

Anesthesia Requirements for Redheads

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Problem Statement

As the melanocortin-1 receptor gene was not discovered until 1995, only anecdotal observation supported that redheads had an increased anesthetic requirement. Utilizing relatively recent research, this project aimed to enhance the knowledge regarding the anesthetic requirements for redheads among student registered nurse anesthetists (SRNAs).

Project Description

The intent of this capstone project was to expand the knowledge of SRNAs regarding the anesthetic requirements of red haired people. Informed consent of all participants was gathered. Prior to the presentation, a pre-test was completed by the SRNAs to determine existing subject knowledge. A presentation was then given that included the pharmacogenetics of the melanocortin-1 receptor gene and its effects on anesthesia, including local anesthetics, inhaled anesthetics, as well as pain sensitivity and various anesthesia related topics. A post-test was administered to assess the SRNAs' knowledge of the topic immediately following the presentation.

Results

The topic was presented once to 44 SRNAs in the fall of 2015. The pre- and post-tests were administered anonymously and no identifying information was collected. The results from the pre- and post-tests were analyzed via a paired t-test. The obtained t value of -13.749 associated with a p-value of < 0.05 level of confidence, indicating that scores improved significantly.

Paired Samples Test	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Pair 1 Pre-test - Post-test	-6.05882	2.56953	0.44067	-6.95538	-5.16227	-13.749	33	0.000

Paired Samples Statistics	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Pre-test	3.7647	34	1.79323	0.30754
Post-test	9.8235	34	2.28924	0.39260

Review of Literature

Author	Year	Sample Size	Subject	Design	P<0.05	P<0.001	Limitations
Chua et al.	2004	39	Human	RCT	Red hair- Higher OAA/S, lower drowsiness VAS		Not blinded to hair color, pharmacokinetics of midazolam unmeasured
Myles et al.	2012	468	Human	Prospective Matched Cohort		No significance found	Self-reported hair phenotype
Liem et al.	2005	60	Human	Prospective	Red hair- more sensitive to cold pain perception and heat pain. Subcutaneous lidocaine less effective.	Red hair- more sensitive to cold pain tolerance	Women only, investigators and subjects not blinded to hair color
Liem et al.	2004	20	Human	Prospective		Red hair required 19% higher desflurane MAC concentration	Small sample size
Xing et al.	2004	40	Mice	Prospective	MC1R mutation required 5.5% increase in MAC (P =0.023)		Small sample size, mice
Gradwohl et al.	2015	1914	Human	Retrospective Cohort		No significance found	Self-reported retrospective review for "red hair". No MC1R testing, BIS as surrogate, multiple agents used, high-risk AWR patients were recruited originally; is this reproducible to the general population?
Galley et al.	2005			Expert Opinion			

Discussion

Interestingly, there was a decided perspectival shift in the opinion of literature reviewed between 2004 and 2015. Earlier studies were supportive of an increased anesthetic requirement of redheads, while more recent studies discouraged such an approach. It is possible that the later studies relied on self-reported hair phenotype, rather than analysis of genetic makeup of the MC1R genotype. Given this, it is plausible that there is a significant difference in the anesthetic requirements of redheads, depending on whether they are homozygous, heterozygous, or compound heterozygous.

Future Implications

Genetic iStat?

It is possible that in a short amount of time, anesthesia providers will be able to more accurately tailor anesthetic levels (and a myriad of other pharmacological interventions) specific to a given genotype. This presentation and information has primarily focused on *one gene* (MC1R) nearly specific to *one phenotype* (redheads), which represents approximately 5% of the global population. What if researchers discover more genetically influential variability that effects a larger percentage of the population???

MAC-Ginger...

If it is, in fact, true that redheads require more anesthetic, be it inhalational or local, or greater benzodiazepine requirement, the astute clinician could take a “mental MAC-Ginger” approach, such that:

MAC of Sevoflurane	2.0%	MAC of Desflurane	6.0%
MAC-Ginger of Sevoflurane	2.38%	MAC-Ginger of Desflurane	7.14%
MAC-BAR of Sevoflurane	2.6%	MAC-BAR of Desflurane	7.8%

(MAC-BAR-Ginger 3.094%!!)

References

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