Carnett's Legacy: Raising Legs and Raising Awareness of an Often Misdiagnosed Syndrome

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Nearly 90 years ago, John Carnett, a Philadelphia surgeon, wrote that chronic right-sided abdominal pain resulting in appendectomy actually originated in the abdominal wall, naming it “intercostal neuralgia.” He detailed the physical findings, including pinch tenderness of a skin/subcutaneous fat fold, cutaneous hyperesthesia at the painful site, and, remarkably, focal tenderness when the abdominal muscles are relaxed and when voluntarily tensed by raising the head or straightened lower extremities off the examination table, now known as a positive Carnett test or Carnett sign [1]. The disorder he described, abdominal wall pain (AWP), has been recognized subsequently to originate anywhere in the abdomen, especially in the lateral border of the rectus abdominis or in a surgical scar, and may occur at multiple sites [2, 3]. A commonly proposed pathophysiology is abdominal cutaneous nerve entrapment (ACNE), chiefly involving the anterior cutaneous branch of a lower thoracic subcostal nerve [4]. The term AWP also sometimes encompasses other nonvisceral disorders, including hernias, thoracic radiculopathy, and myofascial, costal margin, and xiphoid pain [5]. I limit the term AWP to designate what Carnett described, which some authors term ACNE.

Experienced physicians accurately predict many cases when a patient, usually a woman, initially says “I have a constant pain right here,” pointing to a spot on her abdomen with one or two fingers. Carnett emphasized the examiner should maintain finger pressure at the tender site when the patient raises the head or legs. For a positive

Carnett test, Greenberg and colleagues require *increased* tenderness with muscle tensing, not just Carnett’s “almost or quite as much” criterion [2]. Their AWP diagnostic criteria are: (1) localized pain or a fixed location of tenderness and (2) superficial tenderness or point tenderness ≤ 2.5 cm in diameter or a positive Carnett test. Pain relief after injection of a local anesthetic confirms the diagnosis [2]. I routinely assess tenderness when patients separately elevate their head and legs, as some report increased tenderness by only one of these maneuvers. After reviewing follow-up studies, Greenberg’s group concluded that by adhering to their diagnostic criteria and by following patients over time, visceral causes of pain would seldom be missed [2]. Warning signs are important; for example, 4 (2.9 %) of 137 cases I diagnosed at Kaiser Permanente Southern California were subsequently diagnosed with a visceral source, of whom 3 had unintentional weight loss [3]. Despite the simplicity and accuracy of physical diagnosis, AWP is widely unrecognized: It is suspected by few referring physicians among my patients [3] and in other series [2]. Gastroenterologists and medical residents often overlook the diagnosis [2]; >85 % of surveyed surgeons and residents had not heard of ACNE [6].

Although information on the prevalence and the healthcare costs of AWP and ACNE is limited by underdiagnosis, AWP is commonly diagnosed as a cause of abdominal pain in patients referred to gastroenterologists and to chronic pain clinics [2]. A female predominant syndrome, AWP comprised 7.8 % of symptomatic referrals to me at Kaiser, nearly 50 % the rate of referral for irritable bowel syndrome (IBS) [3]. Patient characteristics included 45.8 % overweight (body mass index [BMI] 25–29.9 kg/m²), 38.1 % obese (BMI > 30 kg/m²) and chronic low back pain, gastroesophageal reflux disease, IBS, and depression, each affecting over 20 % of patients [3]. Dutch

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investigators recently developed and validated a questionnaire that distinguishes AWP from IBS, utilizing such discriminating features of AWP as a small area of most intense pain, aggravation by coughing, pain reproduced by pushing on the site and certain physical activities, in the presence of normal bowel movements and absence of gas symptoms. Of the small number of primary care patients diagnosed with functional abdominal pain with scores exceeding a threshold, about half were diagnosed with AWP [6]. Further work of this type could yield quantitative data facilitating epidemiological AWP studies.

Prior to diagnosis, patients typically meander through an expensive pathway of physician visits, diagnostic procedures, and ineffective and potentially dangerous treatments, whereas costs for such services decline markedly after diagnosis [2, 3]. AWP accounts for many patients undergoing abdominal computed tomography (CT) [7]. For example, of 137 non-emergent, primary care outpatients who underwent CT for the complaint of abdominal pain, 11 (8.0 %) were diagnosed with AWP during at least 2 years of follow-up. With no cause of pain established for 60.6 % of patients, it is likely that the number diagnosed with AWP could have been higher had more been referred to aware gastroenterologists [8]. Most patients I see with AWP have undergone CT before referral, likely unnecessary in most cases. Fourteen (12.7 %) of 110 Canadian patients underwent exploratory laparotomy [7]. Patients especially predisposed to mismanagement are those with gallstones and right upper abdominal pain, the most common site of AWP in some series [3, 7]. This common coincidence in patients who are usually female and overweight or obese can culminate in cholecystectomy in patients with nonbiliary pain, incurring cost, and risk, yet not diminishing their AWP [2].

