**Chapter 15**

**Pain-relieving Devices**

American Cancer Society, Surveillance Research. Estimated new cancer cases by sex and age (years) 2014. Atlanta 2004.

Berthoud, H. R., & Neuhuber, W. L. (2000). Functional and chemical anatomy of the afferent vagal system. *Auton Neurosci, 85*(1-3), 1-17. doi:10.1016/S1566-0702(00)00215-0

Bottros, M. M., & Christo, P. J. (2014). Current perspectives on intrathecal drug delivery. *J Pain Res, 7*, 615-626. doi:10.2147/JPR.S37591

The British Pain Society. Spinal cord stimulation for the management of pain: Recommendations for best clinical practice. <http://www.britishpainsociety.org/book_scs_main>. Pdf (accessed November 3, 2016).

Busch, V., Zeman, F., Heckel, A., Menne, F., Ellrich, J., & Eichhammer, P. (2013). The effect of transcutaneous vagus nerve stimulation on pain perception--an experimental study. *Brain Stimul, 6*(2), 202-209. doi:10.1016/j.brs.2012.04.006

Chakravarthy, K., Nava, A., Christo, P. J., & Williams, K. (2016). Review of Recent Advances in Peripheral Nerve Stimulation (PNS). *Curr Pain Headache Rep, 20*(11), 60. doi:10.1007/s11916-016-0590-8

Chakravarthy, K., Chaudhry, H., Williams, K., & Christo, P. J. (2015). Review of the Uses of Vagal Nerve Stimulation in Chronic Pain Management. *Curr Pain Headache Rep, 19*(12), 54. doi:10.1007/s11916-015-0528-6

Chan, C. W., & Peng, P. (2011). Failed back surgery syndrome. *Pain Med, 12*(4), 577-606. doi:10.1111/j.1526-4637.2011.01089.x

Chaparro, L. E., Furlan, A. D., Deshpande, A., Mailis-Gagnon, A., Atlas, S., & Turk, D. C. (2013). Opioids compared to placebo or other treatments for chronic low-back pain. *Cochrane Database Syst Rev*(8), CD004959. doi:10.1002/14651858.CD004959.pub4

Contrada, E. (2016). 2.5 CE Test Hours: Intrathecal Pumps for Managing Cancer Pain. *AJN The American Journal of Nursing*, *116*(5), 45-46.

Cruccu, G., Garcia-Larrea, L., Hansson, P., Keindl, M., Lefaucheur, J. P., Paulus, W., Attal, N. (2016). EAN guidelines on central neurostimulation therapy in chronic pain conditions. *Eur J Neurol, 23*(10), 1489-1499. doi:10.1111/ene.13103

Deer, T. R., Krames, E., Mekhail, N., Pope, J., Leong, M., Stanton-Hicks, M., Committee, Neuromodulation Appropriateness Consensus. (2014). The appropriate use of neurostimulation: new and evolving neurostimulation therapies and applicable treatment for chronic pain and selected disease states. Neuromodulation Appropriateness Consensus Committee. *Neuromodulation, 17*(6), 599-615; discussion 615. doi:10.1111/ner.12204

Deer, T. R., Mekhail, N., Provenzano, D., Pope, J., Krames, E., Leong, M., Committee, Neuromodulation Appropriateness Consensus. (2014). The appropriate use of neurostimulation of the spinal cord and peripheral nervous system for the treatment of chronic pain and ischemic diseases: the Neuromodulation Appropriateness Consensus Committee. *Neuromodulation, 17*(6), 515-550; discussion 550. doi:10.1111/ner.12208

Deer, T. R., Prager, J., Levy, R., Rathmell, J., Buchser, E., Burton, A., Mekhail, N. (2012). Polyanalgesic Consensus Conference 2012: recommendations for the management of pain by intrathecal (intraspinal) drug delivery: report of an interdisciplinary expert panel. *Neuromodulation, 15*(5), 436-464; discussion 464-436. doi:10.1111/j.1525-1403.2012.00476.x

Dowell, D., Haegerich, T. M., & Chou, R. (2016). CDC guideline for prescribing opioids for chronic pain—United States, 2016. *JAMA*, *315*(15), 1624-1645.

