# SUMMARY AND CONCLUSIONS

## Chapter - I.

In this chapter literatures in relation to morphological, biochemical and functional changes in heart during hypothermia have been extensively reviewed. The chapter begins with an explanation of the term hypothermia as has been used in the thesis work together with the concepts of various other workers. The present review includes cardiac metabolism in cold, electrolytes and hypothermic heart, electrocardiographic changes and cardiac arrhythmias etc. bringing out clearly the object of the present thesis work.

## Chapter - II.

The chapter deals with general materials and methods used in the present thesis work. It begins with a short review of the technique of induced hypothermia, the merit of the surface cooling method. The chapter also deals with the question of anaesthesia during hypothermia. This is followed by the actual materials used and the methods followed including recording of blood pressure electrocardiogram and induction of hypothermia.

The efficacy of nembutal as an anaesthetic and the method of measuring body temperature have been discussed in detail.

Chapter - III.

The chapter deals with cardiovascular changes during hypothermia including blood pressure, heart rate, myocardial blood flow and electrocardiographic changes. Each has been presented in a separate section embodying the technique, the results of experiments in detail. Each section also includes a short comment on the results obtained.

Chapter - IV.

The effects of oxygen on the electrocardiographic changes during hypothermia have been presented in this chapter. The reason for such study have been clearly mentioned together with materials, methods and results. The observations made have been critically discussed with those of others.

Chapter - V.

This chapter deals with some antiarrhythmia drugs on the electrocardiographic changes during hypothermia. The results have been critically discussed in relation to their

known pharmacological effects and those observed by others while preventing cardiac arrhythmias during cold.

Chapter - VI.

The effects of cations viz., potassium and calcium on the electrocardiographic changes during hypothermia have been presented in this chapter. The chapter embodies the methods, materials used and the results after stating the object of the work in short. The chapter ends with a brief comment on the results obtained in relation to the known effects of these cations at normal body temperature and the results obtained by others.

Chapter - VII.

This chapter deals with effects of adenosine triphosphate and some intermediary products of Kreb's cycle on the electrocardiographic changes d produced during hypothermia. The chapter begings after stating the object of work in short and describes in detail the technique and the results obtained. The chapter ends with a brief comment on the results obtained and those of others while attempting to reverse cardiac arrhythmias during cold.

Chapter - VIII.

The effects of thyroid hormone on heart rate, blood pressure and electrocardiographic changes during hypothermia have been presented in this chapter. The chapter begins with the object of the present work in short and presents in detail the methods, materials and the results obtained. There is a brief comment at the end of the chapter on the results obtained.

Chapter - IX.

This chapter deals with the studies on the function of thyroid gland during hypothermia using radio-active iodine. After stating its object the chapter presents in detail the methods and materials used and the results obtained. There is a brief comment at the end of the chapter with an analysis of the results of work done by others.

Chapter - X.

The chapter embodies a critical discussion of the various results obtained during the study of those aspects of derangements of cardiac function as are related to

cardiac arrhythmias. The basis of the above discussion being the effects of hypothermia on heart rate, systemic arterial pressure, myocardial blood flow and electrocardiographic studies. Statistical analysis have been made whenever and wherever necessary in the above discussion to arrive at a rational conclusion. The works of contemporary workers have also been critically reviewed in the present discussion.

The most common cause of ventricular fibrillation has been mentioned andthe various postulates put forward so far in an attempt to explain the occurence of ventricular fibrillation in hypothermia have been critically considered one after another bringing out clearly hypoxia as the plausible cause of ventricular fibrillation during hypothermia. A number of evidences have been advanced in support of presence of myocardial hypoxia during hypothermia confirmed eloquently by the results of present investigation wherever possible. It has been argued clearly that hypothermia does not result in descrepancy between myocardial oxygen demand and supply but that it alters myocardial cellular function in such a manner that the cell is unable to utilize the available oxygen such that the metabolic demands of the myocardium are unsatisfied with the usual oxidative process.

The chapter also embodies the essentiality of the thyroid hormone in survival. in cold with numerous references from the literature. The cardiac anabolic effect of the thyroid hormone in contrast to its catabolic effect on other tissues have been clearly indicated. The direct effects of thyroid hormone particularly of triiodothyronine on heart as reported by number of workers have been clearly summarized as having an alround effect on cardiac function viz., on its conduction mechanism, its metabolism and protein synthesis . Such effects of thyroid hromone on heart results in a number of functional changes as has been clearly demonstrated in the present thesis work has been critically discussed in the light of above observations. paripasu the results of the study on thyroid functions in the animals during cold had been of much interest and has enriched the discussion to large extent. Lastly the mechanism of ventricular fibrillation based on the results of the present thesis work and in the light of the work done so far have been presented with a critical discussion pointing out clearly the scope of further work in the field.

## Table - I

Shows changes in the heart rate and Blood Pressure during Hypothermia.

| Cat No., Weight & Sex. | Temp. °C. | Heart rate per minute. | Blood pressure mm.Hg. |
|---|---|---|---|
| 1 | 36 | 166 | 114 |
| 2.5 Kg. | 34 | 166 | 110 |
| F | 28 | 115 | 94 |
| | 26 | 65 | 91 |
| | 24 | 39 | 84 |
| 2 | 37 | 188 | 92 |
| 2.5 Kg. | 34 | 166 | 99 |
| M | 30 | 156 | 92 |
| | 28 | 115 | 81 |
| | 26 | 70 | 38 |
| | 24.4 | 46 | 15 |
| | 24.2 | 46 | 10 |
| 3 | 36.6 | 166 | 90 |
| 2.00 Kg. | 36 | 166 | 80 |
| F | 30 | 156 | 66 |
| | 28.5 | 105 | 60 |
| | 26.5 | 75 | 47 |
| | 25 | 56 | 23 |
| | 24.4 | 46 | 33 |
| | 23.7 | 39 | 28 |
| 4 | 36 | 188 | 84 |
| 2.5 Kg. | 32 | 166 | 80 |
| M | 28 | 115 | 76 |
| | 26 | 75 | 66 |
| | 24 | 39 | 52 |
| | 23 | 35 | 40 |
| | 22.5 | 30 | 38 |

