REVIEW ARTICLE

Chronic Abdominal Wall Pain

A Poorly Recognized Clinical Problem

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SUMMARY

Background: Chronic abdominal wall pain is a poorly recognized clinical problem despite being an important element in the differential diagnosis of abdominal pain.

Methods: This review is based on pertinent articles that were retrieved by a selective search in PubMed and EMBASE employing the terms “abdominal wall pain” and “cutaneous nerve entrapment syndrome,” as well as on the authors’ clinical experience.

Results: In 2% to 3% of patients with chronic abdominal pain, the pain arises from the abdominal wall; in patients with previously diagnosed chronic abdominal pain who have no demonstrable pathological abnormality, this likelihood can rise as high as 30%. There have only been a small number of clinical trials of treatment for this condition. The diagnosis is made on clinical grounds, with the aid of Carnett’s test. The characteristic clinical feature is strictly localized pain in the anterior abdominal wall, which is often mischaracterized as a “functional” complaint. In one study, injection of local anesthesia combined with steroids into the painful area was found to relieve pain for 4 weeks in 95% of patients. The injection of lidocaine alone brought about improvement in 83–91% of patients. Long-term pain relief ensued after a single lidocaine injection in 20–30% of patients, after repeated injections in 40–50%, and after combined lidocaine and steroid injections in up to 80%. Pain that persists despite these treatments can be treated with surgery (neurectomy).

Conclusion: Chronic abdominal wall pain is easily diagnosed on physical examination and can often be rapidly treated. Any physician treating patients with abdominal pain should be aware of this condition. Further comparative treatment trials will be needed before a validated treatment algorithm can be established.

► **Cite this as:**

Koop H, Koprdova S, Schürmann C: Chronic abdominal wall pain—a poorly recognized clinical problem. *Dtsch Arztebl Int* 2016; 113: 51–7.
DOI: 10.3238/arztebl.2016.0051

Chronic pain in the abdomen is usually ascribed to diseases of the intra-abdominal organs, and the abdominal wall is often overlooked as a potential source of pain (1). Physical examination enables the physician to distinguish fairly reliably between pain of visceral origin on the one hand, and pain of parietal origin on the other; the distinction is harder to draw with other diagnostic methods such as endoscopy, imaging, or laboratory testing. Carnett, a surgeon, described the clinical condition of chronic abdominal wall pain in detail in 1923, and his method of diagnosing it is still valid (2). Nonetheless, the affected patients are often subjected to an extensive but fruitless battery of diagnostic tests (1), as Carnett himself already noted (2).

The purpose of this article is to make the condition better known and to present the treatment options, particularly in view of the informative findings of recent clinical studies. We retrieved pertinent articles on the subject with a selective search in PubMed and EMBASE employing the terms “abdominal wall pain” and “cutaneous nerve entrapment syndrome”; among all of the articles retrieved, we analyzed those that contained information on the number of patients treated, patient selection, treatment measures, and outcomes.

Anatomical fundamentals

The abdominal wall is supplied by nerve roots T7 to T12. The intercostal nerves first run along the ribs, then pass onward to innervate the abdominal wall (3). The critical site for pain is located at the lateral edge of the rectus abdominis muscle. The cutaneous nerves make a right angle at this point in order to travel from the inner to the outer part of the abdominal wall; they then make another right angle to continue along the abdominal wall (*Figure 1*). This is the most common site for a pathological change in a nerve to occur (1, 3, 4). Although the precise mode of damage is not known, postulated mechanisms include intra-abdominal or extra-abdominal pressure, ischemia, and compression of the nerve by herniation of the fat pad that normally protects it into the fibrous canal surrounding the nerve. Applegate (4) coined the designation “abdominal cutaneous nerve syndrome” (ACNES), which is widely used in English-speaking countries.

The anatomic situation thus gives rise to a pain-generating site at the lateral edge of the rectus abdominis muscle. The pain is usually felt in the upper abdomen, more commonly on the right side than on the

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FIGURE 1

The nerves of the anterior abdominal wall and their double-right-angle course at the lateral edge of the rectus abdominis muscle.

ARS, anterior rectus sheath; PRS, posterior rectus sheath.

Reproduced from (2) with kind permission by Georg Thieme Verlag

left (5). Variants of this syndrome include affections of the ilioinguinal nerve (T12, L1) and the iliohypogastric nerve, in which the site of pain generation is located 2 to 3 cm medial to the anterior superior iliac spine. The pain is then referred to the hip and groin.

