STUDY OF HEART RATE AND BLOOD PRESSURE CHANGES UNDER DISTENSION OF RIGHT AND LEFT ATRIAL APPENDAGES IN DOGS

J.L. AGARWAL, N. SHUKLA AND G.S. TANDON

Department of Physiology,
K.G's Medical College, Lucknow

Summary: Fifteen healthy stray dogs of both sexes were employed in the present study. The effect of distension of right and left atrial appendages with normal saline was observed on heart rate and blood pressure under different situations. It has been found that distension of either appendages separately or simultaneously invariably evoked tachycardia without any appreciable change in blood pressure. Increase in heart rate was found to be of a same magnitude with 5 *ml* normal saline in both the atrial appendages. However, a higher response was obtained with 10 *ml* normal saline distension in case of right atrial appendage as compared to left one. Increase in the extent of distension causes more significant response, the receptors of which are stimulated and may be allied to stretch receptors. It is contended that tachycardia could be a reflex effect which is abolished by vagotomy. It is further contended that either afferent, efferent or both pathways exist in the vagi.

Key words : atrial appendages, vagus, dogs, distension, blood pressure, heart rate, normal saline

INTRODUCTION

Reflex increase in heart rate has been obtained by distension of left atrium and pulmonary vein atrial junction. The afferent pathway was found in the vagi and efferent in the sympathetic nerves to the heart (17, 15, 12 and 7).

Reflex tachcardia has also been reported by stimulating the receptors situated in the right atrium and the superior vena cava right atrial junction (8). Ballin and Katz (4) failed to produce any change in heart rate during distension of right atrium. On the contrary Aviado *et al.* (2) reported low heart rate and hypotension on distension of right atrium. Distension of left atrium with saline results in decreased heart rate (18 and 16); whereas tachycardia has been reported by earlier authors (3, 17 and 10) who attributed the response to be due to stimulation of receptors situated in atrial appendages. Tachy and bradycardia both have been found to occur after distension of atrium with normal saline by earlier authors (5 and 1). From above, it appears that there exists a controversy regarding the effect of distended atrial appendages on heart rate and blood pressure. In the present study, an attempt has been made to observe the effect of distension of atrial appendages with normal saline under different situations on heart rate and blood pressure in dogs.

MATERIALS AND METHODS

Fifteen healthy stray dogs of both sexes, weighing between 8.5 and 16 *kg* were employed in the present study. Nembutal at 30 *mg/k/W* was administered intraperitoneally to induce anaesthesia. Femoral artery and vein were carefully exposed in the thigh region. Blood pressure was

recorded through femoral artery; whereas normal saline was transfused through femoral vein at the rate of 30 drops per minute to maintain haemostasis. A midline incission was made in the neck to expose trachea and carotid sheath. Vagus nerve was dissected carefully. Trachea was cannulated by a Y-shaped cannula which was connected to a respiratory pump running at a speed of 18 revolutions per minute. The inspired volume was controlled at 30/3 *K/W*. Left common carotid artery was exposed carefully in the neck and heart rate was recorded through it with a venous cannula attached to Hurthley's manometer.

A midline incission was made in the chest to expose the heart and atrial appendages. Purse string suture was applied at the apex of atrial appendages and then a nick was made in which a Folley's catheter no. 8, was inserted and tied properly. The appendages were distended by infusing saline through Folley's catheter to inflate the baloon. The rectal temperature was maintained between 37°C and 38°C. Initial readings in each case acted as control. Heart rate and blood pressure was recorded during and after release of distension. This procedure was adopted under different situations. The experimental dogs were divided in following groups. The experiments were done on 15 dogs only. In each group same dogs were employed though their numbers varied.

Group I, consisted of 15 dogs in which effect of distension of left atrial appendage with 5 and 10 *ml* normal saline was observed on heart rate and blood pressure.

Group II, consisted of 15 dogs of group I, in which effect of distension of right atrial appendage with 5 and 10 *ml* normal saline was observed.

Group III, consisted of 12 dogs, selected from group I, in which effect of simultaneous distension of both atrial appendages with 5 and 10 *ml* normal saline was observed.

Group IV, consisted of 8 dogs of group I, in which left vagotomy was done and both atrial appendages were separately distended with 5 *ml* normal saline.

Group V, consisted of 7 dogs selected from group I, in which right vagotomy was done and both atrial appendages were separately distended with 5 *ml* normal saline.