Table - II

Shows the percentage uptake of radioactive rubidium by the praecordium at normal body temperature and during hypothermia.

| Cat No., Weight & Sex. | Back ground (cpm) | Praecordial count ( cpm ) | Net praecordial count ( cpm ) | Phantom count ( cpm ) | Net phantom count ( cpm ) | Percent praecorcial uptake |
|---|---|---|---|---|---|---|
| **AT NORMAL BODY TEMPERATURE ( 36°C )** | | | | | | |
| 1,2 Kg. | 8 | 48.89 | 40.89 | 368 | 360 | 11.36 |
| 2,3 Kg.M. | 10.2 | 61.96 | 51.76 | 270.2 | 260 | 19.91 |
| 3,2.5 Kg.M. | 6 | 52.11 | 46.11 | 306 | 300 | 15.37 |
| 4,3 Kg.M. | 12 | 33.69 | 21.69 | 332 | 320 | 6.78 |
| 5,2.5Kg.F. | 8 | 54.90 | 46.90 | 358 | 350 | 13.40 |
| 6,3.5Kg. M. | 8.5 | 43.27 | 34.77 | 418.5 | 410 | 8.48 |
| 7,2 Kg. F. | 10 | 50.92 | 40.92 | 375 | 365 | 11.21 |
| 8,3.5Kg.M. | 6.5 | 34.37 | 27.87 | 266.5 | 320 | 8.71 |
| 9,2.5Kg.F. | 6 | 24.8 | 18.8 | 330 | 324 | 5.78 |
| | | | | | | Mean ± S.D. 11.22±4.52 |
| **DURING HYPOTHERMIA ( 26°C )** | | | | | | |
| 1,2.5Kg.F. | 10.0 | 36.5 | 26.5 | 370.6 | 360.6 | 7.3 |
| 2,2.5Kg.F. | 15.2 | 34.6 | 19.4 | 261.8 | 246.6 | 7.8 |
| 3,3.5Kg.M. | 5.6 | 24.8 | 19.2 | 327.4 | 321.8 | 5.9 |
| 4,3. Kg.F. | 6.0 | 22.4 | 16.4 | 328.4 | 322.4 | 5.08 |
| 5,3. Kg.M. | 6.0 | 22.0 | 16.0 | 326.0 | 320.6 | 5.0 |
| | | | | | | Mean±S.D. 6.216±1.624 |

$t = 2.99$

$p < .02 \simeq .01$

## Table - III

Shows the changes in heart rate and different parameters of the electrocardiogram at 36°C.

| Cat No., Weight(Kg.), Sex | Temp. °C. | Heart rate/ min. | P - R interval. (secs) | Obsrd. Q-T interval. (sec.) | P - Q segment (sec.) | S - T interval (sec.) | T - P interval (sec.) | QRS duration (sec) | VAT (sec) | 'J' (Height mm.) | P (Height mm.) | QRS in | T (Nature) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,2.5, F. | 36 | 166 | 0.08 | 0.3 | 0.06 | 0.16 | 0.08 | 0.08 | 0.04 | - | 2 | 6 | Upright |
| 2,2.0, M. | 36 | 188 | 0.08 | 0.24 | 0.04 | 0.08 | 0.04 | 0.04 | 0.04 | - | 2 | 6 | Upright |
| 3,3.0, M. | 36 | 166 | 0.10 | 0.20 | 0.04 | 0.12 | 0.12 | 0.04 | 0.04 | - | 2 | 7 | Upright |
| 4,2.0, M. | 36 | 166 | 0.08 | 0.16 | 0.04 | 0.12 | 0.12 | 0.08 | 0.04 | - | 8 | 32 | Inverted |
| 5,2.5, F. | 36 | 188 | 0.04 | 0.20 | 0.04 | 0.04 | 0.08 | 0.04 | - | - | 2 | 6 | Upright |
| 6,2.5, F. | 36 | 150 | 0.08 | 0.24 | 0.04 | 0.12 | 0.12 | 0.04 | 0.04 | - | 1 | 4 | Upright |
| 7,3.0, M. | 36 | 125 | 0.04 | 0.24 | 0.04 | 0.04 | 0.16 | 0.08 | 0.04 | - | 2 | 13 | Upright |
| 8,3.0, M. | 36 | 166 | 0.08 | 0.12 | 0.04 | 0.12 | 0.08 | 0.04 | 0.04 | - | 1.5 | 3.0 | Upright |
| 9,2.0, F. | 36 | 166 | 0.04 | 0.20 | 0.04 | 0.04 | 0.12 | 0.04 | 0.04 | - | 1.5 | 5.0 | Upright |
| 10,2.5, M. | 36 | 136 | 0.08 | 0.20 | 0.04 | 0.04 | 0.16 | 0.04 | 0.04 | - | 1.5 | 4.0 | Upright |
| M E A N | | 162 | 0.07 | 0.21 | 0.04 | 0.09 | 0.18 | 0.05 | 0.04 | | | | |
| | | | | A T | 32°C. | | | | | | | | |
| 1,2.5, F. | 32 | 166 | 0.08 | 0.36 | 0.04 | 0.08 | 0.04 | 0.12 | 0.04 | - | 2 | 7 | Upright |
| 2,2.0, M. | 32 | 188 | 0.08 | 0.30 | 0.04 | 0.12 | 0.04 | 0.10 | 0.04 | - | 2 | 6.5 | Upright |
| 3,3.0, M. | 32 | 100 | 0.08 | 0.56 | 0.04 | 0.20 | 0.12 | 0.12 | 0.06 | 5 | 4 | 18 | Inverted |
| 4,2.0, M. | 32 | 115 | 0.08 | 0.52 | 0.04 | 0.20 | 0.04 | 0.10 | 0.04 | - | 8 | 30 | Inverted |
| 5,2.5, F. | 32 | | | n o t | | r e c o r d e d | | | | | | | |
| 6,2.5, F. | 32 | 107 | 0.08 | 0.48 | 0.04 | 0.08 | 0.08 | 0.08 | 0.04 | - | 3 | 12 | Upright |
| 7,3.0, M. | 32 | | | n o t | | r e c o r d e d | | | | | | | |
| 8,3.0, M. | 32 | 125 | 0.04 | 0.44 | 0.04 | 0.08 | 0.04 | 0.10 | 0.04 | 2.5 | 2 | 6 | Upright |
| 9,2.0, F. | 32 | 150 | 0.08 | 0.36 | 0.04 | 0.16 | 0.04 | 0.08 | 0.04 | - | 1.5 | 3.5 | Upright |
| 10,2.5, M. | 32 | 126 | 0.08 | 0.48 | 0.04 | 0.16 | 0.08 | 0.08 | 0.04 | - | 4 | 10 | Upright |
| M E A N | | 134.5 | 0.08 | 0.437 | 0.04 | 0.135 | 0.06 | 0.098 | 0.042 | | | | |