Two recently published randomized double-blind trials from the Netherlands impressively document these pathophysiological relationships (Figure 2). These researchers were able to show that, in patients with suspected abdominal wall pain (Carnett's test positive; see "Physical examination," below), the pain improved significantly more often after lidocaine injection than after placebo injection (6). In this study, patients with refractory abdominal wall pain were randomized to treatment with either surgical neurectomy or a sham operation. 73% of patients in the neurectomy group but only 18% in the sham group became largely free of pain (7).

Epidemiology

Estimates of the prevalence of this condition in different groups of patients are given in the Table; these

estimates are derived from prospective studies in which the overall study population was specified. In an unselected group of patients referred to a hospital gastroenterological service or admitted via the emergency room with any kind of chronic abdominal pain, the prevalence of abdominal wall pain was 3% (8). This figure accords with the finding of an informative (albeit retrospective) study of emergency-room patients with abdominal pain, 2% of whom had abdominal wall pain (9). On the other hand, among patients in whom prior diagnostic evaluation (usually for intra-abdominal diseases) yielded no conclusive findings, the prevalence of abdominal wall pain is as high as 30% (10–12; Abstract: Johlin FC, Buhac J: Myofascial pain syndromes: an important source of abdominal pain for refractory abdominal pain. *Gastroenterology* 1996; 110: A6) (Table).

These figures may have been affected by selection bias, as patients with abdominal pain are seen by physicians in a wide variety of disciplines (including primary care, gastroenterology, surgery, pain therapy, and emergency medicine); many patients with abdominal pain were presumably not included in the above studies. Moreover, the patient collectives were imprecisely described in many studies, particularly the older ones. The estimated prevalences are nevertheless valuable as a rough guide. A Dutch group used data from population-based studies to estimate the overall prevalence of the condition at 1 per 1800 persons (9).

In summary, one in 30 to 50 patients seen in an emergency room or a specialty outpatient clinic for chronic abdominal pain actually has chronic abdominal wall pain. If intra-abdominal causes have already been ruled out by diagnostic testing, the probability rises to nearly 1 in 6.

Children and adolescents can also suffer from abdominal wall pain. No reliable estimates of prevalence can be given for this age group, as the available data are mainly derived from individual case reports and small clinical series (13–15).

History

Patients typically complain of sharply localized abdominal wall pain that is always felt in the same place. Most patients say that they have had the pain for several months; 35% to 50% report that their symptoms started more than a year before initial presentation (1; Abstract: Koprdoval S et al: Management chronischer Bauchwand Schmerzen – Monotherapie mit einem Lokalanästhetikum. *Z Gastroenterol* 2015;53:970–1). Some, however, say they have had it only for a short time (9). The pain is usually felt at the lateral edge of the rectus abdominis muscle (see *Anatomical fundamentals*, above). It is independent of food intake or bowel habits and is usually described as dull or stabbing, but not as cramping. The precipitating factors are highly diverse (1, 2); most patients cannot remember the circumstances in which the pain began. The pain is often least intense when the patient lies supine and intensifies when the patient lies on the affected side or

sits. Tight clothing (belts, corsets, etc.) worsens it; sneezing, coughing, laughing, and physical exercise often worsen it as well. Patients generally do not feel “sick,” yet their quality of life is impaired.

A standardized questionnaire was developed on the basis of these characteristic complaints (16); it has not been validated any further to date.

Physical examination

The physical examination is of central importance, as it enables relatively reliable diagnosis and treatment of this condition. The precise technique was described by Carnett in 1926 (2) and is therefore known as “Carnett’s test.” It has been described in detail elsewhere (1, 3) and will therefore only be presented briefly here.

Localization of the pain

The examination is performed with the patient supine. Most patients can localize the site of pain (the trigger point) exactly with a fingertip: typically, it is well circumscribed (maximum diameter, 2 cm) and located at the linea semilunaris, i.e., the lateral border of the rectus abdominis muscle. In rare cases, there is marked hyperalgesia at this site, with marked pain that can be elicited even by light touch (the Hoover sign).

