

دراسة تأثيرات تلف النسيج الداخلي للكيتين على وظائف الكلية والجهاز الدوري في فئران التجارب

رسالة مقدمة من

الطبيب/ رمضان محمد أحمد سعد

المدرس المساعد بقسم الفسيولوجي

توطئة للحصول على درجة الدكتوراه في العلوم الطبية الأساسية
(الفسيولوجيا)

تحت إشراف

الأستاذ الدكتور/ شكري أنستي واكيم

الأستاذ بقسم الفسيولوجي

كلية الطب - جامعة عين شمس

الدكتورة/ فاتن محمود علي دياب

الأستاذ المساعد بقسم الفسيولوجي

كلية الطب - جامعة عين شمس

الدكتور/ محمد عبد العزيز عبد الحي

الأستاذ المساعد بقسم الفسيولوجي

كلية الطب - جامعة عين شمس

الدكتورة/ أمل علي سليمان

الأستاذ المساعد بقسم الهستولوجي

كلية الطب - جامعة عين شمس

الدكتورة/ سحر صبحي ثابت

المدرس بقسم الفسيولوجي

كلية الطب - جامعة عين شمس

كلية الطب

جامعة عين شمس

٢٠٠٨

The effects of damage of the renal papilla on the cardiovascular and renal functions in rats

*Thesis Submitted For Partial fulfillment of M.D. degree
in Basic Medical Science (Physiology)*

By

Ramadan Mohamed Ahmed Saad

*Assistant Lecturer in Physiology department
Faculty of Medicine-Ain Shams University*

Supervised by

Prof. Dr. Shoukri Anesty Wakim

*Professor of Physiology
Faculty of Medicine-Ain Shams University*

Dr. Faten Mahmoud Ali Diab

*Assistant Professor of Physiology
Faculty of Medicine-Ain Shams University*

Dr. Mohamed Abdel-Aziz Abdel-Hy

*Assistant Professor of Physiology
Faculty of Medicine-Ain Shams University*

Dr. Amel Ali Soliman

*Assistant Professor of Histology
Faculty of Medicine-Ain Shams University*

Dr. Sahar Sobhy Thabet

*Lecturer of Physiology
Faculty of Medicine-Ain Shams University*

Faculty of Medicine

Ain Shams University

Acknowledgement

First of all, I thank God for blessing this work as a part of his generous help throughout my life.

I would like to offer special thanks to ***Prof. Dr. Shoukri Anesty Wakim***, Head of Physiology department, Faculty of Medicine, Ain Shams University, for his great support and encouragement, from whom I received faithful supervision, helpful scientific support and assistance.

I am greatly honored to express my utmost thanks to ***Dr. Faten Mahmoud Diab***, Assistant Professor Faculty of Medicine, Ain Shams University for her great support and continuous guidance throughout this work.

I am profoundly grateful to ***Dr. Mohamed Abdel -Aziz***, Assistant Professor of Physiology, Faculty of Medicine, Ain Shams University for his expert guidance and keen supervision.

I am deeply indebted to ***Dr. Sahar Sobhy Thabet***, Lecturer of Physiology, Faculty of Medicine, Ain Shams University, for her continuous help and generous assistance throughout the whole work.

I would like to extend my thanks and appreciation to ***Dr. Amel Ali Soliman***, Assistant Professor of Histology, Faculty of Medicine, Ain Shams University, for her contribution in the histological examinations included in the present study and for the great support and effort.

I would, also, like to thank all members of the Physiology Department for their cooperation and support.

Last but not least, I would like to express my deepest gratitude to my family, who helped and supported me throughout this work.

Contents

	<i>Page</i>
Introduction	١
Aim of the work	٤
Review of Literature.....	٥
Material and Methods.....	٦٢
Results	٨١
Discussion	١٨٦
Summary and Conclusion	٢٠٠
References	٢٠٧
Appendix	٢٦٥
Arabic Summary	

