Effects of Smoking on Neuropathic Pain in Two People With Spinal Cord Injury

J. Scott Richards, PhD; Stephen C. Kogos Jr, PhD; T. J. Ness, MD, PhD; Christina V. Oleson, MD

Department of Physical Medicine and Rehabilitation, University of Alabama at Birmingham, Birmingham, Alabama

Received December 15, 2004; accepted April 20, 2005

Abstract

Background/Objective: To describe an apparent relationship between smoking and the neuropathic pain experience in people with spinal cord injury (SCI).

Method: Case Reports.

Participants/Methods: Two individuals treated at a rehabilitation center. The first was a 38-year-old white man with a T12 SCI, American Spinal Injury Association (ASIA) impairment scale (AIS) A, secondary to motor vehicle crash. Duration of injury was 14 years. He reported burning pain in his legs, and has smoked ½ pack per day for the last 15 years. The second was a 55-year-old African American man with a T6 SCI, AIS A, secondary to gunshot wound. Duration of injury was 22 years. He was a 40-year ½ to 1 pack per day smoker, who, after injury, consistently experienced burning, radicular pain, rated 7/10, around the level of the injury.

Summary: The first subject rated his pain as 4/10 when not smoking and 7/10 when smoking. The pain subsided 30 minutes after smoking was discontinued. He noted an immediate increase in neuropathic pain when smoking. The second subject quit smoking for 1 month and immediately noted that the pain disappeared, rating it 0/10. After he resumed smoking, his radicular pain was 8.5/10 in the morning and 5/10 in afternoon.

Conclusions: No similar reports have been published, based on a MEDLINE search. Nicotinic receptors have been implicated in pain perception. It is unclear to what extent these 2 cases generalize to the SCI population. We plan to explore this via survey and experimental research. Smoking cessation may have a dual benefit of increased health and decreased neuropathic pain.

J Spinal Cord Med. 2005;28:330–332

Key Words: Spinal cord injuries; Paraplegia; Neuropathic pain; Smoking; Cigarettes; Nicotine; Nicotinic receptors

INTRODUCTION

Numerous studies have concluded that smoking cigarettes has significant pathophysiological effects on the human body (1). The effect of nicotine on pain sensitivity in humans has been a topic of controversy (2). In a 1984 study, for example, the investigators (3) found that all 5 of their participants demonstrated pain and anxiety reduction after smoking a nicotine-containing cigarette vs a zero-nicotine cigarette. Nesbitt (4) concluded that cigarette smoking increased pain tolerance in male habitual smokers. On the other hand, Seltzer et al (5) found that pain tolerance was diminished in white

smokers when compared with nonsmokers, and Deyo and colleagues (6) found modest positive correlations between quantity of smoking and reported back pain. A more recent study concluded that smoking was at best a “weak risk indicator” of low back pain, but should not be considered a cause (7). Several researchers (8,9) have noted a relationship between smoking and musculoskeletal pain, with the finding that, compared with nonsmokers, smokers experienced more intense musculoskeletal pain and more frequent musculoskeletal pain. Although a lengthy discussion of nicotinic receptors would require an extensive review that is beyond the scope of this paper, the interested reader is referred to several references (10–12) that discuss the evidence for the existence of nicotine receptors via nicotine-activating primary afferent neurons, smoking’s effects on plastic

Please address correspondence to J. Scott Richards, PhD, 1717 6th Avenue South, 534-C, Birmingham, AL 35233-7330; phone: 205.934.3454; fax: 205.934.2769 (e-mail: Richards@uab.edu).

surgery, and short- and long-term enhancement of excitatory transmission in the spinal dorsal horn by nicotinic acetylcholine receptors.

To our knowledge, there have been no studies that have examined the effect of smoking and the neuropathic pain experience in people with SCI. We encountered 2 subjects with SCI in whom a clear link was apparent between smoking and the intensity of their neuropathic pain, and we report their experiences here.

