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Journal of Scientific Research and Biomedical Informatics
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Opinion

Hypnosis for Pain Relief: Unraveling Neural Correlates of Hypnotic Analgesia

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Received Date: November 05, 2021; Accepted Date: December 23, 2021; Published Date: January 05, 2022

Citation: Giuseppe De Benedittis (2022). Hypnosis for Pain Relief: Unraveling Neural Correlates of Hypnotic Analgesia. *J. Scientific Research and Biomedical Informatics*, 3(1); DOI:10.31579/jsrbi.2022/024

Abstract

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Keywords: hypnotic analgesia; neurosurgery; chronic

The global burden of Pain

Pain is defined as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage", according to the revised definition of the International Association of Pain (IASP) (Raja et al., 2020).

Pain is the most common reason for physician consultation in most of the developed countries (De Bono et al., 2013). It is a major presenting symptom in several medical conditions, and may significantly impact the quality of life and general functioning of a person (Breivik et al., 2008).
Pain persisting for a long duration is referred to as "chronic" pain, while the pain that resolves within a short period of time is referred to as "acute". Chronic pain is defined as the pain that persists or recurs for greater than three months or beyond the expected period of healing (Treede et al., 2019).
Epidemiological studies have reported that 10.1%–55.2% of the people in various countries experience chronic pain (Tsang et al., 2008).The high prominence of pain and pain-related diseases is the leading cause of disability and disease burden globally (Vos et al., 2017).
Owing to their limited efficacy, pain medications are useful only in 20%–70% of the cases (Moore et al., 2015). Moreover, there are frequent significant side effects of medications, such as the recent opioid epidemic in USA (Shipton et al., 2018), which is the most common reason for people shifting to the use of complementary and alternative medicine (Eisenberg et al., 1998).

Neural Correlates of Hypnotic Analgesia

The experience of pain may be dramatically influenced by cognitive modulation (De Benedittis, 2020; De Benedittis, 2021). Among all the cognitive interventions for pain modulation, hypnosis may be the most effective in clinical and experimental pain (Hauser et al., 2016; Jensen & Patterson, 2014; Milling et al., 2021; Thompson et al., 2019).

"Hypnosis" can be defined as a state of consciousness that involves focused attention and reduced peripheral awareness, which is characterized by an enhanced capacity for response to suggestion (Elkins et al., 2015). The subjective experience of hypnosis involves focused attention, absorption capacity, a high degree of authenticity (experienced as real), involuntariness, and cognitive/perceptual flexibility (Cardeña et al., 2013; De Benedittis, 2015).

Given the complex multidimensional nature of the pain experience, it is likely that hypnotic analgesia involves multiple mechanisms for pain modulation.
The main mechanism underlying pain relief by means of hypnosis is a top–down rather than a bottom–up mechanism (Landry et al., 2017).
Although a number of supraspinal sites have been reported to be involved in the perception of pain, the most consistent areas identified across different imaging studies are the thalamus, the primary and the secondary somatosensory cortex (S1 and S2), the anterior cingulate cortex, the insula, and the prefrontal cortex (Apkarian et al., 2005).
Taken together, these studies suggest that clinical hypnosis could play a key role in maximizing both behavioral and neurophysiological responses, as hypnosis is a cognitive phenomenon that affects central nociceptive processing. Furthermore, these studies are supportive of greater cognitive flexibility (i.e., the subjective capacity to shift from one "state" to another) of the high hypnotizables compared to the low hypnotizables (De Benedittis, 2015).
Neuro-imaging techniques have contributed in a decisive manner to reveal the putative mechanisms of cognitive modulation of pain, including hypnotic analgesia. Rainville et al. (1997) first demonstrated that hypnotic manipulation of the degree of negative affective resonance

(unpleasantness) elicited by a nociceptive stimulation in a group of volunteers concomitantly induced corresponding changes in the activities of the brain structures (such as increased/reduced activation of the Anterior Cingulate Cortex, ACC) involved in the coding of motivational-affective component of pain. No change was observed in the activity of the primary sensorimotor cortex (S1), which is involved in the processing of sensory-discriminative component of the nociceptive stimulus. The study was followed by other research studies by the same group as well as by Belgian researchers (Faymonville et al., 2000; Hofbauer et al., 2001), which confirmed and extended the results of the afore-mentioned study, suggesting that the ability of hypnosis to differentially modulate the different aspects of pain perception is not rigid, structural, and unidirectional, and rather dynamic and dependent on the structure and formulation of the hypnotic suggestions.

