EFFECT OF INTRAVENOUS INFUSION OF BLOOD ON THE ELECTROCARDIOGRAM OF ANAESTHETISED DOGS

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Summary: About 250 to 450 *ml* of blood was infused within 3 to 5 minutes to study the effect of rapid intravenous infusion of blood on electrocardiogram of 21 anaesthetised dogs. In 16 dogs with initial heart rate above 136/min, i.v. infusion resulted in bradycardia, decrease in P wave amplitude, increase in R wave amplitude and increase in PR,QT and ST intervals. In 3 dogs with initial heart rates above 136/min there was no change in the heart rate, while in 2 dogs with heart rate below 136/min there was tachycardia after the infusion.

Key words: Bainbridge reflex intravenous infusion electrocardiogram heart rate

INTRODUCTION

Bainbridge (3) demonstrated that intravenous infusion of blood or saline produced tachycardia in anaesthetised dogs. This reflex was confirmed by several workers (1, 4, 16). Others reported variable responses (7, 8, 15). The existence of Bainbridge reflex was disputed by some workers (2, 13). Later it was found that the effect of i.v. infusion on heart rate depends upon initial heart rate prior to infusion (9, 11, 14). In this paper we are reporting the effect of rapid i.v. infusion of blood on heart rate and other electrocardiographic changes associated with it.

MATERIAL AND METHODS

The blood for infusion was tapped by inserting a cannula in the femoral artery of anaesthetised dogs. The blood was collected in a transfusion bottle having 75 *ml* of ACD solution (Trisodium citrate 11.0 *g*, Acid citric 4.1 g, Dextrose 11.2 *g* in 500 *ml* of distilled water) as anticoagulant. The blood was then preserved in a refrigerator.

21 dogs weighing between 12 and 17 *kg* were anaesthetised with intravenously administered pentobarbitone at 30 *mg/kg*. The dogs were then heparinized (500 I.U./*kg*. I.V.). The femoral vein on the right side was exposed and a catheter was pushed through it into inferior vena cava. The bottle containing blood was first warmed to 37°C. Then two glass tubes were introduced into it, one of them was connected with the catheter in the fermoral vein and to the other a sphygmomanometer bulb was attached which was used to build up pressure in the bottle for rapid infusion of blood. The infusion of 250-450 *ml* was completed within 3-5 minutes.

Standard limb lead II of the electrocardiogram was recorded before, immediately after and 5 minutes after the infusion. EKG was studied for heart rate, durations and voltages of P, R, T waves and PR, QT and ST durat ons.

RESULTS

The changes in the heart rate immediately after i.v. infusion of blood (21 dogs) and 5 minutes after the infusion (17 dogs) are shown graphically in Fig. 1. Two dogs having heart rate below

