristics of these trigger points is that they may dissipate after the original condition has resolved but they also may remain for significant periods of time [47, 48].

The most common cause of myofascial pain has been trauma, but in recent years, there has been an appreciation that visceral disease can produce somatic muscle pain and myofascial trigger points [47, 49]. Examples in which there is an interaction of the viscera with somatic tissues include somatic hyperalgesia [50, 51] and trophic changes in tissue [52, 53]. In the rat, intense stimulation of the intrauterine cavity is associated with neurogenic extravasation of administered dye in the region of the dermatomes innervating the pelvic [54]. In visceral pain as well as migraine, there are reports that in addition to myofascial trigger points, there is a development of cutaneous allodynia in the respective dermatomal regions [55, 56].

One important aspect of the physiology of viscerosomatic pain referral has been undertaken in relation to the gall bladder. Diseases of the gall bladder were found to produce changes in pain thresholds in the skin, subcutaneous tissues, and muscle; reduction in muscle thickness; and cutaneous allodynia on the side of the gall bladder when compared to the contralateral side [52]. There was a direct negative correlation between the number of colicky aspects and the measurement of pain threshold.

These findings are also relevant in relation to the pelvis. The pelvic viscera include the uterus, ovaries, Fallopian tubes, pelvic peritoneum, bladder, and rectum. Endometriosis, interstitial cystitis, and irritable bowel syndrome are disorders that affect the visceral tissues. It is now being recognized that visceral pain can generate a specific syndrome associated with myofascial alterations in the pelvic structures [57–59].

A recent descriptive study of the patterns of myofascial pain syndrome among women with chronic pelvic pain indicating a need for awareness will lead to increased options for care [60]. We have conducted two cross-sectional studies of the presence of myofascial pain in association with endometriosis. A review of 112 women presenting with clinical evidence of chronic pelvic pain for more than 6 months were assessed for muscle tenderness and myofascial dysfunction [61]. The study was approved by the ethics committee of The University of Calgary and all patients provided informed consent. The specific areas evaluated included the abdominal wall, perineum, levator ani, and obturator internus muscles. The mean age was 33.7± 11.7 years and the duration of pain was 5.4±5.1 years. The identified areas of myofascial dysfunction ranged from 1 to 11 with a mean of 4.4±2.6. There was a significant negative association of the woman's age and the number of areas of myofascial dysfunction. Using a linear regression model, the number of areas of myofascial dysfunction was predicted by the number of prior laparoscopies and the duration of pain (adjusted R^2=0.242; F=8.973; P<0.001) among women with endometriosis. There was a significantly higher frequency of areas of myofascial dysfunction among women with endometriosis than other causes of pelvic pain. This study indicates there is a common association of myofascial dysfunction with endometriosis.

An additional cross-sectional study was undertaken to explore the use of simple bedside clinical tests for neuroplasticity among women with and without endometriosis as a cause of the pain. This study was similar in design to the previous investigations of Giamberardino et al. [62] in relation to biliary disease. Women with chronic pelvic pain for more than 6 months were similarly tested for cutaneous allodynia, myofascial dysfunction, and reduced pain thresholds. The test for cutaneous allodynia involved the use of a simple culture stick, drawn down the abdominal wall bilaterally along and parallel to the midaxillary line of the abdomen [63]. A positive test was defined as the presence of a sharply demarcated area of a sharp sensation. The abdomen then was examined for the presence of a myofascial trigger point. A positive test was defined as the identification of a tender nodule by flat palpation that, when pressed, caused pain to radiate; when released, the pain was reduced [64]. The presence of a reduced pain threshold in the four quadrants of the abdomen and the perineum was determined using an electronic von Frey anesthesiometer. A positive test was defined as pain that occurred at a pressure less than 100 g, and comparisons were made to normal women without chronic pain and women with chronic pelvic pain due to nonvisceral conditions. The use of algometry has been previously validated in chronic pain and used in the assessment of chronic pelvic pain [65, 66]. The patients included 39 women with a diagnosis of endometriosis as the cause of their pain and 21 women with nonvisceral disorders such as lower pelvic trauma from obstetrical injury, urogenital surgery, or mechanical pelvic pain disorders. The tests were consistently negative among tested women who do not have chronic pain. All patients completed informed consent and ethics approval was available from the University of Calgary. Variables were completely collected for all patients. The results (Table 1) indicate there is a higher frequency of cutaneous allodynia and myofascial trigger