Contd....

Table - III ( Contd ).

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | A T 28°C. | | | | | | | | |
| 1,2.5, F. | 28 | 115 | 0.12 | 0.44 | 0.04 | 0.16 | 0.16 | 0.12 | 0.04 | 3 | 2 | 5 | Upright |
| 2,2.0, M. | 28 | 75 | 0.12 | 0.68 | 0.08 | 0.30 | 0.20 | 0.12 | 0.04 | - | 2 | 11 | Upright |
| 3,3.0, M. | 28 | 71 | 0.12 | 0.72 | 0.08 | 0.24 | 0.24 | 0.12 | 0.06 | 8.5 | 5 | 25 | Inverted |
| 4,2.0, F. | 28 | 71 | 0.12 | 0.76 | 0.08 | 0.36 | 0.28 | 0.12 | 0.06 | - | 8 | 26 | Inverted |
| 5,2.5, F. | 28 | 57 | 0.12 | 0.92 | 0.08 | 0.32 | 0.34 | 0.08 | 0.04 | 3 | 3 | 12 | Upright |
| 6,2.5, F. | 28 | | | n o t | r e c o r d e d | | | | | | | | |
| 7,3.0, M. | 28 | 107 | 0.12 | 0.48 | 0.04 | 0.16 | 0.20 | 0.08 | 0.04 | 2 | 2 | 11 | Upright |
| 8,3.0, M. | 28 | 75 | 0.12 | 0.48 | 0.08 | 0.28 | 0.16 | 0.12 | 0.04 | 1.5 | 2 | 7.5 | Inverted |
| 9,2.0, F. | 28 | 125 | 0.08 | 0.40 | 0.04 | 0.16 | 0.12 | 0.12 | 0.06 | 2 | 2 | 5.0 | Upright |
| 10,2.5, M. | 28 | 100 | 0.12 | 0.56 | 0.04 | 0.12 | 0.16 | 0.08 | 0.04 | 2 | 3 | 7 | Upright |
| M E A N | | 88.4 | 0.12 | 0.64 | 0.06 | 0.23 | 0.20 | 0.106 | 0.046 | | | | |
| | | | | | A T 26°C. | | | | | | | | |
| 1,2.5, F. | 26 | 100 | 0.12 | 0.52 | 0.04 | 0.12 | 0.12 | 0.14 | 0.06 | 5 | 2 | 5 | Biphasic |
| 2,2.0, M. | 26 | 75 | 0.12 | 0.68 | 0.08 | 0.24 | 0.20 | 0.12 | 0.06 | 2.5 | 2 | 2 | Upright |
| 3,3.0, M. | 26 | 44 | 0.20 | 0.72 | 0.14 | 0.24 | 0.44 | 0.16 | 0.06 | 10 | 4 | 22 | Upright |
| 4,2.0, M. | 26 | 60 | 0.12 | 0.52 | 0.08 | 0.36 | 0.40 | 0.12 | 0.06 | - | 3 | 12 | Inverted |
| 5,2.5, F. | 26 | 48 | 0.14 | 1.00 | 0.10 | 0.52 | 0.20 | 0.10 | 0.06 | 4.5 | 4 | 18 | Flat |
| 6,2.5, F. | 26 | 65 | 0.12 | 0.64 | 0.08 | 0.40 | 0.16 | 0.12 | 0.04 | 5.5 | 4 | 22 | Flat |
| 7,3.0, M. | 26 | 71 | 0.12 | 0.48 | 0.08 | 0.28 | 0.34 | 0.12 | 0.06 | 8 | 5.5 | 20 | Upright |
| 8,3.0, M. | 26 | 83 | 0.12 | 0.52 | 0.08 | 0.24 | 0.16 | 0.14 | 0.06 | 3 | 3 | 8 | Inverted |
| 9,2.0, F. | 26 | 107 | 0.12 | 0.40 | 0.04 | 0.20 | 0.14 | 0.14 | 0.04 | 2 | 2 | 6.5 | Upright |
| 10,2.5, M. | 26 | 88 | 0.12 | 0.40 | 0.04 | 0.28 | 0.20 | 0.12 | 0.04 | - | 5.5 | 9 | Inverted |
| M E A N | | 74.1 | 0.13 | 0.538 | 0.076 | 0.288 | 0.236 | 0.128 | 0.054 | | | | |
| | | | | | A T 24°C. | | | | | | | | |
| 1,2.5, F. | 24 | 39 | 0.16 | 0.76 | 0.1 | 0.40 | 0.64 | 0.14 | 0.06 | 10 | 4.5 | 16 | Inverted |
| 2,2.0, M. | 24 | 27 | 0.16 | 0.64 | 0.1 | 0.36 | 1.44 | 0.16 | 0.06 | - | 2 | 6 | Upright |
| 3,3.0, M. | 24 | | | N o t | r e c o r d e d | | | | | | | | |
| 4,2.0, M. | 24 | 37 | 0.16 | 0.88 | 0.1 | 0.56 | 0.56 | 0.12 | 0.08 | - | 4 | 12 | Inverted |
| 5,2.5, F. | 24 | 46 | 0.14 | 0.96 | 0.1 | 0.40 | 0.56 | 0.12 | 0.08 | 4 | 4 | 17 | Inverted |
| 6,2.5, F. | 24 | | | N o t | r e c o r d e d | | | | | | | | |
| 7,3.0, M. | 24 | 46 | 0.12 | 0.56 | 0.08 | 0.27 | 0.36 | 0.14 | 0.06 | 7.5 | 6 | 28 | Upright |
| 8,3.0, M. | 24 | | | N o t | r e c o r d e d | | | | | | | | |
| 9,2.0, F. | 24 | 48 | 0.12 | 0.44 | 0.08 | 0.20 | 0.24 | 0.16 | 0.06 | 3 | 2 | 7.5 | Upright |
| 10,2.5, M. | 24 | 39 | 0.16 | 0.72 | 0.1 | 0.48 | 0.64 | 0.16 | 0.06 | 2 | 2 | 5 | Inverted |
| M E A N | | 40.2 | 0.145 | 0.708 | 0.094 | 0.38 | 0.63 | 0.14 | 0.065 | | | | |