Group VI, consisted of 15 dogs of group I, in which bilateral vagotomy was done and both atrial appendages were separately distended with 5 *ml* normal saline.

Group VII, consisted of 5 dogs selected from group I, with bilateral vagotomy in which both atrial appendages were simultaneously distended with 5 *ml* normal saline. A time-marker was set at 10 per sec interval.

RESULTS

Perusal of Table I, shows an increase in the heart rate as compared to control on distension of left atrial appendage with 5 *ml* normal saline. This increase was found to be statistically significant ($P<0.05$). No significant change was observed in blood pressure ($P<0.98$). On distension of

left atrial appendage with 10 *ml* normal saline, the heart rate was found to be significantly increased ($P<0.05$, Fig. 1). No significant change was noticed in blood pressure ($P<0.07$).

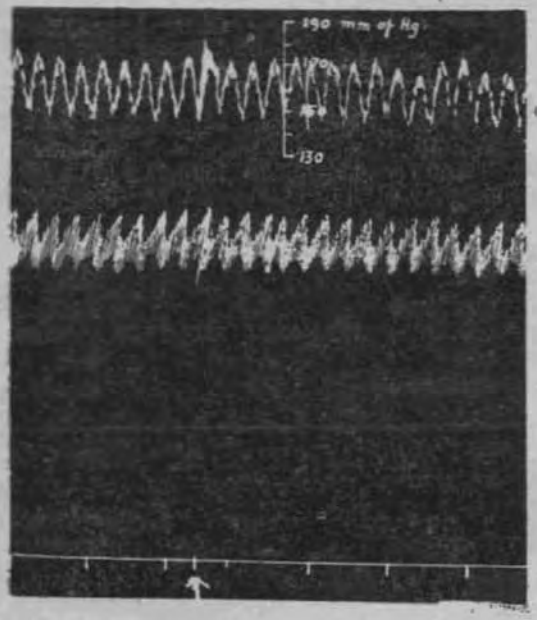

Fig. 1: Kymographic record of dog showing the effect of distending left atrial appendage with 10 *ml* normal saline.

In case of right atrial appendage distension with 5 and 10 *ml* normal saline, an increase in heart rate was recorded which was statistically significant ($P<0.05$ and $P<0.01$ & Fig. 2) respectively. No appreciable change in blood pressure was observed (Table I).

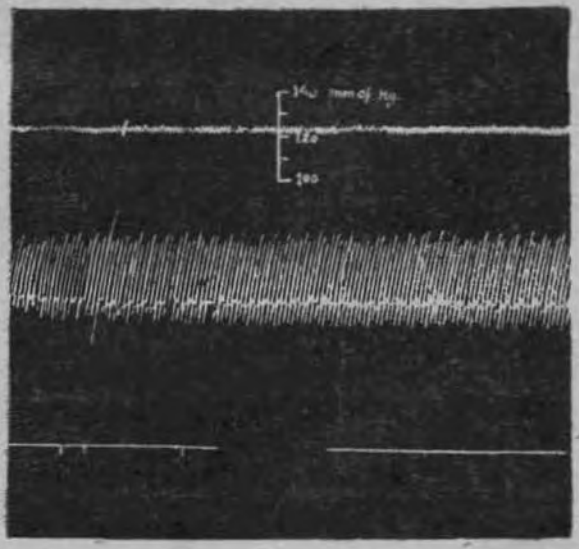

Fig. 2: Kymographic record of dog showing the effect of distending right atrial appendage with 10 *ml* normal saline.

TABLE I: Effect of distension of left and right atrial appendages separately (5 *ml* and 10 *ml* normal saline).

No. of dogs	*Measurement*	*Volume*	*Left atrial appendage*			*Right atrial appendage*		
			Control	*During distension*	*t-values*	*Control*	*During distension*	*t-values*
15	Heart rate (per min)	5 *ml*	130±25.1	148±23.0	2.13 P<0.05	135±25.1	153±26.2	2.04 P<0.05
		10 *ml*	133±25.3	155±27.0	2.60 P<0.05	134±23.7	160±23.6	3.05 P<0.01
15	Blood pressure (mm of Hg)	5 *ml*	130±24.3	124±26.6	1.01 (not significant)	118±30.3	124±37.5	0.98 (not significant)
		10 *ml*	123±26.1	118±32.1	0.57 (not significant)	123±40.3	122±37.5	0.07 (not significant)

On simultaneous distension of both atrial appendages with 5 *ml* normal saline, an increase in heart rate was recorded which was statistically significant (P<0.005, Table II and Fig. 3). Similar changes were noted with 10 *ml* normal saline (P<0.005, Table II). No appreciable change in blood pressure was recorded after simultaneous distension of both atrial appendages with 5 and 10 *ml* normal saline (Table II).