LIST OF ABBREVIATIONS

α OHase	α hydroxylase
$1,25(\text{OH})_2 \text{D}_3$	$1,25$ dihydroxyvitamin D_3
$25(\text{OH})\text{D}_3$	25 -hydroxyvitamin D_3
ACE	Angiotensin converting enzyme
ADMA	Asymmetric dimethyl arginine
AGT	Angiotensinogen
AM	Adrenomodullin
Ang	Angiotensin
ANRL	Antihypertensive neutral renomedullary lipids
APRL	Antihypertensive polar renomedullary lipids
AT α	Angiotensin receptor α
AT β	Angiotensin receptor β
BEA	β -Bromoethylamine hydrobromide
BFU-E	Burst forming unit-erythroid
CAD	Coronary artery disease
CBF	Cortical blood flow
CFU-E	Colony forming unit-erythroid
CHF	Congestive heart failure
CRD	Chronic renal disease
CRF	Chronic renal failure
CVD	Cardiovascular disease
EDHF	Endothelium derived hyperpolarizing factor
EPO	Erythropoietin
ESRD	End stage renal disease
ET A	Endothelin receptor – A
ET B	Endothelin receptor – B
ET- α	Endothelin- α
ET- β	Endothelin- β
ET- γ	Endothelin- γ
GM-CSF	Granulocyte-macrophage colony-stimulating factor.
HDL	High density lipoprotein
HGF	Hepatocyte growth factor
HR	Heart rate
I.V.	Intravenous
IGF-I	Insulin like growth factor α
IL	Interleukin
LDL	Low density lipoprotein

LVH	Left ventricular hypertrophy
LVMi	Left ventricular mass index
m RNA	messenger RNA
MAP	Mean arterial pressure
MBF	Medullary blood flow
NO	Nitric oxide
NOS	Nitric oxide synthase
PCT	Proximal convoluted tubule
PEPT_v	H ⁺ coupled peptide transporter _v
PGE_v	Prostaglandin E _v
PGF_v	Prostaglandin F _v
PGH_v	Prostaglandin H _v
PGs	Prostaglandins
PRA	Plasma renin activity
PTH	Parathyroid hormone
PWV	Pulse wave velocity
RAS	Renin angiotensin system
RIA	Radioimmunoassay
RMDH	Renomedullary depressor hormone
RMICs	Renomedullary interstitial cells
RMNLs	Renal medullary neutral lipids
ROS	Reactive oxygen species
SGLT_v	Na ⁺ -coupled-Glucose transporter _v
SHR	Spontaneously hypertensive rats
TxA_v	Thromboxane A _v
TxA_v-S	Thromboxane A _v Synthase

List of tables

Number	Title	Page
Table. 1	Cumulative results of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	94
Table. 2	Cumulative results of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	95
Table. 3	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of heart rate (HR, bpm) of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control .	96
Table. 4	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of peak developed tension (PT, g) and peak developed tension per unit left ventricular mass (PT, g/100mg), of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	97
Table. 5	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of time to peak tension (TPT, msec), half relaxation time (HRT, msec) and contraction time (CT, msec) of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	98
Table. 6	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of myocardial flow rate (MFR, ml/min.) and myocardial flow rate per unit left ventricular mass (MFR, ml/min./100mg) of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	99
Table. 7	Cumulative results of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (AT), right ventricle (RV), left ventricle (LV) and whole heart (WH) of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	100
Table. 8	Cumulative results of plasma urea, creatinine and renin activity of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	101
Table. 9	Cumulative results of urine glucose, protein, specific gravity and pH of 100mg, 150mg and 200mg BEA - injected rats after 2 weeks and their matching control.	102
Table. 10	Cumulative results of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) of 100mg, 150mg and 200mg BEA - injected rats after 4 weeks and their matching control.	110
Table. 11	Cumulative results of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) of 100mg, 150mg and 200mg BEA - injected rats after 4 weeks	116

	and their matching control.	
Table. ١٢	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of heart rate (HR, bpm) of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ٦ weeks and their matching control.	١١٧
Table. ١٣	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of peak developed tension (PT, g) and peak developed tension per unit left ventricular mass (PT, g/١٠٠mg), of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ٦ weeks and their matching control.	١١٨
Table. ١٤	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of time to peak tension (TPT, msec), half relaxation time (HRT, msec) and contraction time (CT, msec) of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ٦ weeks and their matching control .	١١٩
Table. ١٥	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of myocardial flow rate (MFR, ml/ min.) and myocardial flow rate per unit left ventricular mass (MFR, ml/min./١٠٠mg) of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ٦ weeks and their matching control .	١٢٠
Table. ١٦	Cumulative results of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (AT), right ventricle (RV), left ventricle (LV) and whole heart (WH) of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ٦ weeks and their matching control.	١٢١
Table. ١٧	Cumulative results of plasma urea, creatinine and renin activity of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ٦ weeks and their matching control .	١٢٢
Table. ١٨	Cumulative results of urine glucose, protein, specific gravity and pH of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ٦ weeks and their matching control .	١٢٣
Table. ١٩	Cumulative results of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA-injected rats after ١٢ weeks and their matching control .	١٣٧
Table. ٢٠	Cumulative results of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ١٢ weeks and their matching control.	١٣٨
Table. ٢١	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of heart rate (HR, bpm) of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after ١٢ weeks and their matching control .	١٣٩
Table. ٢٢	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of peak developed tension (PT, g) and peak developed tension per unit left ventricular mass (PT, g/١٠٠mg), of ١٠٠mg, ١٥٠mg and ٢٠٠mg BEA - injected rats after	١٤٠