Table 1 Frequency of signs of neuroplasticity among women with chronic pelvic pain

Patient status	Patients, *n*	Results										
			AbdCA*	PerCA**	AbdTrP*	PerTrP***	RUQ , *g****	LUQ, *g****	RLQ, *g*****	LLQ, *g* g	Perineum, *g****	Reduced pain thresholds***
Non-Endometriosis	20	Mean	0.20	0.30	0.20	0.55	100	100	89.2	93.6	72.2	0.80
		S.D	0.41	0.47	0.41	0.51	0	0	23.2	19.5	22.6	0.41
Endometriosis	38	Mean	0.81	0.68	0.79	0.79	97	97	71.4	71.9	63.2	0.94
		S.D	0.39	0.47	0.41	0.41	10	10	30.7	28.6	25.2	0.23

* Frequency ($P<0.001$); ** Frequency ($P<0.01$); *** Not significant ($P>0.05$)

AbdCA abdominal-wall cutaneous allodynia; *AbdTrP* abdominal-wall trigger points; *LLQ* left lower quadrant; *LUQ* left upper quadrant; *PerCA* perineal cutaneous allodynia; *PerTrp* perineal trigger points; *RLQ* right lower quadrant; *RUQ* right upper quadrant

points in the abdomen and perineum among women with endometriosis. The pain threshold measures were lower in the right and left lower quadrants among women with endometriosis. However, there was no difference in the pain threshold measurements on the perineum. These tests are simple to undertake, are well tolerated, and provide insight into the possible causes of the condition and its change in status over time. Another benefit of these simple tests is that they provide validation of the pain experience to the woman who has had her pain challenged by others.

Application to the Management of the Case History

In regard to the case history described above, the injection was initially helpful in diagnosis and immediate management of pain, but in fact, the pain persisted and the patient developed a chronic pain state. Importantly, myofascial trigger point injections are but one component of care required for this complex disorder of central sensitization that resulted in the identified neuroplastic changes. The overall goal is to shift from a pain-centered life to a life with pain using the overall principle of self-management. Perhaps one of the important aspects of this case is that the use of trigger point injections is only one aspect of care. The following observations are a brief summary of major collaborative guidelines for the management of chronic pelvic pain [67, 68].

Multidisciplinary Care

Management of the myofascial aspects of the disease involves education related to chronic pain. In many cases, it is important to indicate that the chronic pain, once it has become continuous, may persist for many years. The therapeutic model with the greatest evidence of efficacy is multidisciplinary care [69].

Within this model, the medical assessment is critical. The presence of cutaneous allodynia is helpful in differentiating myofascial pain of trauma (usually absent) and viscerosomatic pain (usually present) [70]. Flat palpation of the area of the woman's pain will direct the examiner to potential myofascial trigger points. They are commonly found along the lateral border of the rectus muscle in the region of the anterior cutaneous nerves. Gentle pressure will reproduce the pain; it may radiate into the back, chest, or leg.

Deep pressure lateral to the rectus may indicate a psoas trigger point identified from direct tenderness, nausea, and referral of pain into the hip.

In the pelvis, cutaneous allodynia is commonly identified in cases of viscerosomatic pain [63]. A single-digit examination of the perineum just external to the hymen can

identify a band-like trigger point of the perineal body. Band-like trigger points can be located in the levators and obturator muscles.

Abdominal pain due to myofascial dysfunction, usually described as stabbing or sharp, easily can be mistaken for adnexal endometriosis and recurrent disease. One of the most challenging aspects of clinical care is to determine the pain is either visceral, myofascial, or both. This challenge to the pelvic examination may be the reason for the recognized high rates of "negative" laparoscopies and high rates of repeated laparoscopies [71]. There are many anecdotal cases, and one reports that some women have had many laparoscopies for the excision of endometriosis [72]. Characteristically, after an operation to remove endometriosis implants, women feel well for about 6 months and then the pain returns. It is possible that the repetitive pain improvement that follows these repeated laparoscopies involves the relaxation of myofascial trigger points by the anesthetic agents, particularly the use of paralytics. Avoiding excessive force in the examination by the use of a single digit to determine the presence or absence of cervical excitation is often sufficient to determine if there is an ongoing visceral component requiring further gynecological intervention.