Brain imaging studies have also shown increased activity in several regions of prefrontal cortices and the brain stem during hypnotic analgesia (De Benedittis, 2021). This activation seems consistent with the putative activation of the descending pathways involved in pain regulation. A review of functional neuro-imaging studies on pain perception during hypnosis (Del Casale et al., 2012; Del Casale et al., 2016) indicated that hypnosis-induced modifications in pain perception are associated with functional changes in several Regions of Interest (ROIs), including the cingulate (mainly ACC) as well as the prefrontal, insular, and pregenual cortices, the thalamus, and the striatum. The ACC appears to be the key target in the process of reducing pain perception, regardless of the nociceptive stimulus applied, emphasizing the critical role of ACC in hypnosis-induced modification in the sensory, affective, behavioral, and cognitive aspects of nociception.

It is becoming increasingly clear that hypnosis is able to effectively modulate not just the motivational-affective component of pain, rather also the sensory-discriminative one (which is further directly linked to the intensity of the nociceptive stimulation), although to a lesser extent. These findings confirm the great cognitive-perceptual flexibility mediated by trance, and would certainly exert a significant impact in the clinical context. The hypnotic modulation in pain intensity causes changes in pain-related activity mainly in the primary somatosensory cortex (S1), while the modulation of pain unpleasantness induces changes mainly in the anterior cingulate cortex (ACC), with the anterior (mid) cingulate cortex possibly modulating both sensory and affective components of pain (Faymonville et al., 2000).

Hypnotic analgesia may also be dependent on the activation of the descending inhibitory systems that specifically modulate the spinal transmission of the nociceptive input (Sandrini et al., 2000) . The involvement of these systems during hypnotic suggestions of analgesia was demonstrated in a few electrophysiological studies that reported that hypnosis leading to a significant reduction in the amplitude of the nociceptive flexion reflex (R-III), which is believed to be linearly correlated to the intensity of perceived pain (Danziger et al., 1998; Kiernan et al., 1995), and the effect was proportional to the extent of hypnotic suggestibility.

In addition to spinal and supraspinal mechanisms, hypnosis also modulates the activity of the autonomic nervous system (ANS) and possibly the peripheral nervous system (PNS) as well. The sympatho-vagal interaction of the ANS during trance was investigated for the first time by De Benedittis et al. (1994) through the spectral analysis of the heart rate variability signal (RR interval). The authors demonstrated that hypnosis modulates the RR interval by shifting the balance of the sympatho-vagal interaction toward an increased parasympathetic output, concomitant with a reduction in the sympathetic tone. The effect correlated positively with hypnotic susceptibility.

It has also been shown (Langlade et al., 2002) that the heat pain threshold assessed with thermal stimuli is significantly elevated during hypnosis, suggesting that hypnosis may down-regulate the neuronal inflow from the stimulation of A delta and C fibres. A recent study (Paqueron et al., 2019) demonstrated that a focal glove hypnotic hand anesthesia could induce thermal changes within the area of hypnotic protection.

In summary, the current evidence strongly supports the existence of multiple hierarchical pain-control systems during hypnotic suggestions of analgesia at different levels and sites within the nervous system (De Benedittis, 2020; De Benedittis, 2021). At the peripheral level, hypnosis may modulate the nociceptive input by down-regulating the stimulation of A delta and C fibers and reducing the sympathetic arousal, which is relevant for inducing and maintaining certain chronic pain states. At the spinal level, hypnosis probably activates the descending inhibitory systems by reducing the nociceptive R-III reflex, parallel to self-reported reduction in pain. At the supraspinal cortical level, neuro-imaging and electrophysiological studies have demonstrated the ability of hypnotic suggestions of analgesia to directly and selectively modulate both sensory and affective dimensions of pain perception (the latter exhibiting greater significant reduction compared to pain). Furthermore, the highly hypnotizable subjects possess stronger attentional filtering abilities compared to the low hypnotizable subjects, and this greater cognitive flexibility might result in better focusing and diverting attention from the nociceptive stimulus as well as in better ignoring the irrelevant stimuli in the environment.

Taken together, these data support the notion that cognitive (hypnotic) modulation of pain causes dramatic alterations in the cortical Pain Matrix .This complex network may represent the 'Neurosignature' of the hypnotic modulation of pain (De Benedittis, 2020; De Benedittis, 2021). However, hypnosis is not a panacea and is unlikely to serve as a stand-alone therapy in the treatment of a variety of chronic pain syndromes, including inflammatory and neuropathic pain. Given the multifactorial nature of chronic pain, a multimodal approach, which includes hypnosis as well as pharmacotherapy (such as NSAID, tricyclic antidepressants, and antiepileptic drugs), is often the preferred and the most appropriate treatment for pain control (De Benedittis et al., 2021).