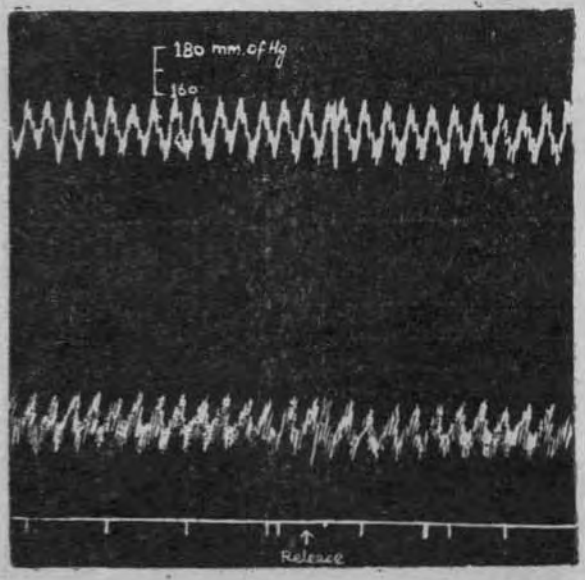

Fig. 3: Kyomographic record of dog showing the effect of distending both right and left atrial appendages with 5 *ml* normal saline.

TABLE II: Effect of simultaneous distension of right and left atrial appendages with 5 *ml* and 10 *ml* normal saline.

No. of dogs	*Measurement*	*Volume of saline injected*	*Control*	*During distension*	*t-values*
12	Heart rate (per min)	5 *ml*	135±21.0	162±19.6	3.25 P<0.05
5		10 *ml*	131±19.1	172±23.3	3.0 P<0.005
12	Blood pressure (mm of Hg)	5 *ml*	123±33.3	122±30.8	0.06 (not significant)
5		10 *ml*	130±23.9	127±28.8	0.12 (not significant)

On distension of left atrial appendage with 5 *ml* normal saline after left vagotomy, no appreciable change was observed in heart rate and blood pressure (Table III). On distension of right atrial appendage with 5 *ml* normal saline, an increase in heart rate was recorded; whereas no appreciable change was noted in blood pressure (Table III).

TABLE III: Effect of distending left and right atrial appendages separately with 5 *ml* normal saline after cutting left and right cervical vagus respectively.

			Left atrial appendage			*Right atrial appendage*		
No. of dogs	*Measurement*	*Vagus cut*	*Control*	*During distension*	*t-values*	*Control*	*During distension*	*t-value*
8	Heart rate (per min)	Left	147±15.4	145±17.5	0.19 (not significant)	145±17.5	152±17.5	0.50 (not significant)
7		Right	171±26.4	174±25.5	0.21 (not significant)	174±26.4	168±20.6	0.29 (not significant)
8	Blood pressure (mm of Hg)	Left	106±31.2	103±31.3	0.19 (not significant)	103±31.6	103±31.3	0.00 (not significant)
7		Right	148±30.7	138±30.2	0.46 (not significant)	138±30.2	142±29.8	0.28 (not significant)

Distension of left atrial appendage with 5 *ml* normal saline after right vagotomy brings an appreciable increase in heart rate; whereas no appreciable change in blood pressure was observed (Table III). Distension of right atrial appendage in same animals with 5 *ml* normal saline, does not bring any appreciable change in heart rate and blood pressure (Table III).

In case of bilateral vagotomy, distension of left and right atrial appendages separately and simultaneously with 5 *ml* normal saline does not register any appreciable change in heart rate and blood pressure (Table IV).

TABLE IV: Bilater vasotomy.