Dubinsky, R. M., & Miyasaki, J. (2010). Assessment: efficacy of transcutaneous electric nerve stimulation in the treatment of pain in neurologic disorders (an evidence-based review): report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. *Neurology, 74*(2), 173-176. doi:10.1212/WNL.0b013e3181c918fc

Ellrich, J. (2011). Transcutaneous vagus nerve stimulation. *Eur Neurol Rev*, *6*(4), 254-6.

Falowski, S. M. (2015). Deep Brain Stimulation for Chronic Pain. *Curr Pain Headache Rep, 19*(7), 27. doi:10.1007/s11916-015-0504-1

Froholdt, A., Reikeraas, O., Holm, I., Keller, A., & Brox, J. I. (2012). No difference in 9-year outcome in CLBP patients randomized to lumbar fusion versus cognitive intervention and exercises. *Eur Spine J, 21*(12), 2531-2538. doi:10.1007/s00586-012-2382-0

Guan, Y. (2012). Spinal cord stimulation: neurophysiological and neurochemical mechanisms of action. *Curr Pain Headache Rep, 16*(3), 217-225. doi:10.1007/s11916-012-0260-4

Ghazwani, Y. Q., Elkelini, M. S., & Hassouna, M. M. (2011). Efficacy of sacral neuromodulation in treatment of bladder pain syndrome: long-term follow-up. *Neurourol Urodyn, 30*(7), 1271-1275. doi:10.1002/nau.21037

Hayek, S. M., Deer, T. R., Pope, J. E., Panchal, S. J., & Patel, V. B. (2011). Intrathecal therapy for cancer and non-cancer pain. *Pain Physician, 14*(3), 219-248.

Johnson, M., & Martinson, M. (2007). Efficacy of electrical nerve stimulation for chronic musculoskeletal pain: a meta-analysis of randomized controlled trials. *Pain, 130*(1-2), 157-165. doi:10.1016/j.pain.2007.02.007

Kumar, K., Hunter, G., & Demeria, D. D. (2002). Treatment of chronic pain by using intrathecal drug therapy compared with conventional pain therapies: a cost-effectiveness analysis. *J Neurosurg, 97*(4), 803-810. doi:10.3171/jns.2002.97.4.0803

Kumar, K., Malik, S., & Demeria, D. (2002). Treatment of chronic pain with spinal cord stimulation versus alternative therapies: cost-effectiveness analysis. *Neurosurgery*, *51*(1), 106-116.

Kumar, K., Rizvi, S., & Bishop, S. (2013). Cost effectiveness of intrathecal drug therapy in management of chronic nonmalignant pain. *Clin J Pain, 29*(2), 138-145. doi:10.1097/AJP.0b013e31824b5fc9

Kumar, K., Rizvi, S., Bishop, S., & Tang, W. (2013). Cost impact of intrathecal polyanalgesia. *Pain Med, 14*(10), 1569-1584. doi:10.1111/pme.12204

Kumar, K., Rizvi, S., Nguyen, R., Abbas, M., Bishop, S., & Murthy, V. (2014). Impact of wait times on spinal cord stimulation therapy outcomes. *Pain Pract, 14*(8), 709-720. doi:10.1111/papr.12126

Kumar, K., & Wilson, J. R. (2007). Factors affecting spinal cord stimulation outcome in chronic benign pain with suggestions to improve success rate. *Acta Neurochir Suppl, 97*(Pt 1), 91-99.

Lange, G., Janal, M. N., Maniker, A., Fitzgibbons, J., Fobler, M., Cook, D., & Natelson, B. H. (2011). Safety and efficacy of vagus nerve stimulation in fibromyalgia: a phase I/II proof of concept trial. *Pain Med, 12*(9), 1406-1413. doi:10.1111/j.1526-4637.2011.01203.x

Levy, R., Deer, T. R., & Henderson, J. (2010). Intracranial neurostimulation for pain control: a review. *Pain Physician, 13*(2), 157-165.

