



Introduction

The use of local anesthetic is vital to a patient's tolerance of outpatient therapeutic injections. There are many types of local anesthetics, however each inhibit pain signals by blocking voltage gated sodium channels in pain nerve fibers (Taylor & McLeod, 2020).

Decreased efficacy of local anesthetic can be caused by many factors such as the anxiety and stress level of the patient, localized infection, and poor administration technique (Bhattacharya, 2011). Another factor that may contribute to reduced efficacy of local anesthetic is hair color. A few studies have indicated that female redheads differ from their dark-haired counterparts in terms of their anesthetic tolerance. Similarly, we observed in clinic female redheads that failed to respond to a specific local anesthetic, lidocaine. However, they did respond to another local anesthetic, chloroprocaine.

Materials and Methods

Observation of two female redhead patients during outpatient procedures.

The Role of Chloroprocaine as a Local Anesthetic: A Case Report

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For redheads, Chloroprocaine may be a more effective local anesthetic than Lidocaine

Discussion

Liem et al. demonstrated that female redheads are more resistant to the anesthetic effects of lidocaine than females with dark hair. Both groups in this study showed a similar baseline pain threshold to electrical stimulation. However, when both groups were injected with subcutaneous lidocaine, redheads showed a lower pain threshold to the electrical stimulation as compared to the dark hair group. The finding that lidocaine has a diminished effect on redheads aligns with our clinical observations.

The differences between lidocaine and chloroprocaine stem from their molecular makeup. Both are considered weak bases with pK_a 's > 7.0 . Lidocaine is an amide, while chloroprocaine is an ester with a chloride on its benzene ring. The chloride helps stabilize the protonated version of Chloroprocaine, making it a stronger base with a pK_a greater than Lidocaine. PK_a values of local anesthetics are thought to be negatively correlated with speed of onset. As the pK_a values increase, the amount of un-ionized molecules able to cross the fatty nerve membrane to act on sodium channels decreases. However, chloroprocaine is an exception to this rule as chloroprocaine has an extremely fast onset compared to Lidocaine. Chloroprocaine is rapidly degraded in the plasma by pseudocholinesterase with a half life of 6 minutes. This rapid metabolism lowers risk of system toxicity, which allows for a higher concentration to be injected in the system. Greater concentration of chloroprocaine causes a quicker onset of action. While chloroprocaine is rapidly hydrolyzed in the plasma, lidocaine is metabolized the liver with a half life of 100 minutes (Taylor & McLeod, 2020). Although the mechanism of action between these two local anesthetics are the same, their differences may play a role in their varying effects on redheads.

Melanocortin 1 receptor (MC1R) plays an essential role in determining an individual's hair color. MC1R is primarily located on melanocytes. When activated, a cascade of intracellular signaling within melanocytes produces eumelanin, the predominant pigment in dark haired individuals. Mutations in the MC1R gene creates receptors that remain inactivated on the surface of melanocytes, resulting in pheomelanin formation which is the predominant pigment found in redheads (Wolf et al., 2016). Although MC1R is primarily expressed on the surface of melanocytes, MC1R has been found in other areas including the periaqueductal gray matter (PAG). The PAG plays an important role in analgesia by sending signals in that CNS that ultimately inhibit pain communication to the brain. Our understanding of the role of MC1R expression in the PAG is limited, however further research could provide more insight into the relationship between MC1R mutations and anesthetic tolerance.

Results / Case Report

A 42 year old female redhead of Northern European descent and a 44 year old female redhead of Northern European descent were observed in clinic. Both patients underwent cervical medial branch blocks to address their axial cervical pain. Lidocaine 1% was injected in order to reduce the pain sensation associated with the placement of a larger, 25 gauge 3.5 inch spinal needle. Typical time was allotted to allow for the local anesthetic to take effect before placement of the spinal needle. Both patients demonstrated atypical, extreme discomfort when the spinal needle placement was attempted. More lidocaine was injected, followed by waiting for the local anesthetic to take effect. Again, spinal needle placement was attempted, however both patients showed similar discomfort and the procedure was aborted.

Upon patient's consent, a second procedure attempt was made 12 days later for the 42 year old patient, and 14 days later for the 44 year old patient. Chloroprocaine was substituted for lidocaine. Both patients showed significant improvement in their tolerance for the spinal needle, and were both able to complete the procedure with relative comfort.

References

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