Scholars Journal of Medical Case Reports
Abbreviated Key Title: Sch J Med Case Rep
ISSN 2347-9507 (Print) | ISSN 2347-6559 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Anesthesiology

Impact of Temperature on the Quality of Local Anesthetic Effect during Subarachnoid Block

Imran Ahmed Khan[1*], Nurul Haque Siddiqui[2], Anita Singh[3]

[1]Senior Resident, Department of Community Medicine, BRD Medical College, Gorakhpur, UP, India
[2]Senior Consultant Anaesthesiologist, Department of Anaesthesia, Balrampur Hospital, Lucknow, UP, India
[3]Associate Professor, Trauma Surgery & Gynaecological Trauma, KGMU, Lucknow UP, India

DOI: 10.36347/sjmcr.2024.v12i02.024 | **Received:** 19.01.2023 | **Accepted:** 24.02.2024 | **Published:** 27.02.2024

***Corresponding author:** Imran Ahmed Khan
Senior Resident, Department of Community Medicine, BRD Medical College, Gorakhpur, UP, India

Abstract **Review Article**

In contrast to general anesthesia, which affects the entire body, spinal anesthesia specifically targets a limited area, leading to a temporary loss of sensory and motor function. The duration of the effect varies on many factors depending on the specific anesthetic agent used, level of injections given and, baricity, dose, temperature and, many more factors. The temperature of the administered bupivacaine solution has been recognized as a potential modulator of its onset of action, influencing factors such as speed, depth, and duration of anesthesia. The temperature of the medication can influence the speed at which the local anesthetic takes effect. Warmer solutions may have a faster onset of action compared to colder ones. The duration of anesthesia may also be affected, with warmer solutions potentially providing a more prolonged effect. The temperature of the injected medication can influence the patient's comfort during the administration of spinal anesthesia. The present analysis indicates that there is a definite relationship between the temperature of the injected local anesthetic and the quality of the block achieved.

Keywords: Baricity, bupivacaine, local anesthetics, spinal anesthesia, temperature.

INTRODUCTION

Spinal anesthesia, also known as spinal block or subarachnoid block, is a medical procedure commonly employed in various surgical and obstetric interventions to induce regional anesthesia. Unlike general anesthesia, which affects the entire body, spinal anesthesia specifically targets a limited area, leading to a temporary loss of sensory and motor function. This anesthesia technique involves the administration of injection of a local anesthetic into the subarachnoid space through a fine needle, allowing the anesthetic to directly affect the nerves floating in the cerebrospinal fluid surrounding the spinal cord [1]. This results in a rapid onset of action, providing quick and profound anesthesia to the area of the body supplied by those nerves [2]. Spinal anesthesia induces autonomic, sensory, and motor blockade leading to vasodilatation presenting as a loss of sensation in the affected body parts and a temporary paralysis of the muscles in the affected area, facilitating surgical procedures and ensuring patient comfort. The duration of the effect varies on many factors depending on the specific anesthetic agent used, level of injections given and, baricity, dose, temperature and, many more factors [3].

Commonly used for various surgeries, including lower abdominal surgeries, orthopedic procedures of the lower extremities, cesarean sections, and urological interventions, spinal anesthesia offers advantages such as rapid onset, effectiveness, and the ability to provide targeted anesthesia without the need for general anesthesia in certain cases [4]. While generally considered safe, spinal anesthesia does carry potential complications, including hypotension, bradycardia, headache, nerve damage, and allergic reactions to the anesthetic agents used [5]. Despite these risks, spinal anesthesia remains a valuable and widely used technique in modern anesthesia practice, contributing to effective pain relief and muscle relaxation for a range of surgical and obstetric procedures.