Patient Education Regarding Pain and Chronic Pain

The management of endometriosis traditionally has been focused entirely on the acute care model. As the pain becomes continuous and myofascial elements become more relevant, the approach now recommended is one of rehabilitative care, with surgical interventions being the exception. Self-management is a fundamental approach, along with cognitive-behavioral management [73].

Menstrual Suppression

Although the emphasis in endometriosis has been to manage the hormonal state, recent reviews have suggested there should be an alternative approach that encompasses the principles of chronic pain management [1••]. The rational for this shift in thinking is the fact that the current management often is not successful. Although it is an inflammatory disease and NSAIDs are helpful, they often are not sufficient to manage the disease. Surgical excision of the lesions of endometriosis has varied reports of success, with some evidence of effectiveness [74–77]. These findings have not been uniformly successful in sham surgical trials, particularly in the excision of early-stage disease [26, 27]. A balanced review recently was published [2••]. Medical management is based on the reduction in estrogenic stimulus of the ectopic endometrium, but this has been shown to be of benefit to some, but not a large portion, of women. It has become apparent for women who have severe chronic pelvic pain that menstrual bleeding is a severe pain generator, and so, in addition to the reduction of estrogen stimulation of ectopic endometrium, the induction of amenorrhea is very helpful [78]. Newer medication methods for the institution of amenorrhea have included the use of continuous oral contraception [78]. The insertion of the medicated intrauterine device at the time of diagnostic or operative laparoscopy for the management of pelvic pain is also used, owing to the randomized trial indicating its effectiveness in the management of pain [79, 80]. The use of gonadotrophin releasing–hormone agonists has been increasing owing to better patient acceptance with the use of estrogen add-back techniques [81].

Management of Hyperalgesia

In many cases, the woman is severely sensitized and pain management is required before a tolerable approach to physical therapy is possible. Specific drugs for the management of endometriosis include the anti-inflammatory drugs, oral contraceptive, intrauterine contraceptive device, and gonadotrophin releasing–hormone agonists alone or with estrogen add-back therapy [79, 82]. Specific drugs for chronic pain (eg, gabapentin, pregabalin, and amitriptyline) also can be effective [83]. Oral and transdermal narcotics may be required for women with severe sensitization.

Psychological Support

Cognitive-behavioral techniques now are being recognized as very effective interventions in the management of chronic pain. Further, these approaches can provide coping skills as well as observation of the patient for the development of depression, which can affect up to 50% of women [73]. Depression is recognized as a significant barrier to improvement.

Myofascial Management

Activities to address myofascial dysfunction involve appropriate analgesia to support the necessary stretching exercise undertaken in the abdomen and pelvis of women with endometriosis. Strengthening of the core muscles and postural improvements are important for women who are physically deconditioned. In conjunction with a physiotherapist, abdominal wall myofascial injections with lidocaine are helpful. For women with psoas muscle pain, injection with either lidocaine or botulinum toxin x-ray guidance can be very helpful.

The dyspareunia associated with endometriosis is commonly a function of myofascial dysfunction and can involve penetration pain, deep pain, pain with orgasm,

and pain lasting for days after intercourse. Myofascial injections with botulinum toxin can be helpful in all these complaints, but long-term success requires stretching exercises of the relevant muscles [84].

Occupational Therapy

Chronic pelvic pain commonly is associated with difficulties in maintaining employment due to reduced sitting tolerance, and ergonomic evaluation, including standing desks and inflatable pillows, are among the interventions that help.

Conclusions

The interaction of endometriosis with viscerosomatic pain referral and resultant myofascial pain is common. Contemporary approaches to the management of endometriosis are focusing more on the management of pain. The shift from a sole focus on endometriotic lesions provides alternative effective approaches incorporating the treatment of the myofascial aspects of pain as part of a multidisciplinary approach.

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