Liem, L., Russo, M., Huygen, F. J., Van Buyten, J. P., Smet, I., Verrills, P., Kramer, J. (2013). A multicenter, prospective trial to assess the safety and performance of the spinal modulation dorsal root ganglion neurostimulator system in the treatment of chronic pain. *Neuromodulation, 16*(5), 471-482; discussion 482. doi:10.1111/ner.12072

Lima, M. C., & Fregni, F. (2008). Motor cortex stimulation for chronic pain: systematic review and meta-analysis of the literature. *Neurology, 70*(24), 2329-2337. doi:10.1212/01.wnl.0000314649.38527.93

Mandat, T., Koziara, H., Barszcz, S., Rola, R., Karliński, M., Sliwińska, A., Bonicki, W. (2012). Motor cortex stimulation in the treatment of neuropathic pain. *Neurol Neurochir Pol, 46*(5), 428-435.

Mekhail, N. A., Mathews, M., Nageeb, F., Guirguis, M., Mekhail, M. N., & Cheng, J. (2011). Retrospective review of 707 cases of spinal cord stimulation: indications and complications. *Pain Pract, 11*(2), 148-153. doi:10.1111/j.1533-2500.2010.00407.x

Nnoaham, K. E., & Kumbang, J. (2008). Transcutaneous electrical nerve stimulation (TENS) for chronic pain. *Cochrane Database Syst Rev*(3), CD003222. doi:10.1002/14651858.CD003222.pub2

Nemeroff, C. B., Mayberg, H. S., Krahl, S. E., McNamara, J., Frazer, A., Henry, T. R., Brannan, S. K. (2006). VNS therapy in treatment-resistant depression: clinical evidence and putative neurobiological mechanisms. *Neuropsychopharmacology, 31*(7), 1345-1355. doi:10.1038/sj.npp.1301082

Pain management devices market by device type (neurostimulation, SCS, TENS, RF ablation, infusion pumps), application (cancer, neuropathy, musculoskeletal, migraine, facial), by mode of purchase (OTC, prescription-based) – Global Forecast to 2020.

Peppin, J. F., Passik, S. D., Couto, J. E., Fine, P. G., Christo, P. J., Argoff, C., Goldfarb, N. I. (2012). Recommendations for urine drug monitoring as a component of opioid therapy in the treatment of chronic pain. *Pain Med, 13*(7), 886-896. doi:10.1111/j.1526-4637.2012.01414.x

Poitras, S., & Brosseau, L. (2008). Evidence-informed management of chronic low back pain with transcutaneous electrical nerve stimulation, interferential current, electrical muscle stimulation, ultrasound, and thermotherapy. *Spine J, 8*(1), 226-233. doi:10.1016/j.spinee.2007.10.022

Poree, L., Krames, E., Pope, J., Deer, T. R., Levy, R., & Schultz, L. (2013). Spinal cord stimulation as treatment for complex regional pain syndrome should be considered earlier than last resort therapy. *Neuromodulation, 16*(2), 125-141. doi:10.1111/ner.12035

Prager, J., Deer, T., Levy, R., Bruel, B., Buchser, E., Caraway, D., Stearns, L. (2014). Best practices for intrathecal drug delivery for pain. *Neuromodulation, 17*(4), 354-372; discussion 372. doi:10.1111/ner.12146

Rizvi, S., & Kumar, K. (2015). History and present state of targeted intrathecal drug delivery. *Curr Pain Headache Rep, 19*(2), 474. doi:10.1007/s11916-014-0474-8

Simpson, E. L., Duenas, A., Holmes, M. W., Papaioannou, D., & Chilcott, J. (2009). Spinal cord stimulation for chronic pain of neuropathic or ischaemic origin: systematic review and economic evaluation. *Health Technol Assess, 13*(17), iii, ix-x, 1-154. doi:10.3310/hta13170

Stadler, J. A., Ellens, D. J., & Rosenow, J. M. (2011). Deep brain stimulation and motor cortical stimulation for neuropathic pain. *Curr Pain Headache Rep, 15*(1), 8-13. doi:10.1007/s11916-010-0161-3

Sukul, V. V., & Slavin, K. V. (2014). Deep brain and motor cortex stimulation. *Curr Pain Headache Rep, 18*(7), 427. doi:10.1007/s11916-014-0427-2

Welberg, L. (2012). Techniques: Optogenetic control in monkey brains. *Nature Reviews Neuroscience*, *13*(9), 603-603.