Table - IV

Shows the correlation co-efficients between temperature and different parameters of the electrocardiogram in an individual cat with their significance.

| Cat No., Weight(Kg) & Sex. | Relationship between | Correlation coefficient ( r ) | Level of signifi-cance(p) |
|---|---|---|---|
| 1,2.5, F. | Temperature & QRS duration | -0.94 | $< .01$ |
| | Temperature & observed Q-T interval | -0.90 | $< .02$ |
| | Temperature & P-R interval | -0.91 | $\simeq .01$ |
| | Temperature & P-Q segment | -0.35 | $> 0.1$ |
| | Temperature & S-T interval | -0.93 | $< 0.01$ |
| | Temperature & T-P interval | -0.69 | $< 0.1$ |
| | Temperature & VAT | -0.79 | $< 0.05$ |
| | Temperature & Heart Rate | +0.92 | $\simeq .01$ |

Table - V

Shows the correlation co-efficients between height of Osborn wave ('J') and different parameters of the electrocardiogram in an individual cat with their significance.

| Cat No., Weight(Kg) & Sex. | Relationship between | Correlation coefficient (r) | Level of significance(p) |
|---|---|---|---|
| 3, 2.0, M. | 'J' & QRS duration | +0.62 | $> 0.1$ |
| | 'J' & observed QT interval | +0.96 | $< 0.05$ |
| | 'J' & S-T interval | +0.95 | $= 0.05$ |
| | 'J' & VAT | very low | |

## Table - VI

Shows the effect of oxygen on the elctrocardiographic changes during hypothermia

| Cat No., Weight(Kg) & Sex. | Temperature in °C | Heart Rate/ min. | P - R interval (Sec) | Obsrvd. Q-T interval ( sec) | S - T interval (sec) | QRS duration (sec) | VAT (sec) | 'J' (ht. in mm.) | T wave (Nature) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 37 | 166 | 0.08 | 0.24 | 0.10 | 0.04 | 0.04 | - | T wave which was upright at 30°C gradually became inverted at 28°C & with administration of $O_2$ it became flat. |
| 2.5 | 30 | 88 | 0.08 | 0.32 | 0.24 | 0.04 | 0.04 | - | |
| F | 28 | 60 | 0.12 | 0.50 | 0.36 | 0.04 | 0.04 | 1.5 | |
| | $27+O_2$ | 53 | 0.12 | 0.40 | 0.40 | 0.06 | 0.04 | 1.5 | |
| | $28+O_2$ | 60 | 0.12 | 0.40 | 0.40 | 0.06 | 0.04 | 1.5 | |
| 2 | 38 | 250 | 0.12 | 0.20 | 0.08 | 0.04 | 0.04 | - | T wave which was upright at 38°C became flat at 31°C & remained so upto 26°C. Following administration of $O_2$ it became upright with an increase in amplitude than that observed at 38°C. |
| 2.0 | 29 | 187 | 0.12 | 0.30 | 0.20 | 0.04 | 0.04 | - | |
| F | 26 | 136 | 0.12 | 0.24 | 0.24 | 0.04 | 0.04 | 3 | |
| | $26+O_2$ | 136 | 0.08 | 0.32 | 0.16 | 0.04 | 0.04 | 2.5 | |
| 3 | 35 | 250 | 0.04 | 0.20 | 0.08 | 0.04 | 0.04 | - | T wave which was upright at 35°C became almost flat at 30.5°C & inverted at 27.6°C and remained so till 27°C. But following administration of $O_2$ it became upright at 27°C. |
| 3.0 | 29 | 185 | 0.08 | 0.24 | 0.10 | 0.04 | 0.04 | - | |
| M | 27 | 100 | 0.08 | 0.40 | 0.28 | 0.04 | 0.04 | 3 | |
| | $27+O_2$ | 100 | 0.08 | 0.28 | 0.20 | 0.04 | 0.04 | 3 | |