Conclusions

Robust evidence suggests that hypnosis could be effective in the top-down modulation of pain sensation in both acute and chronic pain states. Recent studies on hypnotic analgesia are rather convergent and strongly supportive of multiple hierarchical pain control systems during hypnotic suggestions of analgesia at different levels and sites within the nervous system, thereby providing a cognitive modulation of the Pain Matrix.

Taken together, these data support the notion that cognitive (hypnotic) modulation of pain causes dramatic alterations in the cortical Pain Matrix (De Benedittis, 2020; De Benedittis, 2021). This complex network may represent the 'Neurosignature' of the hypnotic modulation of pain (De Benedittis, 2021). However, hypnosis is not a panacea and is unlikely to serve as a stand-alone therapy in the treatment of a variety of chronic pain syndromes.

Author Contributions

GDB wrote the manuscript and reviewed the final manuscript.

Competing Interests

The Author has declared that no competing interests exist.

References

1. Apkarian, A.V., Bushnell, M.C., Treede, R.D., Zubieta, J.K. (2005). Human brain mechanisms of pain perception and regulation in health and disease. Eur J Pain; 9: 463-484.
2. Breivik, H., Borcgrevink, P.C., Allen, S.M., Rosseland, L.A., Romundstad, L., Breivik, Hals, E.K., et al. Assessment of pain. (2008). Br J Anaesth. 101: 17-24. doi:10.1093/bja/aen103. PMID 18487245.