Carnett’s test

Once the pain has been localized to a specific point, the patient is asked to tense the abdominal wall (3), either by elevating the extended legs or by raising the upper body without the aid of the arms. The examiner presses with a finger on the point of greatest pain while the anterior abdominal wall muscles contract; typically, the pain gradually worsens (positive Carnett’s test), but sometimes

TABLE

Epidemiological data on the prevalence of chronic abdominal wall pain

Authors	Year	n	Prevalence of CAWP	Features of the overall study population
Thomson, Francis (10)	1977	120	23 (19%)	Localized abdominal pain, presentation to emergency room, exclusion of intra-abdominal pathology including laparoscopy in 11 patients ^{*1}
Hall, Lee (11)	1988	ca. 160	15%	Nonspecific abdominal pain, prior exclusion of intra-abdominal disease ^{*1}
Gray et al. (12)	1988	67	19 (28%)	Nonspecific abdominal pain, evaluation on a surgical service, exclusion of intra-abdominal disease ^{*1}
Johlin, Buhac ^{*2}	1996	226	68 (30%)	Gastroenterological referrals and referrals to a tertiary care center after prior diagnostic evaluation
Adibi et al. (8)	2012	998	30 (3%)	Unselected patients with chronic abdominal pain

This table is based on prospective studies in which the features of the overall population were described in detail.

^{*1} no further information on the type of evaluation performed to rule out intra-abdominal disease.

^{*2} Abstract: Johlin FC, Buhac J: Myofascial pain syndromes: an important source of abdominal pain for refractory abdominal pain. *Gastroenterology* 1996; 110: A6.
CAWP, chronic abdominal wall pain

it does not become any worse than on examination with relaxed musculature. In contrast, patients with pain originating in the abdominal viscera have markedly less pain when they tense the abdominal wall muscles (negative Carnett’s test). Proper performance of the test requires adequate voluntary contraction of the anterior abdominal musculature.

FIGURE 2

Randomized trials on the efficacy of treatment of chronic abdominal wall pain by neurectomy versus sham neurectomy (beige columns), and by lidocaine versus placebo injection (red columns). The treatment was rated as successful if the pain score on the Visual Analog Scale decreased by at least 50%, and/or the pain score on a four-point scale decreased by at least 2 points. Data from Boelens et al. (6, 7). CI, 95% confidence interval

The efficacy of injection therapy with various drugs for chronic abdominal wall pain, according to data from the available observational studies and controlled trials. Treatment efficacy was assessed with Carnett's test, in which the circumscribed site of pain is identified and the change in pain intensity on contraction of the anterior abdominal musculature is noted. Blue columns—immediate treatment effect (within minutes to 48 hours); dark red columns—intermediate-term treatment effect after a single injection (2 weeks to 6 months); beige columns—long-term efficacy, usually after multiple injections (variable follow-up periods of up to 7 years). LA, local anesthetic; steroids, corticosteroids (prednisolone, trimcinolone, other).
* Abstract: Koprđova S, et al.: Management chronischer Bauchwandschmerzen – Monotherapie mit einem Lokalanästhetikum. Z Gastroenterol 2015; 53: 970–971.

FIGURE 3

Local injection of anesthetic

In a third step, for both confirmation of the diagnosis and treatment, local anesthetic should be injected directly into the site of pain. 5 mL of 1% lidocaine are injected into the abdominal wall at various depths. If the diagnosis of abdominal wall pain is correct, local anesthetic injection relieves the pain totally, or nearly so, in 2–3 minutes. The pain is then no longer triggerable by means of Carnett's test (negative Carnett's test).

If local anesthetic injection fails to relieve the pain at once, the reason may be any of the following:

- The anesthetic was not injected directly into the site of pain. A technically adequate injection can be difficult in obese patients; sometimes, an additional injection performed immediately after the first one can clarify the situation.
- The pain is actually of radicular origin, i.e., its source is more proximal along the course of the nerve.
- The diagnosis of abdominal wall pain is incorrect.

Differential diagnosis

Similar symptoms can arise from scars, including small scars caused by trochars, through herniation of tissue into a small gap in a tissue layer under the scar. Pain can also arise from direct irritation of a nerve; pain of this type responds to local anesthetic injection. Further differential diagnoses include abdominal

wall hernias such as a Spiegelian hernia. Primary neurogenic conditions such as polyneuropathy (usually diabetic) (17) should be considered as well, as should other spinal diseases, e.g., metastases to the spine. Endometriosis should always be considered in female patients, particularly those who have undergone a Cesarean section.