Table - VII

Shows the percentage saturation of oxygen in blood in normal and during hypothermia, & following oxygen administration.

| Cat No., Weight(Kg) & Sex. | Percent saturation of oxygen in blood. | | |
|---|---|---|---|
| | Normal (37°C) | During Hypothermia ( 27°C ) | Following admin. of oxygen. |
| 1,2.5, F. | 90 | 84 | 93.5 |
| 2,2.0, F. | 85 | 60 | 90.0 |
| 3,2.5, M. | 84 | 72 | 92.5 |
| 4,2.0, M. | 90 | 82 | 94.5 |
| Meand ± S.D. | 87.3 ± 3.2 | 74.5 ± 11.0 | 92.6 ± 2.0 |
| | | t = 2.99 ; p < 0.05 | |

## Table - VIII

Shows the effect of xylocaine on the electrocardiographic changes during Hypothermia

| Cat No., Weight(Kg) & Sex. | Temp. °C. | Heart Rate/ min. | P - R interval (sec) | Obsrvd. Q-T interval ( sec) | S - T interval (sec) | QRS duration * (sec) | VAT (sec ) | 'J' (ht. in mm) | T wave ( Nature ) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 32 | 150 | 0.08 | 0.30 | 0.16 | 0.04 | 0.04 | - | Upright at normal body |
| 2.5 | 28 | 100 | 0.10 | 0.48 | 0.32 | 0.04 | 0.04 | 3.0 | temp. became biphasic at 29°C and inverted |
| M | 27 | 75 | 0.10 | 0.52 | 0.36 | 0.04 | 0.06 | 6.5 | at 27.5°C & remained |
| | 27 (xylocaine) | 75 | 0.12 | 0.56 | 0.40 | 0.04 | 0.06 | 6.5 | so even after the administration of the |
| | 26.5 (After 45 mins) | 60 | 0.12 | 0.64 | 0.40 | 0.04 | 0.06 | 6.5 | drug. |
| 2 | 35 | 214 | 0.06 | 0.20 | 0.12 | 0.04 | 0.04 | - | Upright at normal body |
| 2.0 F | 32 | 166 | 0.08 | 0.30 | 0.16 | 0.04 | 0.04 | - | temp.(35°C) became flat |
| | 28.5 | 100 | 0.12 | 0.40 | 0.28 | 0.04 | 0.04 | 2.5 | at 29.5°C and inverted |
| | 28.5 (xylocaine) | 100 | 0.12 | 0.48 | 0.28 | 0.04 | 0.04 | 2.5 | at 27°C remained so even after the administration of the drug. |
| | 28 | 93 | 0.12 | 0.48 | 0.32 | 0.04 | 0.06 | 4.0 | |
| | 27 | 75 | 0.12 | 0.56 | 0.40 | 0.04 | 0.06 | 5.0 | |
| | 26.5 | 57 | 0.16 | 0.60 | 0.40 | 0.06 | 0.06 | 5.0 | |

* The qRs complex changed to qrS each time the drug was administered.

Table - IX

Shows the effect of neostigmine on the electrocardiographic changes during Hypothermia

| Cat No., weight(Kg) & Sex. | Temp. $^{o}C$ | Heart Rate/ min. | P- R interval (sec) | Obsrvd. Q-T interval ( sec) | QRS duration (sec) | VAT (sec) | 'J' (ht. in mm) | S - T interval (sec) | T wave ( Nature ) |
|---|---|---|---|---|---|---|---|---|---|
| 1 2.0 F | 31 | 100 | 0.12 | 0.36 | 0.04 | 0.04 | 3 | 0.16 | Upright at normal body temp. became flat at 29°C & remained so even after administration of the drug. Ultimately the cat died due to asystole. |
| | 25 (neostigmine) | 60 | 0.12 | 0.32 | 0.04 | 0.04 | 3 | 0.32 | |
| | 25 | 15 | 0.12 | 0.36 | 0.04 | 0.04 | 2.5 | 0.28 | |
| 2 3.0 M | 37 | 166 | 0.04 | 0.24 | 0.04 | 0.04 | - | 0.12 | Upright at normal body temp. became flat at 29°C, remained so even after the administration of the drug. The T wave became inverted and the cat ultimately died due to extreme slowing of the heart and ventricular ectopics. |
| | 29 | 93 | 0.08 | 0.40 | 0.04 | 0.04 | 2 | 0.28 | |
| | 29 (neostigmine) | 100 | 0.08 | 0.48 | 0.04 | 0.04 | 2 | 0.24 | |
| | 27 (after 45 mins) | 69 | 0.10 | 0.48 | 0.04 | 0.04 | 2 | 0.20 | |