3. Cardeña, E., Jönsson, P., Terhune, D.B., Marcusson-Clavertz, D. (2013). The neurophenomenology of neutral hypnosis. Cortex; 49: 375-385. doi: 10.1016/j.cortex.2012.04.001.
4. Danziger, N., Fournier, E., Bouhassira, D., Michaud, D., De Broucker, T., Santarcangelo, E., et al. (1998). Different strategies of modulation can be operative during hypnotic analgesia: A neurophysiological study. Pain. 75: 85-92.
5. De Benedittis G. (2020). Neural Mechanisms of Hypnotic Analgesia. OBM Integrative and Complementary Medicine, (5) 2: 1-13.
6. De Benedittis, G. (2021). Neural Mechanisms of Hypnosis and Meditation-Induced Analgesia: A Narrative Review. International Journal of Clinical & Experimental Hypnosis,69(3):363-382,
7. De Benedittis G. (2015). Neural mechanisms of hypnosis and meditation J.Physiology (Paris), 109 : 152-164.
8. De Benedittis, G., Cigada, M., Bianchi, A., Signorini, M.G., Cerutti, S. (1994). Autonomic changes during hypnosis: A heart rate variability power spectrum analysis as a marker of sympatho-vagal balance. Intern J Clin Experiment Hypn.; 42: 141-153.
9. De Benedittis, G., Loriedo, C., Mammini, C. , Rago, N. (eds.) (2021). Trattato di Ipnosi (Treatise on Hypnosis), p. 1-850, F.Angeli, Milano.
10. De Bono, D.J., Hoeksema, L.J., Hobbs, R.D. (2013). Caring for patients with chronic pain: Pearls and pitfalls. J Am Osteopath Assoc.; 113: 620-627. doi:10.7556/jaoa.2013.023. PMID 23918913
11. Del Casale, A., Ferracuti, S., Rapinesi, C., De Rossi, P., Angeletti, G., Sani, G., et al. (2016).Hypnosis and pain perception: An Activation Likelihood Estimation (ALE) meta-analysis of functional neuroimaging studies. J. Physiol Paris. ; 109: 165-172. doi: 10.1016/j.jphysparis.2016.01.001.
12. Del Casale, A., Ferracuti, S., Rapinesi, C., Serata, D., Sani, G., Savoja, V., et al. (2012).Neurocognition under hypnosis. Findings from recent functional neuroimaging studies. Int J Clin Exp Hypnosis ; 60: 286-317.
13. Eisenberg, D.M., Favis, R..B, Ettner, S.L., et al. (1998). Trend in Alternative Medicine in the United States, 1990-1997. Results of Follow-up national survey. JAMA; 279: 1569-1575.
14. Elkins, G.R., Barabasz, A.F., Council, J.R., Spiegel, D. (2015). Advancing research and practice: The revised APA division 30 definition of hypnosis. Int J Clin Exp Hypn. ; 63: 1-9.
15. Faymonville, M.E., Laureys, S., Degueldre, C., DelFiore, G., Luxen, A., Franck, G., et al. (2000). Neural mechanisms of antinociceptive effects of hypnosis. Anesthesiology ; 92: 1257-1267.
16. Hauser, W., Hagl, M., Schmierer, A., Hansen, E. (2016). The safety, efficacy and applications of medical hypnosis. Dtsch Arztebl Int.; 113: 289-296.
17. Hofbauer, R.K., Rainville, P., Duncan, G.H., Bushnell, M.C. (2001) Cortical representation of the sensory dimension of pain. J Neurophysiol ; 86: 402-411.
18. Jensen, M.P. & Patterson, D.R. (2014). Hypnotic approaches for chronic pain management: Clinical implications of recent research findings. Am Psychol. 69: 167-177.
19. Kiernan, B.D., Dane, J.R., Phillips, L.H., Price, D.D. (1995). Hypnotic analgesia reduces R-III nociceptive reflex: Further evidence concerning the multifactorial nature of hypnotic analgesia. Pain ; 60: 39-47.
20. Landry, M., Lifshitz, M., Raz, A. (2017). Brain correlates of hypnosis. A systematic review and a meta-analytic exploration. Neurosci Biobehav Rev. ; 81: 75-98. doi: 10.1016/j.neubiorev.2017.02.020.
21. Langlade, A., Jussiau, C., Lamonerie, L., Marret, E., Bonnet, F. (2002). Hypnosis increases heat detection and heat pain thresholds in healthy volunteers. Reg Anesth Pain Med. ; 27: 43-46.
22. Milling, L.S., Valentine, K.E., LoStimolo, L.M., Nett, A.M., McCarley, H.S. (2021).Hypnosis and the Alleviation of Clinical Pain: A Comprehensive Meta-Analysis. Int J Clin Exp Hypn. 69(3):297-322. doi: 10.1080/00207144.2021.1920330. Epub 2021 May 26. PMID: 34038322
23. Moore, R.A., Wiffen, P.J., Derry, S., Maguire, T., Roy, Y.M., Tyrrell, L. (2015). Non-prescription (OTC) oral analgesics for acute pain - an overview of Cochrane reviews. Cochrane Database Syst Rev. ; 11: CD010794. doi:10.1002/14651858.CD010794.pub2.
24. Paqueron, X., Musellec, H., Virot, C., Boselli, E. (2019). Hypnotic glove anesthesia induces skin temperature changes in adult volunteers: A Prospective Controlled Pilot Study. Int J Clin Exp Hypn. 67: 408-427. doi: 10.1080/00207144.2019.1649544.
25. Rainville, P., Duncan, G.H., Price, D.D., Carrier, B., Bushnell, M-C. (1997). Pain affect encoded in human anterior cingulate but not somatosensory cortex. Science. 277: 968-971.
26. Raja, S. N., Carr, D. B., Cohen, M., Finnerup, N. B., Flor, H., Gibson, S., Keefe, F. J., Mogil, J. S., Ringkamp, M., Sluka, K. A., Song, X. J., Stevens, B., Sullivan, M. D., Tutelman, P. R., Ushida, T., & Vader, K. (2020). The revised international association for the study of pain definition of pain: Concepts, challenges, and compromises. Pain, 161(9), 1976–1982.
27. Sandrini, G., Milanov, I., Malaguti, S., Nigrelli, M.P., Moglia, A., Nappi, G. (2000). Effects of hypnosis on diffuse noxious inhibitory controls. Physiol Behavi.; 69: 295-300.
28. Shipton, E.A., Shipton, E.E, Shipton, A.J. (2018). A review of the opioid epidemic: What do we do about it? Pain Ther.;7: 23-36. doi: 10.1007/s40122-018-0096-7.
29. Thompson, T., Terhune, D.B., Oram, C., Sharangparni, J., Rouf, R., Solmi, M., Veronese, N., Stubbs, B. (2019). The effectiveness of hypnosis for pain relief: A systematic review and meta-analysis of 85 controlled experimental trials, Neurosci Biobehav Rev, 99: 298-310.
30. Treede, R.D., Rief, W., Barke, A., Aziz, Q-, Bennett, M.I., Benoliel, R., et al. (2019). Chronic pain as a symptom or a disease: The IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain; 160: 19-27. doi: 10.1097/j.pain.0000000000001384
31. Tsang, A., Von Korff, M., Lee, S., Alonso, J., Karam, E., Angermeyer, M.C., et al. (2008). Common chronic pain conditions in developed and developing countries: Gender and age differences and comorbidity with depression-anxiety disorders. J Pain. ; 9: 883-891.
32. Vos, T., Allen, C., Arora, M. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 390:1211–1259.

DOI: 10.31579/jsrbi.2022/024