Research to guide physicians on treatment is mostly limited to uncontrolled observations. In this issue of *Digestive Diseases and Sciences*, Mayo Clinic physicians report their results of ultrasound-guided injection of an anesthetic–corticosteroid combination for AWP in 120 patients [9]. Six to 12 months later, 36 % of respondents reported being “significantly better” and 22 % “slightly better.” Somatization inversely predicted response. Patients were predominantly female, most often complained of right upper abdominal pain, were often diagnosed with IBS, and tended to be overweight. Remarkably, 34 % had undergone cholecystectomy before referral, raising speculation that some of these surgeries resulted from misdiagnosis of biliary pain. Of note, 57 % of respondents reported maximal pain intensity of at least 8 on a 10-point scale. Although it is impossible to compare the severity of Mayo patients’ pain with other series that did not use this severity scale, their 38 % narcotic use rate and care seeking at a tertiary referral center suggest they

represented the severe end of the spectrum. Nevertheless, failure to obtain follow-up from 45 % of their original 218 cases could have biased the outcome results. In comparison, only 7 (5.3 %) of 133 Kaiser patients received injection therapy. When 93 (72.1 %) of 129 patients were interviewed by telephone a mean of 4 years after diagnosis, 44 (47.3 %) denied any AWP, whereas the other 49 reported their pain intensity was 64.8 % of the level experienced before consultation [3]. Thus, the long-term outcome was approximately the same in the predominately uninjected Kaiser patients and in the Mayo cases and in other patients who received injection therapy [2, 7]. Nonetheless, variation in patient features, specific aspects of care, and outcome measurements complicates comparison.

There are no published studies on the value of symptom explanation and reassurance. Yet, I specifically explain to patients how the Carnett test strongly supports the diagnosis of AWP, a benign condition. Patients, often arriving perplexed and worried, seem relieved after receiving the diagnosis. Although simple measures such as oral analgesics, local heat application, and low-dose tricyclic antidepressants are also formally untested, I employ them with only fair success. The usefulness of weight loss is untested, but the presence of fat in the rectus channel through which the anterior cutaneous branch of the subcostal nerve passes [4] suggests this approach could help obese patients. Based on my experience, I explain that the pain will probably improve or disappear over months–years, reserving injection therapy for the most severe cases. Still, little is known of the natural history of AWP. Spontaneous fluctuating intensity over time could impact the results reported from uncontrolled treatment observations. Physicians wanting to individualize injection treatment might find some support from the Mayo finding that a high level of somatization correlated with poor response [9].

Use of ultrasound to guide injections, as Alnahhas et al. report [9], has not been compared with the conventional palpation-guided method in patients with AWP. The latter technique not only has little risk, but also does not require special equipment. Though Applegate meticulously described methods for palpating abdominal wall structures [4], many physicians confidently identify the tender site for injection without full knowledge of all of his details. Ultrasound is possibly of particular efficacy in obese patients. Combining a corticosteroid with an anesthetic may enhance anesthesia, even though a Canadian study reported steroid addition had no effect on pain relief in small numbers of comparison cases [7]. These commonly used agents and others, such as phenol injected by some pain specialists [5], have not been compared in treating AWP.

Surgery benefits some patients: In 154 Dutch patients with severe pain refractory to injection therapy, moderate improvement in pain was reported 1–3 months after 70 % and 3–93 months after 61 % of 181 anterior neurectomies. Therefore, pain worsened in some initially improved patients, and some had unchanged pain or multiple operations [10].

Although Carnett's diagnostic advice still holds true after nearly a century, many patients who consult physicians who are unaware of the syndrome and do not employ his methods remain undiagnosed. Injection therapy is moderately helpful, but uncertainties persist about which patients should receive injections, how to perform them and other aspects of care. Controlled treatment trials are needed for this common problem.

Compliance with ethical standards

Conflict of interest The author has no financial disclosures and received no writing assistance.

References

1. Carnett JB. Chronic pseudoappendicitis due to intercostal neuralgia. *Am J Med Sci*. 1927;174:579–599.
2. Srinivasan R, Greenbaum DS. Chronic abdominal wall pain: a frequently overlooked problem. *Am J Gastroenterol*. 2002;97:824–830.
3. Costanza CD, Longstreth GF, Liu AL. Chronic abdominal wall pain: clinical features, health care costs, and long-term outcome. *Clin Gastroenterol Hepatol*. 2004;2:395–399.
4. Applegate WV. Abdominal cutaneous nerve entrapment syndrome (ACNES): a commonly overlooked cause of abdominal pain. *Perm J*. 2002;6:20–27.
5. Suleiman S, Johnston DE. The abdominal wall: an overlooked source of pain. *Am Fam Physician*. 2001;64:431–438.
6. van Assen T, de Jager-Kievit JW, Scheltinga MR, Roumen RM. Chronic abdominal wall pain misdiagnosed as functional abdominal pain. *J Am Board Fam Med*. 2013;26:738–744.
7. Nazareno J, Ponich T, Gregor J. Long-term follow-up of trigger point injections for abdominal wall pain. *Can J Gastroenterol*. 2005;19:561–565.
8. Master SS, Longstreth GF, Liu AL. Results of computed tomography in family practitioners' patients with non-acute abdominal pain. *Fam Pract*. 2005;22:474–477.
9. Alnahhas MF, Oxentenko S, Locke GR, et al. Outcomes of ultrasound guided trigger point injection for abdominal wall pain. *Dig Dis Sci*. (Epub ahead of print). doi:[10.1007/s10620-015-3857-8](https://doi.org/10.1007/s10620-015-3857-8).
10. van Assen T, Boelens OB, van Eerten PV, Perquin C, Scheltinga MR, Roumen RM. Long-term success rates after an anterior neurectomy in patients with an abdominal cutaneous nerve entrapment syndrome. *Surgery*. 2015;157:137–143.