## Table - X A

Shows the effect of potassium ion on the electrocardiographic changes during Hypothermia

| Cat No., Weight(Kg) & Sex. | Temp. $^{o}C$ | Heart Rate/ min. | P - R interval (sec). | Obsrvd. Q-T interval ( sec) | S - T interval (sec) | QRS Duration. (sec) | VAT ( sec ) | 'J' (ht. in mm) | T (ht. in mm) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 23 | 44 | 0.12 | 0.64 | 0.40 | 0.04 | 0.04 | 7 | -2 |
| 3.0 Kg M | 23 (KCl) | 44 | 0.12 | 0.60 | 0.40 | 0.04 | 0.04 | 7 | -2 |
| | 22 | 42 | 0.12 | 0.60 | 0.48 | 0.04 | 0.04 | 7 | -2 |
| | 21.5 | 42 | 0.14 | 0.68 | 0.48 | 0.04 | 0.04 | 7.5 | -2 |
| 2 | 28 | 107 | 0.12 | 0.40 | 0.40 | 0.08 | 0.04 | 6 | -1 |
| 2.0 Kg F | 27.8 ( KCl after | 106 30 mins.) | 0.12 | 0.40 | 0.40 | 0.08 | 0.04 | 6 | -1 |

Table - X B

Shows the effect of calcium ion on the elctrocardiographic changes during Hypothermia

| Cat No., Weight(Kg) & Sex. | Temp. $^{o}C$ | Heart Rate/ min. | P - R interval (sec.) | Obsrvd. Q - T interval(sec) | S - T interval (sec ) | QRS Duration (sec) | VAT (sec ) | 'J' (ht. in mm) | T ( ht. in mm) |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 26.3 | 100 | 0.12 | 0.40 | 0.28 | 0.04 | 0.04 | 8.5 | -2 |
| 2.5 F | 26.3 ($CaCl_2$) | 75 | 0.12 | 0.48 | 0.20 | 0.06 | 0.04 | 10.5 | -6 |
| | 26 | 75 | 0.12 | 0.48 | 0.16 | 0.06 | 0.04 | 10.0 | -5 |
| | 25.5 | 75 | 0.12 | 0.50 | 0.16 | 0.04 | 0.04 | 10.0 | -11 |
| | 25 | 68 | 0.12 | 0.48 | 0.12 | 0.04 | 0.04 | 5.5 | -13 |
| | 24 | 53 | 0.12 | 0.48 | 0.08 | 0.04 | 0.04 | 2.0 | -9 |

Table - XI A

Shows the effect of sodium succinate on the electrocardiographic changes during Hypothermia.

| Cat No., Weight(Kg) & Sex. | Temp. $^{o}C$ | Heart Rate/ min. | P - R interval (sec) | Obsrvd. Q - T interval (sec) | S - T interval ( sec ) | QRS Duration (sec) | VAT (sec) | 'J' (ht. in mm) | T ( ht. in mm). |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 36 | 166 | 0.10 | 0.20 | 0.12 | 0.04 | 0.04 | - | 4 |
| 3.0 | 28 | 71 | 0.12 | 0.60 | 0.36 | 0.08 | 0.06 | 8.5 | -5 |
| M | 28 (succinate) | 71 | 0.14 | 0.52 | 0.32 | 0.08 | 0.06 | 8.5 | -5 |
| | 27.2 | 65 | 0.14 | 0.52 | 0.32 | 0.08 | 0.06 | 8.5 | -5.5 |
| | 27.5 | 68 | 0.12 | 0.48 | 0.32 | 0.06 | 0.04 | 8.5 | -5 |
| 2 | 36 | 166 | 0.08 | 0.16 | 0.12 | 0.04 | 0.04 | - | -1 |
| 2.0 | 25 | 45 | 0.12 | 0.72 | 0.48 | 0.06 | 0.06 | 2 | -3 |
| M | 24 | 37 | 0.16 | 0.88 | 0.56 | 0.08 | 0.06 | 2 | -5 |
| | 24 (succinate after 30 mins.) | 37 | 0.16 | 0.92 | 0.52 | 0.08 | 0.06 | 5 | -3.5 |

Table - XI B

Shows the effect of ATP on the electrocardiographic changes during Hypothermia

| Cat No., Weight(Kg) & Sex. | Temp. $^{o}C$ | Heart Rate/ min. | P - R interval ( sec ) | Obsrvd. Q - T interval (sec) | S - T interval (sec) | QRS Duration (sec) | VAT (sec) | 'J' (ht. in mm) | T ( ht. in mm). |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 36 | 166 | 0.10 | 0.20 | 0.12 | 0.04 | 0.04 | - | 14 |
| 3.0 | 28 | 71 | 0.12 | 0.60 | 0.36 | 0.08 | 0.04 | 8.5 | -5 |
| M | 27.5 | 68 | 0.12 | 0.48 | 0.32 | 0.06 | 0.04 | 8.5 | -5 |
| | 25.5(ATP) | 50 | 0.16 | 0.64 | 0.16 | 0.04 | 0.04 | 11.0 | -7.5 |
| | 25.2 | 46 | 0.16 | 0.68 | 0.36 | 0.04 | 0.04 | 10.0 | -5 |
| | 25 | 46 | 0.16 | 0.64 | 0.40 | 0.04 | 0.04 | 8.0 | -6 |
| 2 | 35.5 | 187 | 0.08 | 0.16 | 0.12 | 0.04 | 0.04 | - | 1.5 |
| 2.5 | 25 | 68 | 0.12 | 0.60 | 0.48 | 0.06 | 0.06 | 3 | -3 |
| F | 24.5(ATP) | 65 | 0.12 | 0.64 | 0.48 | 0.06 | 0.06 | 3.5 | -5 |
| | 24.2 | 68 | 0.12 | 0.56 | 0.40 | 0.04 | 0.04 | 2.5 | -2.5 |
| | 24 (after 30 mins) | 68 | 0.14 | 0.56 | 0.40 | 0.04 | 0.04 | 2.5 | -3 |
| 3 | 37 | 210 | 0.08 | 0.24 | 0.08 | 0.04 | 0.04 | - | 1.5 |
| 2.5 | 24.5 | 68 | 0.14 | 0.56 | 0.34 | 0.04 | 0.06 | 3 | 3 |
| F | 24.5(ATP) | 65 | 0.14 | 0.56 | 0.32 | 0.04 | 0.06 | 3 | 3 |
| | 24 | 60 | 0.20 | 0.60 | 0.34 | 0.04 | 0.06 | 4 | 7 |
| | 23.5 | 57 | 0.20 | 0.56 | 0.40 | 0.06 | 0.06 | 2 | 2 |
| | 23.8 | 57 | 0.16 | 0.56 | 0.36 | 0.06 | 0.06 | 3 | -1.5 |