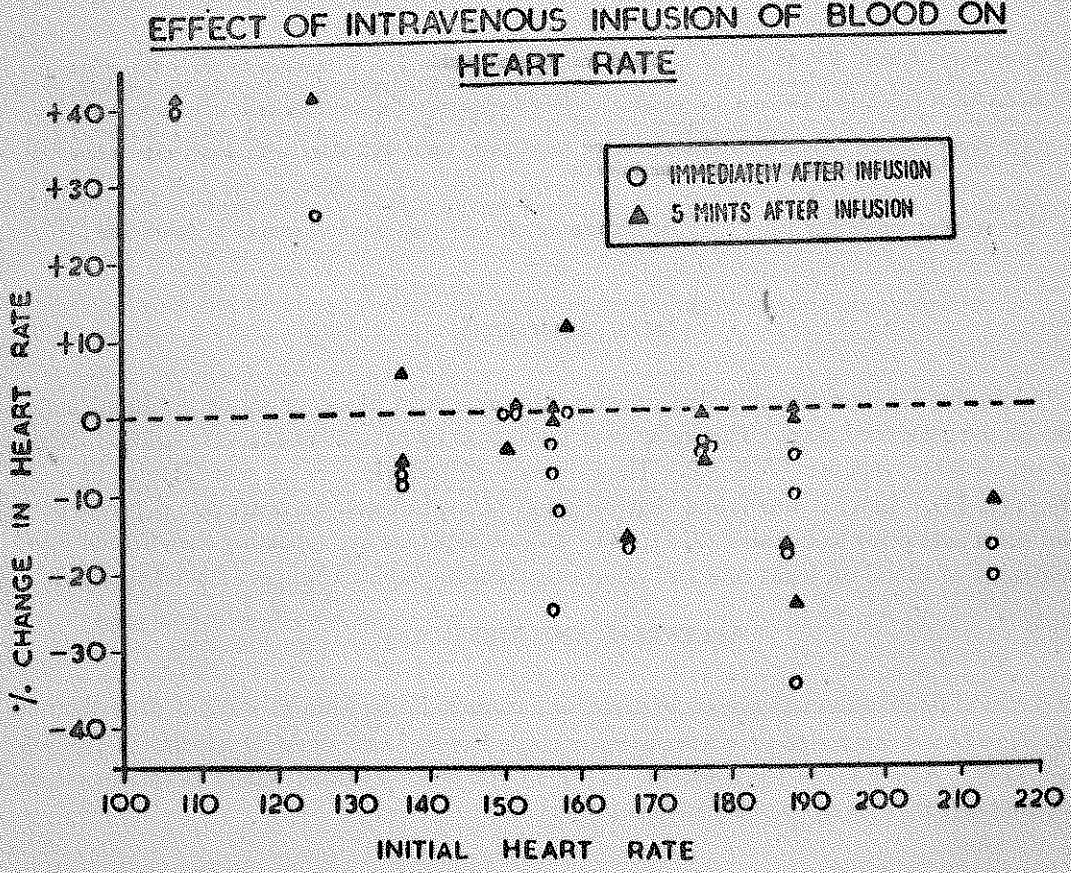

Fig. 1

136/min exhibited tachycardia (upto 40%), while 16 dogs with initial heart rate above 136/min exhibited bradycardia (4% to 36%) and 3 dogs showed no change after infusion. The extent of bradycardia had no relationship with the initial heart rate. For example an animal with initial heart rate of 187 showed bradycardia of 19%, while two other animals with initial heart rate of 188 exhibited bradycardia of 6% and 11% respectively. Most animals exhibiting heart rate

changes immediately after infusion showed resumption of increased heart rates as indicated by EKG records taken 5 mins after infusion.

Table I shows EKG changes in 16 dogs where i.v. infusion resulted in significant bradycardia immediately following infusion and remained significant even after 5 minutes ($P<0.05$). P wave

