

Effects of pilocarpine and atropine on heart rate



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Abstract

Heart rate is controlled in a normal heart by the parasympathetic and sympathetic nervous systems. Pilocarpine and atropine are cholinergic drugs that affect heart rate by affecting the acetylcholine receptors. A frog heart was used to compare the effects of pilocarpine and atropine on heart rate. Pilocarpine was shown to decrease the heart rate and atropine increased heart rate. These results are consistent with how the two drugs affect the receptors.

Introduction

Although the heart has autorhythmic cells the heart rate is regulated by the sympathetic and parasympathetic nervous systems of the autonomic nervous system (Dahian, 2006; Silverthorn, 2009; Stabler, 2009). Acetylcholine is released by the parasympathetic nervous system to slow heart rate down (Silverthorn, 2009; Stabler, 2009). Pilocarpine and atropine are cholinergic which means they act on acetylcholine either by increases its activity or decreasing the activity (Silverthorn, 2009; Stabler, 2009).

These two drugs also act on the muscarinic receptors which means they act mostly on smooth muscle, cardiac muscle, and glands (Silverthorn, 2009). Pilocarpine is a muscarinic receptor agonist and increases the activity of acetylcholine released by the parasympathetic nervous system thus slowing the heart rate (Silverthorn, 2009). Atropine on the other hand is a muscarinic receptor antagonist and competes with acetylcholine for binding on the receptors which means it blocks acetylcholine released by the parasympathic system and allows the heart rate to increase (Silverthorn, 2009).

A frog heart has three chambers and the human heart beats faster in a normal state but the mechanisms in both hearts are very similar, so a frog heart can be a good candidate for research to apply to humans (Stabler, 2009).

Materials and Methods

A frog heart was obtained and hung by placing a hook through the apex of the heart and tying a string to the hook and to a metal rod above. Ringers solution was applied to the heart at 23 degrees Celsius. An oscilloscope monitor was also used to monitor the heart rate. Bottles of pilocarpine and atropine were obtained. A few drops of pilocarpine were dropped on to the suspended frog heart. Results of heart rate were then recorded once the heart rate was stabilized. Room temperature (23°C) Ringers solution was then applied to rid the heart of the pilocarpine. A few drops of Atropine were then dropped on to the suspended frog heart. Results of heart rate were again recorded once the heart rate was stabilized. Room temperature Ringers solution was then reapplied to the heart to rid the heart of atropine. (Stabler, 2009)

Results

Normal, initial heart rate was determined by the oscilloscope to be 60 beats per minute (bpm). The stabilized heart rate of the frog heart after pilocarpine was applied was 45bpm. The stabilized heart rate of the frog heart after atropine was applied was 70bpm.

Table 1: Effects of Pilocarpine and Atropine on Heart Rate

Solution	Heart
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	Rate
None	60
Pilocarpine	45
Atropine	70

Rate of the frog heart beat before and after pilocarpine and atropine were applied.

Discussion

Pilocarpine is a muscarinic receptor agonist that increases the activity of muscarinic acetylcholine receptor (Silverthorn, 2009). This means that pilocarpine increases the effects of acetylcholine in the body. As previously noted acetylcholine is used by the parasympathetic nervous system and one of its functions is to slow down the heart rate (Silverthorn, 2009). Therefore since pilocarpine increases the activity of the parasympathetic nervous system, it slows down the heart rate. The results are consistent with the function of pilocarpine. Other experiments have been done that show that pilocarpine decreases heart rate as well (Saad, et al., 2003).

Atropine is an anticholinergic drug and acts as a muscarinic receptor antagonist. Atropine competes with acetylcholine for the binding sites on the receptors (Dahian, 2006; Silverthorn, 2009). Once atropine binds it blocks the binding of acetylcholine and thus blocks the effects of acetylcholine (Dahian, 2006; Silverthorn, 2009). As previously noted acetylcholine

regulates the heart rate by slowing it down when needed. Since acetylcholine cannot bind the heart rate increases. Thus the results are consistent with the way atropine affects acetylcholine receptors. Dahian's results on atropine on rats showed that atropine increased the heart rate (2006).

Literature Cited

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