Table - XII

Shows the effect of triiodothyronine ( $T_3$) on the electrocardiographic changes during Hypothermia.

| Cat No., Weight(Kg) & Sex. | Temp. $^oC$ | Heart Rate/ min. | P - R interval (sec) | Q - T interval (sec) | S - T interval (sec) | QRS Duration (sec) | VAT (sec ) | 'J' (ht. in mm ) | T (ht. in mm). |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 36 | 188 | 0.04 | 0.20 | 0.04 | 0.04 | 0.04 | - | flat |
| 3.0 F | 27 | 57 | 0. 12 | 0.92 | 0.32 | 0.08 | 0.08 | 3.0 | - |
| | 24 | 46 | 0.14 | 0.96 | 0.40 | 0.08 | 0.08 | 4.5 | - |
| | 23($T_3$) | 46 | 0.12 | 0.88 | 0.48 | 0.04 | 0.04 | 4.2 | - |
| | 22 | 50 | 0.16 | 0.68 | 0.48 | 0.04 | 0.04 | 3.2 | - |
| | 21.5 | 46 | 0.16 | 0.76 | 0.52 | 0.04 | 0.04 | 3.4 | -2 |
| | 20.9 | 40 | 0.12 | 0.84 | 0.56 | 0.04 | 0.04 | 3.0 | -2 |
| | 20.5 | 26 | 0.12 | 0.92 | 0.68 | 0.04 | 0.04 | 3.0 | -1.5 |
| | 19.5 | 27 | 0.12 | 1.00 | 0.72 | 0.04 | 0.04 | 3.0 | -1.5 |
| | 19 | 27 | 0.12 | 1.00 | 0.74 | 0.04 | 0.04 | 3.0 | -1.5 |
| 2 | 35.5 | 187 | 0.08 | 0.24 | 0.08 | 0.04 | 0.04 | - | 1 |
| 2.0 F | 28 | 107 | 0.12 | 0.40 | 0.20 | 0.06 | 0.04 | 6.5 | -1 |
| | 28($T_3$) | 102 | 0.12 | 0.42 | 0.22 | 0.06 | 0.04 | 6.0 | -2 |
| | 27.8 | 100 | 0.12 | 0.40 | 0.20 | 0.04 | 0.04 | 5.3 | +1 |
| | 26.8 | 100 | 0.12 | 0.40 | 0.20 | 0.04 | 0.04 | 3.2 | +1 |
| | 26.5 | 107 | 0.10 | 0.36 | 0.24 | 0.04 | 0.04 | 2.5 | +1 |
| | 26.7 | 107 | 0.10 | 0.32 | 0.20 | 0.04 | 0.04 | 4.5 | +1 |
| | 26.7 | 107 | 0.08 | 0.30 | 0.20 | 0.04 | 0.04 | 4.0 | +1 |
| | 26.7 | 107 | 0.08 | 0.30 | 0.20 | 0.04 | 0.04 | 2.6 | +1 |

Table - XII ( Contd. )

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 34 | 166 | 0.10 | 0.28 | 0.08 | 0.06 | 0.04 | - | 5.5 |
| 2.0 M | 28 | 88 | 0.12 | 0.44 | 0.28 | 0.04 | 0.04 | 1.8 | -1.5 |
| | 28($T_3$) | 84 | 0.14 | 0.46 | 0.30 | 0.04 | 0.04 | 1.4 | -1.5 |
| | 27 | 83 | 0.08 | 0.40 | 0.28 | 0.04 | 0.04 | 1.5 | -0.5 |
| | 24 | 60 | 0.12 | 0.64 | 0.20 | 0.06 | 0.06 | 2.6 | -2.0 |
| | 24($T_3$) | 60 | 0.12 | 0.56 | 0.40 | 0.04 | 0.04 | 1.3 | -1.0 |
| | 24.1 | 65 | 0.12 | 0.44 | 0.36 | 0.044 | 0.04 | 2.2 | -0.5 |
| | 24.5 | 68 | 0.12 | 0.40 | 0.28 | 0.04 | 0.04 | 2.4 | +0.5 |
| 4 | 35.5 | 150 | 0.08 | 0.24 | 0.12 | 0.04 | 0.04 | - | +1.5 |
| 3.0 M | 22 | 83 | 0.12 | 0.48 | 0.24 | 0.04 | 0.06 | 3 | -1 |
| | 22($T_3$) | 85 | 0.12 | 0.44 | 0.32 | 0.04 | 0.04 | 2 | -1 |
| | 22.1 | 85 | 0.12 | 0.46 | 0.32 | 0.04 | 0.04 | 1.5 | +1 |
| | 22.2 | 85 | 0.12 | 0.46 | 0.32 | 0.04 | 0.04 | 1.5 | +1 |

Table - XIII A.