CASE REPORTS

Two individuals treated at a rehabilitation center noted an association between smoking and their pain. The first was a 38-year-old widowed white man with a 14-year history of T12 paraplegia, American Spinal Injury Association (ASIA) impairment scale A. His injury was secondary to a motor vehicle crash. He reported smoking ½ pack of cigarettes per day for the last 15 years. He had 2 different types of pain, a motion-sensitive, deep pain localized to the back at the level of his injury (nociceptive mechanical pain using nomenclature developed by the International Association for the Study of Pain, IASP; 13), and a bilateral, spontaneous burning sensation in his lower extremities (below the level of neuropathic pain). His nociceptive pain was responsive to methadone treatment (20 mg, twice daily) and his neuropathic pain was responsive to gabapentin therapy (300mg, twice daily). He also took 5 mg of diazepam 3 times a day. This individual required a surgical thigh flap procedure for a nonhealing pressure ulcer and was asked by his surgeon to stop smoking before the surgical procedure. He complied with this request and experienced a marked reduction in his neuropathic pain, to the point that he was pain-free at times. He continued to experience his nociceptive mechanical pain even after quitting smoking. After discharge, he resumed smoking and observed a relationship between his pain and smoking. He states that his neuropathic pain is at an intensity of 4/10 when he is not smoking and 7/10 when he is smoking. He notes an immediate increase in neuropathic pain upon smoking, saying, “I feel it on the first drag,” and suggests, “smoking doesn’t cause my pain, but it definitely intensifies it.” His pain takes 30 minutes to subside after smoking.

Because of the apparent link between his smoking and his pain, the subject decided to stop smoking and used a nicotine patch as an aide. Within 30 minutes of the application of the nicotine patch, he reported that his neuropathic pain became more intense than it had ever been since the time of his initial injury. He removed the patch and his pain subsided. He now abstains from smoking, but is uncertain whether he will be able to continue with his planned abstinence.

The second individual in whom an association of pain with smoking was noted was a 55-year-old widowed African American man with T6 paraplegia, ASIA impairment scale A. His injury was secondary to a gunshot wound received 22 years ago. He reports

smoking ½ to 1 pack per day. Immediately after his injury, the subject reportedly began experiencing a burning, radicular pain around the injury level, consistent with “at level neuropathic pain” using IASP nomenclature. He rated this pain as 7/10 in intensity. The subject was scheduled to undergo flap surgery for a nonhealing sacral pressure ulcer. His surgeon asked him to stop smoking. He complied with this request, and stated that he experienced immediate elimination of his neuropathic pain. The subject underwent successful flap surgery, and subsequently received 2 weeks of inpatient therapy. During this time, he continued to abstain from smoking and experienced no neuropathic pain. His medications were 10 mg of diazepam once daily and 5 mg of Lortab (acetaminophen plus hydrocodone) twice daily, as needed. He was discharged to home where he resides alone.

After discharge, this individual began smoking again and estimated smoking approximately ½ pack of cigarettes per week. Notably, his neuropathic pain returned and is described as the same as his presurgery pain: burning, radicular, and around the level of injury. It is notable that the second subject, in addition to the immediate aversive experience of severe, burning neuropathic pain when smoking, reports having 2 relatives who died of cancer and has been educated about the health risks of cigarette smoking. Despite these experiences, he continues to smoke.

DISCUSSION

We report 2 individuals who experienced neuropathic pain associated with SCI that was exacerbated by smoking. Although these anecdotal accounts are certainly not sufficient to establish a cause-and-effect relationship, the reports of these 2 subjects are quite compelling. They report either the initiation or intensification of neuropathic pain immediately after smoking and a reduction of pain upon discontinuance.

The first person’s experience with a nicotine patch suggests that nicotine is the active agent associated with this pain magnification. The potential pathophysiological mechanism for nicotine’s effects on neuropathic pain remains unknown. Nicotine is known to act at nicotinic acetylcholine receptors that are located on peripheral nerves, in sympathetic ganglia, and in the central nervous system. Central administration of nicotinic acetylcholine receptor agonists has been noted to produce antinociceptive effects in both animals and humans (14,15), but peripheral administration of these same agonists can have pronociceptive effects (12) through mechanisms such as the sensitization of vanilloid receptors on primary afferent terminals (16). Increased sympathetic nervous system activity caused by direct ganglionic activation can also produce pain-modulatory effects. Smoking seems to influence both cortical and autonomic arousal (17,18), but there is debate whether activation of the peripheral or central nervous systems mediates the effects of

smoking on pain sensitivity. As mentioned earlier, an in-depth discussion of specific nicotinic receptors, their location, and their relationship with pain is beyond the scope of these case reports, but the interested reader may consult several articles (10–12) for more information in this area. We believe that further investigation of this area is needed, and that smoking cessation may prove fruitful in reducing neuropathic pain in people with SCI.