Differentiation of chronic abdominal wall pain from functional disorders and somatization disorders can be difficult (18). Fibromyalgia and myofascial pain are generally characterized by pain at multiple sites; the affected areas are usually larger than those seen in chronic abdominal wall pain, and they are often located on the chest as well. The pain in these conditions is not influenced in any consistent way by body posture or physical activity. In uncertain cases, test injection of lidocaine can help in these conditions, but the results may be hard to interpret because of the placebo effect. Conversely, many patients with chronic abdominal wall pain are wrongly labeled as suffering from a functional disorder (19).

Treatment

Patient education is an important part of treatment. Pain relief after local anesthetic injection often helps to reassure the patient that he or she is not suffering from a serious or dangerous condition. An explanation of the correct diagnosis brings lasting reassurance and markedly reduces the patient's use of health-care re-

FIGURE 4

Diagnostic and therapeutic algorithm for suspected chronic abdominal wall pain. CS, corticosteroids; ?, efficacy of this treatment option not well established

sources (visits to physicians and emergency rooms, diagnostic tests, etc.) (5). Patients with recurrent pain of only moderate intensity may choose to live with it rather than undergo any further treatment, while others can be helped by further injection therapy.

Four treatment methods are available:

- Local anesthetic injection
- Combined injection of local anesthetic and corticosteroids
- Chemical neurolysis, e.g., with phenol
- Surgery (neurectomy or nerve decompression).

In the discussion below, we consider only the findings of clinical studies based on a standardized protocol that included well-defined target criteria to assess the effect of treatment. Diagnosis by Carnett's test was the basis for treatment in all of these studies, yet comparisons across them are difficult because of varying criteria for patient selection and varying definitions of successful treatment (*eTable*). Complete relief was required in some studies; in others, an improvement on a pain scale by more than 50% or a "partial response" was termed a therapeutic success. The timing of follow-up evaluation varied widely as well.

Injection therapy

All clinical studies in which the primary diagnostic test was Carnett's test with injection of local anesthetic (with or without steroids) into the trigger point as sole therapy (20–24; Abstract: Koprdiva S, et al.: Management chronischer Bauchwand Schmerzen – Monotherapie mit einem Lokalanästhetikum. *Z Gastroenterol* 2015; 53: 970–971) yielded a high rate of immediate relief of symptoms (83–91% of patients) (*Figure 3*). A single injection led to lasting relief in 20–30% of patients; among patients with recurrent pain, a second injection into the trigger point led to lasting relief in a small percentage. Thus, injection therapy led to lasting relief in 40–50% of patients overall. Injection therapy had a relatively high failure rate in the study of Boelens et al. (21), perhaps because many patients underwent neurectomy rather than repeated injection therapy when their pain recurred after an initial injection.

Combined local anesthetic and steroid injections have higher reported success rates than local anesthetic injections alone (*Figure 3*), but no direct comparison has ever been made and the difference may be due, in part, to

differences in patient selection. In a study that has only been published in abstract form to date (Abstract: Rajoriya N, et al.: Bupivacaine vs. bupivacaine and triamcinolone for focal abdominal wall pain—a UK tertiary referral experience. *Gastroenterol* 2008; 134 [Suppl]: A550), bupivacaine injection was compared with the injection of both bupivacaine and triamcinolone. The combined injection yielded a higher rate of complete relief at two weeks (95% versus 47%) and also relieved the pain for a longer time (median, 4 versus 2 weeks), although some patients in both groups needed repeated injections. Overall, combined injections seem to be preferable for initial treatment. There are no data on possible differences among steroid drugs with regard to efficacy (short-acting ones such as prednisolone versus long-acting ones such as triamcinolone).

Injection therapy can be performed without risk; fears of adverse effects are unfounded. In all studies, there were practically no complications, aside from very rare hematomas at the injection site (1, 10). The patient should always be asked beforehand about possible allergy to local anesthetics.

Chemical neurolysis

There have been a few reports of neurolysis by phenol injection to treat chronic abdominal wall pain (25, 26); this is a treatment that should, theoretically, be effective over the long term. In some patients, the site of injection was precisely identified with the aid of electrical stimulation eliciting paresthesia in the painful area. Nonetheless, this mode of therapy yielded only a 54% rate of permanent and total relief, which was not significantly better than that of other treatments—in particular, that of local anesthetic injection with or without steroids (*Figure 3*). No direct comparisons have been carried out to date.

It should be pointed out, however, that the reported clinical experience with phenol injections is still very limited (only 120 patients to date). It is also unclear whether ultrasonography, rather than electrical nerve stimulation, might be an equally effective method of deciding where to inject the drug (27).