Shows the combined effect of triiodothyronine ($T_3$) with oxygen on the electrocardiographic changes during Hypothermia.

| Cat No., Weight(Kg) & Sex. | Temp. °C | Heart Rate/ min. | Obsrvd. Q - T interval (sec) | S - T interval (sec) | P - R interval (sec) | QRS duration (sec) | VAT (sec) | 'J' (ht. in mm. | T ( ht. in mm). |
|---|---|---|---|---|---|---|---|---|---|
| 1 3.0 M | 37 | 187 | 0.20 | 0.12 | 0.06 | 0.04 | 0.02 | - | +1 |
| | 29 | 115 | 0.32 | 0.20 | 0.12 | 0.04 | 0.04 | 2.5 | +2 |
| | 27 | 100 | 0.38 | 0.20 | 0.08 | 0.04 | 0.04 | 2.5 | +1 |
| | 27 ($T_3$+$O_2$) | 100 | 0.38 | 0.20 | 0.08 | 0.06 | 0.04 | 2.0 | +1 |
| | 26 | 83 | 0.40 | 0.28 | 0.10 | 0.06 | 0.04 | 4.0 | -2 |
| | 25.5 | 75 | 0.44 | 0.32 | 0.12 | 0.06 | 0.08 | 4.0 | -2 |
| | 25.4 ($T_3$ +$O_2$) | 83 | - | - | 0.10 | 0.04 | 0.06 | 2.0 | flat |
| | 25 (after 10 mins) | 78 | 0.44 | 0.28 | 0.08 | 0.04 | 0.04 | 2.0 | +1.5 |
| | 25.4 (after 1 hr.) | 100 | 0.40 | 0.28 | 0.08 | 0.04 | 0.04 | 1.5 | +2 |
| | 25.5 (after 1 hr.15 mins.) | 94 | 0.40 | 0.28 | 0.08 | 0.04 | 0.04 | 1.5 | +2 |

## Table XIII B

Shows the combined effect of triiodothyronine ($T_3$) with ATP on the electrocardiographic changes during Hypothermia.

| Cat No., Weight(Kg) & Sex. | Temp. $^oC$ | Heart Rate/ min. | P - R interval (sec) | Obsrvd. Q-T interval (sec) | S - T interval (sec) | QRS Duration (sec) | VAT ( sec ) | 'J' (ht. in mm ) | T ( ht. in mm) |
|---|---|---|---|---|---|---|---|---|---|
| 1 3.0 M | 36.5 | 187 | 0.08 | 0.20 | 0.08 | 0.06 | 0.04 | - | +2 |
| | 24 | 42 | 0.20 | 0.88 | 0.52 | 0.08 | 0.06 | 8.5 | -10 |
| | 23.5 | 41 | 0.20 | 0.92 | 0.56 | 0.08 | 0.06 | 8.5 | -10.5 |
| | 23.5 ($T_3$ +ATP) | 34 | 0.20 | 1.08 | 0.64 | 0.06 | 0.06 | 7.5 | -10 |
| | 24 | 34 | 0.20 | 0.88 | 0.60 | 0.04 | 0.04 | 5.0 | -5.5 |
| | 23.8 | 39 | 0.20 | 0.80 | 0.52 | 0.04 | 0.04 | 5.0 | -4 |
| | 24 | 40 | 0.20 | 0.72 | 0.52 | 0.04 | 0.04 | 4.5 | -2.5 |
| | 24.3 | 40 | 0.18 | 0.60 | 0.44 | 0.04 | 0.04 | 4.0 | -1.5 |

## Table - XIV

Shows the correlation coefficients with their significance between body temperature and different parameter of electrocardiogram during hypothermia following administration of triiodothyronine ($T_3$).

| | Heart Rate/ Minute | P - R interval (sec) | Observed Q - T interval ( sec ) | S - T interval (sec) | QRS duration (sec) | VAT (sec) | 'J' ( ht. in mm.) |
|---|---|---|---|---|---|---|---|
| Temperature | r= +0.02<br>p $\gg$ 0.1 | r= very low | r= +0.818<br>p $<$ 0.05 | r = +0.848<br>p $<$ 0.05 | r= very low | r = very low | r= +0.833<br>P $<$ 0.1 |

Table - XV A

Shows the percentage uptake of radioiodine and PBI(I-131) in controls ( 36°C )

| Cat No., Weight (Kg) & Sex. | PBI-48 Hour (% per litre) | 2 hour uptake ( % ) | 4 hour uptake ( % ) | 6 hour uptake ( % ) |
|---|---|---|---|---|
| 1,3.0, M | 0.38 | 15.57 | 10.64 | 11.89 |
| 2,2.5, F | 0.14 | 12.30 | 12.25 | 12.53 |
| 3,2.0, M | 0.29 | 12.48 | 13.27 | 15.60 |
| 4,3.0 F | 0.12 | 13.86 | 14.14 | 15.60 |
| 5,2.5 M | 0.30 | 13.90 | 14.64 | 15.90 |
| Mean ± S.D. | 0.246 ± 0.1118 | 13.62 ± 1.321 | 12.988 ± 1.597 | 14.304 ± 1.929 |

Table - XV B

Shows the percentage uptake of radioiodine and PBI(I-131) in Hypothermia(27°C).

| | | | | |
|---|---|---|---|---|
| 1, 2.5,M | 0.417 | 0.97 | 1.03 | 0.96 |
| 2, 2.5,F | 0.408 | 1.10 | 1.14 | 1.05 |
| 3, 2.5,M | 0.359 | 1.12 | 1.13 | 1.03 |
| 4, 2.0,F | 0.407 | - | - | - |
| Mean ± S.D. | 0.398 ± 0.0263 | 1.06 ± 0.081 | 1.10 ± 0.061 | 1.01 ± 0.047 |
| | p ∠0.05 __ 0.02 | p ∠0.001 | p ∠ 0.001 | p ∠ 0.001 |