Measurement	*Effect of destension of left atrial appendage* (15 *dogs*)			*Effect of destension of right atrial appendage* (15 *dogs*)			*Simultaneous destension of both atrial appendages* (5 *dogs*)		
	Control	*During distension*	*t-value*	*Control*	*During distension*	*t-value*	*Control*	*During distension*	*t-value*
Heart rate (per min)	160±18.7	156±18.6	0.55 (not significant)	156±18.7	154±20.9	0.76 (not significant)	162±21.5	162±16.6	0.0 (not significent)
Blood pressure (mm of Hg)	120±30.0	115±28.3	0.45 (not significant)	115±28.3	120±30.0	0.42 (not significant)	126±28.1	124±-2.1	0.62 (not significant)

DISCUSSION

Present observations show that distension of left atrial appendage with 5 and 10 *ml* normal saline respectively register an increase in heart rate which is statistically significant ($P<0.05$, Table I). However, no appreciable change was noted in blood pressure. These findings are in conformity with earlier author (10), who reported an increase in heart rate after distending left atrial appendage with 3 to 7 *ml* normal saline. Floyd *et al.* (6) observed a reflex increase in heart rate following distension of left atrial appendage and attributed this increase to complex unencapusultated nerve endings in atrial receptors. They were however, of the opinion that the end net may form part of the receptor system involved in this reflex. In case of distension of right atrial appendage with 5 *ml* normal saline, an increase in heart rate was observed (Table I). However, this response was found to be of higher magnitude with 10 *ml* normal saline distension (Fig. 2). No appreciable difference was found between right and left atrial appendage distension with 5 *ml* normal saline. The response was found to be of higher magnitude in case of 10 *ml* distension in right atrial distension as compared to left one (Fig. 1 and 2). This could be attributed due to the fact that right side of the heart is concerned mainly with the inflow of blood and hence needs a better sensing mechanism to register even slight variations in blood volume. This variation appears to be essential to a great extent to fulfil the physiological need of the body. These findings are in agreement with Kappagoda *et al.* (10), who reported smaller response with left atrial appendage as compared to right atrial appendage which was similar in magnitude on distending the junction between superior vena cava and right atrium.

Simultaneous distension of both atrial appendages with 5 and 10 *ml* normal saline registers a statistically significant increase in heart rate ($P<0.005$, $P<0.005$, Table II) respectively. These observations are also in full accord with Kappagoda *et al.* (10).

No appreciable change was noted in blood pressure on distension of left and right atrial appendages either separately or simultaneously (Tables I and II). These findings are in conformity with those reported by Kappagoda *et al.* (10). They failed to find any correlation between changes in heart rate and blood pressure. These findings also get support from earlier authors (7 and 8),

who also did not find any co-relation between blood pressure and heart rate by distending the junction between superior vena cava and right atrium. On the contrary, Ledsome and Lindon (15) reported an increase in heart rate with an increase in blood pressure on distension of pulmonary vein and left atrial junction.

In the present study, it has been found that right vagotomy abolishes the response to right atrial appendage distension; whereas slight increase in heart rate was found on distension of left atrial appendage after right vagotomy (Table III). The left vagotomy reduces the response to distension of right atrial appendage on heart rate which is statistically insignificant. The response to distension of left atrial appendage was totally abolished (Table III). These observations are in conformity with those of Kappagoda *et al.* (10).

No appreciable change was noticed in the heart rate after bilateral vagotomy by distending atrial appendages separately or simultaneously (Table IV). This suggests that afferent or efferent or both pathways are present in vagus nerve and the response is reflex in nature. It is aknown fact that simple increase in heart rate over the normal range of function results in decrease in both diastolic and stroke volume (15). Therefore it is possible to speculate that the importance of the reflex may be to represent one of the mechanism which regulates the size of the heart within very narrow limits. It is therefore suggested that reflex is responsible for the increased heart rate in response to increased rate of flow into atrium during ventricular systole, which maintains the volume of heart relatively constant during the increased venous return.

CONCLUSIONS

Distension of either appendages invariably evoked tachycardia without any appreciable change in blood pressure. Increase in heart rate was found to be of same magnitude with 5 *ml* normal saline distension in both the appendages; whereas the response was more marked in right atrial appendage as compared to left one with 10 *ml* normal saline distension. This shows a difference in the physiological role of receptors on two sides. Increase in extent of distension, causes more significant response, the receptors of which are stimulated by distension which may be allied to stretch receptors. It is contended that tachycardia may be due to reflex effect which is abolished by vagotomy. It is further contended that afferent, efferent or both pathways exist in vagi.

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