	12 weeks and their matching control .	
Table. 23	Cumulative result of baseline values and maximal responses to isoproterenol as well as delta changes of time to peak tension (TPT, msec), half relaxation time (HRT, msec) and contraction time (CT, msec) of 100mg, 150mg and 200mg BEA - injected rats after 12 weeks and their matching control .	141
Table. 24	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of myocardial flow rate (MFR, ml/ min.) and myocardial flow rate per unit left ventricular mass ((MFR, ml/min./100mg)) of 100mg, 150mg and 200mg BEA - injected rats after 12 weeks and their matching control	142
Table. 25	Cumulative results of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (AT), right ventricle (RV), left ventricle (LV) and whole heart (WH) of 100mg, 150mg and 200mg BEA - injected rats after 12 weeks and their matching control .	143
Table. 26	Cumulative results of plasma urea, creatinine and renin activity of 100mg, 150mg and 200mg BEA - injected rats after 12 weeks and their matching control	144
Table. 27	Cumulative results of urine glucose, protein, specific gravity and pH of 100mg, 150mg and 200mg BEA - injected rats after 12 weeks and their matching control.	145
Table. 28	Cumulative results of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) of 100mg, 150mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching control.	146
Table. 29	Cumulative results of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) of 100mg, 150mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching control.	147
Table. 30	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of heart rate (HR, bpm) of 100mg, 150mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching control.	148
Table. 31	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of peak developed tension (PT, g) and peak developed tension per unit left ventricular mass (PT, g/100mg), of 100mg, 150mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching controls.	149
Table. 32	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of time to peak tension (TPT, msec), half relaxation time (HRT, msec) and contraction time (CT, msec) of 100mg, 150mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching controls.	150
Table. 33	Cumulative results of baseline values and maximal responses to isoproterenol as well as delta changes of myocardial flow rate (MFR, ml/min.) and myocardial flow rate per unit left ventricular mass (MFR,	151

	ml/min./100mg) of 100mg, 100mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching controls .	
Table. 34	Cummulative results of body weight (BW,g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (AT), right ventricle (RV), left ventricle (LV) and whole heart (WH) of 100mg, 100mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching control.	102
Table. 35	Cumulative results of plasma urea, creatinine and renin activity of 100mg, 100mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching control.	103
Table. 36	Cumulative results of urine glucose, protein, specific gravity and pH of 100mg, 100mg and 200mg BEA - injected rats after 2, 6, 12 weeks and their matching control.	104
Table. 37	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) from 2 weeks group of control rats.	260
Table. 38	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from 2 weeks group of control rats.	266
Table. 39	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from 2 weeks group of control rats.	267
Table. 40	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from 2 weeks group of control rats.	268
Table. 41	Effect of graded isoproterenol infusion on peak developed tension per 100mg left ventricular mass (PT /LV, g. /100 mg) of hearts isolated from 2 weeks group of control rats.	269
Table. 42	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from 2 weeks group of control rats.	270
Table. 43	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from 2 weeks group of control rats.	271
Table. 44	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated from 2 weeks group of control rats.	272
Table. 45	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml / min.) of hearts isolated from 2 weeks group of control rats.	273
Table. 46	Effect of graded isoproterenol infusion on myocardial flow rate per 100mg left ventricular mass (MFR /LV, ml / min. /100 mg) of hearts isolated from 2 weeks group of control rats.	274
Table. 47	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from 2 weeks group of control rats.	275
Table. 48	Values of plasma urea, creatinine and renin activity from 2 weeks group of control rats.	276