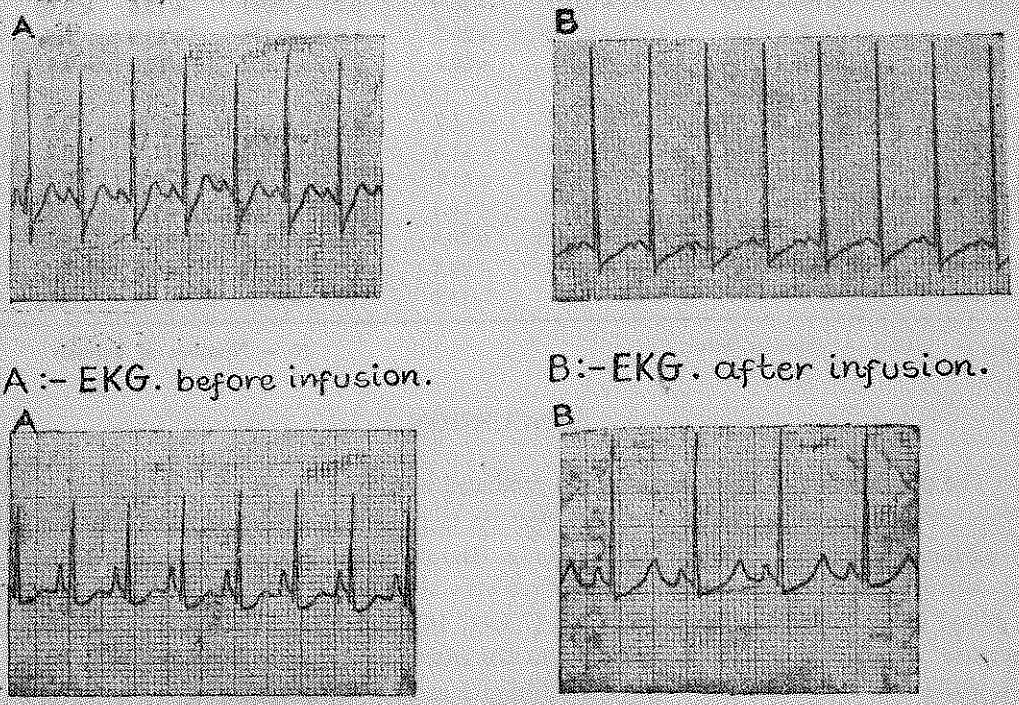

Fig. 2

amplitude was decreased immediately after infusion ($P<0.05$) but regained slightly after 5 mins. R wave amplitude was increased immediately after infusion, and remained significantly increased ($P<0.01$) even after 5 minutes, Similarly there was significant increase in PR ($P<0.05$), QT ($P<0.01$) and ST ($P< 0.02$) intervals immediately after infusion (Fig.2).

In 2 dogs with initial heart rate of 107 and 125, i.v. infusion resulted in tachycardia (150 and 157 respectively). There was no change in heart rate of three dogs (initial heart rate 150, 150 and 158) on i.v. infusion of blood.

Table I: Mean EKG changes after intravenous infusion of blood in 16 dogs showing bradycardia.

	a	*b*		*c*			
	Before	*Immediately after infusion*	*Change* (%)	*5 min after infusion*	*Change%*	*a vs b N = 16 P value*	*a vs c N = 12 P value*
Voltage (mv)							
P wave	0.199 ± 0.029	0.166 ± 0.027	—16.5	0.25 ± 0.041	+13.6	<0.05	NS
R wave	1.598 ± 0.147	1.922 ± 0.182	+20.2	1.818 ± 0.179	+25.9	HS	<0.01
T wave	0.258 ± 0.045	0.31 ± 0.044	+20.1	0.278 ± 0.052	+17.8	=0.3	<0.3
Durations (sec)							
P wave	0.058 ± 0.004	0.057 ± 0.004	— 1.7	0.055 ± 0.004	—6.8	<0.9	<0.4
R wave	0.026 ± 0.002	0.023 ± 0.002	—11.5	0.023 ± 0.001	—11.5	<0.2	<0.3
T wave	0.108 ± 0.01	0.123 ± 0.008	+13.8	0.106 ± 0.011	—6.2	<0.1	<0.5
PR interval	0.085 ± 0.001	0.094 ± 0.004	+10.5	0.089 ± 0.004	+4.7	<0.05	<0.3
ST interval	0.181 ± 0.01	0.218 ± 0.012	+20.4	0.20 ± 0.011	+6.9	<0.02	<0.2
QT interval	0.208 ± 0.004	0.25 ± 0.011	+20.1	0.226 ± 0.011	+6.6	<0.01	<0.3
Heart rate	173.2 ± 5.81	149.2 ± 5.22	—14.0	159.3 ± 6.21	—7.5	HS	<0.05

Values are means ± standard error. N = Number of animals

DISCUSSION

The present study shows that changes produced in heart rate on i. v. infusion of blood are dependent on the initial heart rate. Bradycardia is produced on infusion of blood when the initial heart rate is higher than 136 beats/min. The extent of bradycardia thus produced is independent on the initial heart rate. Other workers also observed bradycardia on i.v. infusion of blood if the initial heart rate was high (7,9,11, 14). But Hirsch *et al.* (11) have shown that decrease in heart rate was proportional to the extent initial heart rate deviated from 120/min while Gulzar Ahmed's findings (9) confirm our results. We obtained tachycardia on infusion of blood in those dogs whose initial heart rate was low. Similar results have also been reported by other workers (6, 10, 12).

The present study further shows that there is decrease in amplitude of P-wave and increase in amplitude of R-wave with increase in P-R, S-T and Q-T intervals of EKG on infusion of blood. Bhatnagar and Gupta (5) have reported decrease in the amplitude of P-wave on i.v. injection of 30-40 *ml* of dextrose solution in dogs. This they attribute to increased atrial strain. But the details of the mechanism of production of changes in EKG still need to be investigated.

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