Surgical treatment

For medically intractable cases, surgical decompression and neurectomy is available as a treatment of last resort (28). At the site of maximal pain, the nerve bundle is exposed and a 5 cm segment of it is ligated and excised; accompanying vessels are ligated or electrocoagulated. Such procedures are presumably suitable for patients who have experienced definite but only temporary relief after repeated injection treatments. Among the patient collectives that have been discussed in published studies, the percentage that underwent surgical treatment varied widely, from 2% to 50% (4, 11, 21, 24), probably because of varying surgical indications. In one study, the primary success rate of surgical treatment over the long term was 70% (28). If a first neurectomy fails to bring relief of pain, repeated surgery can be considered, with a reported success rate of about 60–70% (29). A second operation for recurrent pain is more likely to succeed if the patient was

free of pain immediately after initial surgery; the rate of improvement after the second operation in such cases was 93%. It was only 50% in patients who had derived no benefit at all from their first operation (29).

Before any operation is considered, however, the failure to respond to conservative treatment should first prompt a critical re-evaluation of the diagnosis.

Treatment in children

Data on treatment outcomes in children are scant. In small-scale clinical series, the results of injection therapy were as mixed as in adults: a single injection brought lasting relief in some cases (13), but some patients needed multiple injections (14, 30, 31). Surgical therapy was particularly effective in children, with a nearly 100% rate of lasting pain relief (14, 31). Thus, for children and adolescents with chronic abdominal wall pain, early surgery may be a more attractive option than for adults.

A treatment algorithm

A treatment algorithm for patients with chronic abdominal wall pain has been developed on the basis of the available data (*Figure 4*).

Further clinical studies are urgently needed, however. These should be designed to answer the following questions:

- How common is this condition in various care settings (doctors' offices, outpatient clinics, emergency rooms)?
- What are the results of various kinds of treatment, e.g. injection therapy, when studied in randomized trials?
- When is the best time for surgery?
- What is the long-term outcome after various kinds of treatment?

Such studies will be possible only if physicians from a wide variety of disciplines keep the abdominal wall in mind as a potential site of origin for chronic abdominal pain.

KEY MESSAGES

- Chronic abdominal wall pain is a common but poorly recognized clinical condition that is often misdiagnosed.
- It is characterized by pain localized to a very small area, usually at the lateral edge of the rectus abdominis muscle.
- The diagnosis can be established very reliably with the aid of Carnett's test.
- The first line of treatment is the local injection of lidocaine combined with a corticosteroid. This brings about persistent relief of pain in 40–50% of patients (after repeated injections if necessary).
- If repeated injections lead to definite, but only temporary relief of pain after each injection, neurectomy of the affected nerves of the abdominal wall can bring about longer-lasting relief.

Conflict of interest statement

The authors declare that no conflicts of interest exist.

Manuscript submitted on 25 June 2015, revised version accepted on 30 September 2015.

Translated from the original German by Ethan Taub, M.D.

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Supplementary material
eTable:
www.aerzteblatt-international.de/16m0051

Supplementary material to:

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Dtsch Arztebl Int 2016; 113: 51–7. DOI: 10.3238/arztebl.2016.0051

eTABLE

Follow-up duration and success criteria in studies with standardized protocols (cf. Figure 3)

Authors	n	Treatment*	Mean follow-up	Success criteria
Greenbaum et al. (20)	72	LA	14 months	>50% improvement
Boelens et al. (21)	139	LA	18 months	>50% improvement (Visual Analog Scale / pain score)
Koprdoва et al.*	23	LA	6 months	Total relief of pain
Shute (22)	269	LA + CS	<1 year: n = 53 1 to >6 years: n = 216	Total relief of pain
Gallegos, Hobsley (23)	26	LA + CS	29 months	Total relief of pain or partial improvement
Hershfield (24)	30	LA + CS	(no data)	Total relief of pain
Mehta, Rangar (25)	82	Phenol	42 months	Total relief of pain or partial improvement
McGrady, Marks (26)	35	Phenol	6–48 months	Total relief of pain or partial improvement

LA, local anesthetic; CS, corticosteroid (prednisolone, triamcinolone, other).

* Abstract: Koprdoва S, et al.: Management chronischer Bauchwand Schmerzen – Monotherapie mit einem Lokalanästhetikum. Z Gastroenterol 2015; 53: 970–71.