Table. 49	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg), mean arterial blood pressure (MAP, mmHg) from 100 mg/Kg BEA - injected rats after 7 weeks.	277
Table. 50	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from 100 mg/Kg BEA - injected rats after 7 weeks.	278
Table. 51	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from 100 mg/Kg BEA-injected rats after 7 weeks.	279
Table. 52	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from 100 mg/Kg BEA - injected rats after 7 weeks.	280
Table. 53	Effect of graded isoproterenol infusion on peak developed tension per 100 mg left ventricular mass (PT /LV, g /100 mg) of hearts isolated from 100 mg/Kg BEA-injected rats after 7 weeks.	281
Table. 54	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from 100 mg/Kg BEA-injected rats after 7 weeks.	282
Table. 55	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from 100 mg/Kg BEA - injected rats after 7 weeks.	283
Table. 56	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated from 100 mg/Kg BEA-injected rats after 7 weeks.	284
Table. 57	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml/min) of hearts isolated from 100 mg/Kg BEA - injected rats after 7 weeks.	285
Table. 58	Effect of graded isoproterenol infusion on myocardial flow rate per 100 mg left ventricular mass (MFR /LV, ml / min. /100 mg) of hearts isolated from 100 mg/Kg BEA - injected rats after 7 weeks.	286
Table. 59	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from 100 mg/Kg BEA - injected rats after 7 weeks.	287
Table. 60	Values of plasma urea, creatinine and renin activity from 100 mg/Kg BEA - injected rats after 7 weeks.	288
Table. 61	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) from 150 mg/Kg BEA - injected rats after 7 weeks.	289
Table. 62	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from 150 mg/Kg BEA - injected rats after 7 weeks.	290
Table. 63	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from 150 mg/Kg BEA - injected rats after 7 weeks.	291
Table. 64	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from 150 mg/Kg BEA - injected rats after 7 weeks.	292
Table. 65	Effect of graded isoproterenol infusion on peak developed tension per 100 mg left ventricular mass (PT	293

	/LV, g /100 mg) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	
Table.66	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	294
Table.67	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	295
Table.68	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	296
Table.69	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml/min) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	297
Table.70	Effect of graded isoproterenol infusion on myocardial flow rate per 100mg left ventricular mass (MFR /LV, ml / min. /100 mg) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	298
Table.71	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from 100mg/Kg BEA - injected rats after 7 weeks.	299
Table.72	Values of plasma urea, creatinine and renin activity from 100mg/Kg BEA - injected rats after 7 weeks.	300
Table.73	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) from 200mg/Kg BEA-injected rats after 7 weeks.	301
Table.74	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from 200mg/Kg BEA - injected rats after 7 weeks.	302
Table.75	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	303
Table.76	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	304
Table.77	Effect of graded isoproterenol infusion on peak developed tension per 100mg left ventricular mass (PT /LV, g /100 mg) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	305
Table.78	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	306
Table.79	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	307
Table.80	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	308
Table.81	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml/min) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	309
Table.82	Effect of graded isoproterenol infusion on myocardial flow rate per 100mg left ventricular mass (MFR /LV,	310

	ml / min. / 100 mg) of hearts isolated from 100 mg/Kg BEA - injected rats after 7 weeks.	
Table. 83	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from 100 mg/Kg BEA - injected rats after 7 weeks.	311
Table. 84	Values of plasma urea, creatinine and renin activity from 100 mg/Kg BEA - injected rats after 7 weeks.	312
Table. 85	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) from 7 weeks group of control rats.	313
Table. 86	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from 7 weeks group of control rats.	314
Table. 87	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from 7 weeks group of control rats.	315
Table. 88	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from 7 weeks group of control rats.	316
Table. 89	Effect of graded isoproterenol infusion on peak developed tension per 100 mg left ventricular mass (PT /LV, g / 100 mg) of hearts isolated from 7 weeks group of control rats.	317
Table. 90	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from 7 weeks group of control rats.	318
Table. 91	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from 7 weeks group of control rats.	319
Table. 92	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated 7 weeks group of control rats.	320
Table. 93	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml / min.) of hearts isolated from 7 weeks group of control rats.	321
Table. 94	Effect of graded isoproterenol infusion on myocardial flow rate per 100 mg left ventricular mass (MFR /LV, ml / min. / 100 mg) of hearts isolated from 7 weeks group of control rats.	322
Table. 95	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from 7 weeks group of control rats.	323
Table. 96	Values of plasma urea, creatinine and renin activity from 7 weeks group of control rats.	324
Table. 97	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) from 100 mg/Kg BEA - injected rats after 7 weeks.	325
Table. 98	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from 100 mg/Kg BEA injected rats after 7 weeks.	326