The temperature of the administered local anesthetic solution has been recognized as a potential modulator of its onset of action, influencing factors such as speed, depth, and duration of anesthesia [6]. Maintaining a consistent temperature standard for spinal anesthesia medications helps establish uniformity in practice and contributes to predictable outcomes. It is essential for healthcare providers to consider and control the temperature of spinal anesthesia medications to

optimize patient safety, comfort, and the efficacy of the anesthesia. However, the specific temperature recommendations may vary based on the type of medication used and individual patient factors, emphasizing the need for adherence to established guidelines and best practices in clinical settings. Investigating this relationship is essential to consolidate existing evidence, identify patterns, and address gaps in the current understanding. Such a review aims to provide a comprehensive synthesis of findings from diverse studies, offering insights that can guide clinical practice, enhance patient safety, and contribute to the refinement of anesthesia protocols. By evaluating the impact of the temperature of local anesthetic on the quality of anesthesia, this research endeavour seeks to inform evidence-based practices, ensuring optimal outcomes in spinal anesthesia procedures.

METHODS

We included studies with any of the study designs. Studies reporting the effect of the temperature of local anesthetic on the effect of the spinal block were included in the review. We conducted a comprehensive, systematic, and extensive search in the electronic databases PubMed, and Google Scholar. For PubMed we selected the terms required for the search during the protocol stage. We used both the medical subject headings (MeSH) and free-text words while searching these databases. The keywords and their synonyms were searched using appropriate truncations, and proximity searching. Bibliographies of the retrieved articles were also hand-searched to identify any themes missed during the database search.

RESULTS AND DISCUSSION

Intrathecal distribution of local anaesthetic solutions can be influenced by several factors [7]. The temperature of the medication used in spinal anesthesia holds significant importance due to its potential impact on several aspects of the anesthesia procedure and patient outcomes. Studies investigating the influence of temperature on local anesthetic action during spinal anesthesia have yielded diverse findings. Warmer solutions have been associated with a faster onset of action due to increased solubility and diffusion of the local anesthetic agent, leading to more rapid nerve blockade. Additionally, warmer solutions may promote better spread within the subarachnoid space, resulting in more extensive anesthesia coverage and improved block quality. Conversely, colder solutions have been reported to exhibit slower onset and reduced efficacy, potentially necessitating higher doses to achieve desired anesthesia levels. A statistically significant higher mean maximum sensory block levels was found by Nazli B. *et al*., in group where warmer levobupivacaine was used. Similarly, warmer 0.5% levobupivacaine was found mildly hypobaric at 37°C in comparison to room temperature. It is hypothesized that Increasing the temperature of levobupivacaine increases its molecular kinetic energy, leading to more active particles and maybe contributing to higher sensory block levels. They concluded that the time necessary for synchronisation of temperature within the CSF, the temperature of 0.5% levobupivacaine solution, is a significant factor in the determination of the sensory spread [8]. Richardson MG *et al*., also concluded that the temperature can affect the viscosity of the medication. Warmer solutions may have lower viscosity, facilitating smoother injection and better flow within the subarachnoid space [9]. The duration of anesthesia may also be affected, with warmer solutions potentially providing a more prolonged effect [10]. The temperature of the injected medication can influence the patient's comfort during the administration of spinal anesthesia. Cold solutions may cause discomfort or a sensation of coolness upon injection [11]. Cold solutions may induce vasoconstriction at the injection site, potentially affecting blood flow. This can have implications for hemodynamics, leading to changes in blood pressure and perfusion to the spinal cord [12]. The temperature of the medication may influence nerve conduction and the extent of nerve blockade. Warmer solutions may enhance the spread of the local anesthetic, providing a more extensive block [13]. Temperature can impact the pharmacokinetics of the local anesthetic, affecting its absorption, distribution, metabolism, and elimination within the body [14]. Extreme temperatures, whether too hot or too cold, may pose a risk of tissue damage or irritation at the injection site, potentially leading to complications.

Despite the potential benefits of optimizing temperature in spinal anesthesia, challenges and limitations exist. Variability in temperature control methods, individual patient factors, and procedural nuances may impact outcomes and limit generalizability across studies. Furthermore, the precise temperature thresholds for achieving optimal anesthesia outcomes remain an area of ongoing investigation and debate.