CONCLUSION

No similar reports have been published that we are aware of, based on a MEDLINE search. Nicotinic receptors have clearly been implicated in pain perception. It is unclear to what extent these 2 cases generalize to the SCI population, but we believe that they certainly merit further investigation. We plan to explore this via survey and experimental research, because smoking cessation may pose the dual benefit of increased health and decreased neuropathic pain in people with SCI.

REFERENCES

1. Sherman CB. Health effects of cigarette smoking. *Clin Chest Med*. 1991;12:643–658.
2. Jamner LD, Girdler SS, Shapiro D, Jarvik ME. Pain inhibition, nicotine, and gender. *Exp Clin Psychopharmacol*. 1998;6(1):96–106.
3. Pomerleau OF, Turk DC, Fertig JB. The effects of cigarette smoking and pain on anxiety. *Addict Behav*. 1984;9(3):265–271.
4. Nesbitt PD. Smoking, physiological arousal, and emotional response. *Pers Soc Psychol*. 1973;25:137–144.
5. Seltzer CC, Friedman GD, Siegelau AB, Collen MF. Smoking habits and pain tolerance. *Arch Environ Health*. 1974;29:170–172.
6. Deyo RA, Bass JE. Lifestyle and low-back pain: the influence of smoking and obesity. *Spine*. 1989;14(5):501–506.
7. Leboeuf-Yde C. Smoking and low back pain. *Spine*. 1999;24:1463–1470.
8. Eriksen WB, Brage S, Bruusgaard D. Does smoking aggravate musculoskeletal pain? *Scand J Rheumatol*. 1997;26:49–54.
9. Andersson HI, Ejlertsson G, Leden I. Widespread musculoskeletal chronic pain associated with smoking: an epidemiological study in a general rural population. *Scand J Rehabil Med*. 1998;30:185–191.
10. Aköz T, Akan M, Yildirim S. If you continue to smoke, we may have a problem: smoking's effects on plastic surgery. *Aesth Plast Surg*. 2002;26:477–482.
11. Genzen JR, McGehee DS. Short- and long-term enhancement of excitatory transmission in the spinal dorsal horn by nicotinic acetylcholine receptors. *Proc Natl Acad Sci*. 2003;100:6807–6812.
12. Jinks SL, Carstens E. Activation of spinal wide dynamic range neurons by intracutaneous microinjection of nicotine. *J Neurophysiol*. 1999;82:3046–3055.
13. Putzke JD, Richards JS, Ness T, Kezar L. Interrater reliability of the International Association for the Study of Pain and Tunks' Spinal Cord Injury Pain Classification Schemes. *Am J Phys Med Rehabil*. 2003;82(6):437–440.
14. Decker MW, Meyer MD. Therapeutic potential of neuronal nicotinic acetylcholine receptor agonists as novel analgesics. *Biochem Pharmacol*. 1999;58:917–923.
15. Jain KK. Modulators of nicotinic acetylcholine receptors as analgesics. *Curr Opin Investig Drugs*. 2004;5:76–81.
16. Liu L, Zhu W, Zhang ZS, et al. Nicotine inhibits voltage-dependent sodium channels and sensitizes vanilloid receptors. *J Neurophysiol*. 2004;91:1482–1491.
17. Waller D, Schalling D, Levander S, Edman G. Smoking, pain tolerance, and physiological activation. *Psychopharmacology*. 1983;79:193–198.
18. Knott VJ, De Lugt D. Subjective and brain-evoked responses to electrical pain stimulation: effects of cigarette smoking and warning conditions. *Pharmacol Biochem Behav*. 1991;39:889–893.