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The effect of atropine on heart-rate: a comparison between two ethnic groups

The effect of atropine on heart-rate may differ greatly between individuals at equivalent doses (Crawford, 1923). Atropine also has varying effects on the heart-rate, depending on the age of the subject (Nalefski & Brown, 1950). Vagal tone is thought to be the most important determinant of effective dose (Chamberlain & Turner, 1967) as a definite negative correlation exists between basal resting heart rate and the dose required for complete parasympathetic blockage (Kauf, 1926). The dose of atropine sufficient to cause striking cardiac acceleration in an untrained individual may be relatively ineffective in an athlete (Chamberlain & Turner 1967). A difference in response to atropine in Caucasian and Negroid races has been described (McGuigan, 1921; Paskind, 1921). Paskind (1921) reported that the initial bradycardia after parenteral administration of atropine does not occur in the American Negro at doses which cause a bradycardia in matched white controls. The initial bradycardia only occurs transiently at relatively much higher doses of atropine. This decreased susceptibility to the bradycardia effects of atropine cannot be explained on pharmacokinetic grounds.

After rapid intravenous administration of atropine, a second episode of bradycardia occurring 1 h after administration has been described (Meyer *et al.*, 1986; Rudolf, 1924). In the present study, the effect of intravenous atropine 0.5 mg, on the heart-rate of eight white male volunteers was compared with the effect on 10 Venda males. The trial was single-blind, placebo controlled and ethically approved. There was no significant difference in the average age of the two groups of volunteers, and volunteers remained fasting and supine during the trial period of 5 h. Pulse rate was counted from the QRS complexes on ECG tracings (lead 2) taken continuously for the first 4 min after rapid intravenous administration of atropine 0.5 mg, and thereafter from 30 s tracings taken at 15, 30, 60, 90, 120, 150, 180, 210, 240, 270 and 300 min. For statistical analysis the differences between the atropine and placebo values were calculated to determine the effect of atropine on each group. The absolute change in pulse rate (i.e. pulse rate at specific time – base line pulse) at each time-interval was further calculated and the two groups compared with each other by means of an analysis of variance, P values < 0.05 being regarded as significant throughout.

There was no difference statistically in the basal pulse rate between the two groups (Whites and Vendas 65 and 64 respectively).

After the administration of placebo there was no significant change in the pulse rate during the trial session.

After the administration of atropine 0.5 mg, there was a significant difference in heart-rate reaction between the Venda and White volunteers (Figure 1). The White volunteers developed a slight, statistically insignificant decrease in heart-rate (mean of 2 beats min^{-1}) while the Venda group responded with a mean increase of 8 beats min^{-1}. At 15 min the White volunteers had a slight increase in pulse rate of 4 beats min^{-1}, while the Vendas had a significant increase of 11 beats min^{-1}. The bradycardia developing at 150 min was significantly different between the two groups (Whites a mean decrease of 1 beat min^{-1} and Vendas a mean decrease of 12 beats min^{-1}).

Of the White volunteers, five developed early heart-arrhythmias; four developed A-V dissociation within the first 4 min and one developed downward displaced ST-segments. All the arrhythmias were of short duration and not present on the ECG tracings after 15 min. Of the

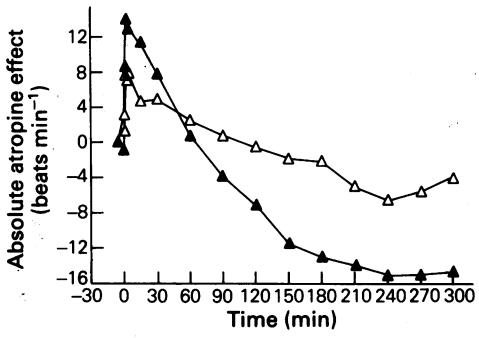

Figure 1 Heart rate changes after administration of atropine 0.5mg to two ethnic groups i.e. Whites (△) (n = 8) and Venda (▲) (n = 10).
Absolute atropine effect—difference between effect obtained with atropine and with placebo.

Venda group, only two volunteers developed transient arrhythmias; one had a few bigeminal beats within the first 4 min, and a second had A-V dissociation with complete synchronization which lasted for 4 min. These differences are statistically significant, but were of no clinical importance. The volunteers were unaware of any arrhythmias during the trial.

In this trial, the Venda volunteers were resistant to the initial bradycardia effect of atropine 0.5mg, but were however more susceptible to the late bradycardia effect of atropine. The tachycardia effect was also significantly more pronounced than that of the White volunteers.

If the Venda volunteers are relatively resistant to the initial slowing action of atropine as our results seem to suggest, and the postulated mechanism for the most common cardiac arrhythmic effect of atropine, i.e. simple A-V dissociation, is a temporary imbalance between the slowing and accelerating action of atropine on the S-A and A-V nodes (Averill & Lamb, 1959), one would expect a lower incidence of early arrhythmias in this group. This was indeed so in this trial.

We would postulate that the differences in reaction of heart-rate after atropine administration may be due to a difference in sensitivity to atropine between the two groups, or a difference in requirements resulting from inequality of vagal or sympathetic tone. These results suggest a varying pharmacogenetic sensitivity which warrants further investigation.

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