CONCLUSION

The present analysis indicates that there is a definite relationship between the temperature of the injected local anesthetic drugs on the quality of the spinal anesthetic effect. Extreme cold or hot local anesthetic may present with various complications as tissue injury, partial block, block failure and early dissipation of effect. Keeping the temperature of the local anesthetic agent gives a predictable effect and smooth anesthesia. The impact of temperature on local anesthetic action during spinal anesthesia is multifaceted and warrants careful consideration in clinical practice. While warmer solutions may offer advantages in terms of faster onset, improved block quality, and hemodynamic stability, further research is needed to elucidate optimal temperature ranges and standardize temperature management protocols. By advancing our understanding of temperature's influence on local anesthetic action, clinicians can enhance the quality and safety of spinal

anesthesia, ultimately improving patient outcomes and satisfaction.

REFERENCES

1. Chin, A., & van Zundert, A. (2023). Spinal anesthesia. Amyotrophic lateral sclerosis (ALS).
2. Paliwal, N. W., & Khan, I. K. (2023). Basics of Thoracic Segmental Spinal Anesthesia. 1st ed. Pulse Publication. https://www.researchgate.net/publication/375058163_Basics_of_Thoracic_Segmental_Spinal_Anesthesia
3. Richards, L., Lee, A. I., Kotha, R., & Gonzalez, J. (2023). Anesthesia for Urogynecologic Surgery. *Journal of Gynecologic Surgery*, *39*(6), 266-270.
4. Khan, I. A., & Ansari, M. A. (2023). Thoracic Segmental Anesthesia: A New Paradigm in Anesthesiology Practice. Archives of Anesthesiology and Critical Care.
5. Yüksek, A., Miniksar, Ö. H., Honca, M., & Öz, H. (2020). Incidence and causes of failed spinal anesthesia. *Dubai Medical Journal*, *3*(2), 50-54.
6. Huang, S. C., Chau, A., Shapiro, A., & Prabhakar, C. (2020). Effect of temperature on the density, local anesthetic, and glucose concentrations of 0.75% hyperbaric bupivacaine for spinal anesthesia. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*, 67, 617-618.
7. Hocking, G., & Wildsmith, J. A. W. (2004). Intrathecal drug spread. *British journal of anaesthesia*, *93*(4), 568-578.
8. Nazli, B., Oguzalp, H., Horasanli, E., Gamli, M., Dikmen, B., & Gogus, N. (2014). The effects on sensorial block, motor block, and haemodynamics of levobupivacaine at different temperatures applied in the subarachnoid space. *BioMed Research International*, 2014.
9. Richardson, M. G., & Wissler, R. N. (1997). Densities of dextrose-free intrathecal local anesthetics, opioids, and combinations measured at 37 degrees C. *Anesthesia & Analgesia*, *84*(1), 95-99.
10. Hogan, M. E., Perampaladas, K., Machado, M., Einarson, T. R., & Taddio, A. (2011). Systematic review and meta-analysis of the effect of warming local anesthetics on injection pain. *Annals of emergency medicine*, *58*(1), 86-98.
11. Feng, G., Wang, Y., Feng, J., Luo, X., Li, C., & Yao, S. (2021). The relationship between core temperature and perioperative shivering during caesarean section under intrathecal anesthesia with bupivacaine and ropivacaine: a randomized controlled study. *Journal of anesthesia*, *35*(6), 889-895.
12. Heller, A. R., Zimmermann, K., Seele, K., Rössel, T., Koch, T., & Litz, R. J. (2006). Modifying the baricity of local anesthetics for spinal anesthesia by temperature adjustment: model calculations. *The Journal of the American Society of Anesthesiologists*, *105*(2), 346-353.
13. Arai, Y. C. P., Ueda, W., Takimoto, E., & Manabe, M. (2006). The influence of hyperbaric bupivacaine temperature on the spread of spinal anesthesia. *Anesthesia & Analgesia*, *102*(1), 272-275.
14. Wasan, E. K., Sacevich, C., El-Aneed, A., Mohammed, M., Syeda, J., Neville, E., ... & Gamble, J. (2019). Investigation into spinal anesthetic failure with hyperbaric bupivacaine: the role of cold exposure on bupivacaine degradation. *Canadian Journal of Anesthesia*, 1-10.