Table. ٩٩	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from ١٠٠mg/Kg BEA-injected rats after ٦ weeks.	٣٢٧
Table. ١٠٠	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٢٨
Table. ١٠١	Effect of graded isoproterenol infusion on peak developed tension per ١٠٠mg left ventricular mass (PT /LV, g. /١٠٠ mg) of hearts isolated from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٢٩
Table. ١٠٢	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٠
Table. ١٠٣	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣١
Table. ١٠٤	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٢
Table. ١٠٥	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml/min) of hearts isolated from ١٠٠mg/Kg BEA injected rats after ٦ weeks.	٣٣٣
Table. ١٠٦	Effect of graded isoproterenol infusion on myocardial flow rate per ١٠٠mg left ventricular mass (MFR /LV, ml / min. /١٠٠ mg) of hearts isolated from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٤
Table. ١٠٧	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٥
Table. ١٠٨	Values of plasma urea, creatinine and renin activity from ١٠٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٦
Table. ١٠٩	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) from ١٥٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٧
Table. ١١٠	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from ١٥٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٨
Table. ١١١	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from ١٥٠mg/Kg BEA - injected rats after ٦ weeks.	٣٣٩
Table. ١١٢	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from ١٥٠mg/Kg BEA - injected rats after ٦ weeks.	٣٤٠
Table. ١١٣	Effect of graded isoproterenol infusion on peak developed tension per ١٠٠mg left ventricular mass (PT /LV, g /١٠٠ mg) of hearts isolated from ١٥٠mg/Kg BEA - injected rats after ٦ weeks.	٣٤١
Table. ١١٤	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from ١٥٠mg/Kg BEA - injected rats after ٦ weeks.	٣٤٢
Table. ١١٥	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from ١٥٠mg/Kg BEA - injected rats after ٦ weeks.	٣٤٣

Table.116	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	344
Table.117	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml/min) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	345
Table.118	Effect of graded isoproterenol infusion on myocardial flow rate per 100mg left ventricular mass (MFR /LV, ml / min. /100 mg) of hearts isolated from 100mg/Kg BEA - injected rats after 7 weeks.	346
Table.119	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from 100mg/Kg BEA - injected rats after 7 weeks.	347
Table.120	Values of plasma urea, creatinine and renin activity from 100mg/Kg BEA - injected rats after 7 weeks.	348
Table.121	Values of systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg) and mean arterial blood pressure (MAP, mmHg) from 200mg/Kg BEA - injected rats after 7 weeks.	349
Table.122	Values of heart rate (HR, bpm), R voltage (μ volt) and durations of P-R, Q – T as well as corrected Q-T (Q-Tc) intervals (msec) from 200mg/Kg BEA injected rats after 7 weeks.	350
Table.123	Effect of graded isoproterenol infusion on heart rate (HR, bpm) of hearts isolated from 200mg/Kg BEA-injected rats after 7 weeks.	351
Table.124	Effect of graded isoproterenol infusion on peak developed tension (PT, g) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	352
Table.125	Effect of graded isoproterenol infusion on peak developed tension per 100mg left ventricular mass (PT /LV, g. /100 mg) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	353
Table.126	Effect of graded isoproterenol infusion on time to peak tension (TPT, msec) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	354
Table.127	Effect of graded isoproterenol infusion on half relaxation time (HRT, msec) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	355
Table.128	Effect of graded isoproterenol infusion on contraction time (CT, msec) of hearts isolated from 200mg/Kg BEA-injected rats after 7 weeks.	356
Table.129	Effect of graded isoproterenol infusion on myocardial flow rate (MFR, ml/min) of hearts isolated from 200mg/Kg BEA - injected rats after 7 weeks.	357
Table.130	Effect of graded isoproterenol infusion on myocardial flow rate per 100mg left ventricular mass (MFR /LV, ml / min. /100 mg) of hearts isolated from 200mg/Kg BEA injected rats after 7 weeks.	358
Table.131	Values of body weight (BW, g), absolute cardiac weights (mg) and weight indices (mg/g) of atria (At), right ventricle (RV), left ventricle (LV) and whole heart (WH) from 200mg/Kg BEA - injected rats after 7 weeks.	359