“THE STUDY OF INCIDENCE AND PATTERNS OF ADRENAL HAEMORRHAGE IN ALL DEATH CASES”

Dissertation submitted in partial fulfilment of

The requirements for the degree

M.D. (Forensic Medicine)

BRANCH- XV

INSTITUTE OF FORENSIC MEDICINE

MADRAS MEDICAL COLLEGE

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THE TAMILNADU

Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI

2015 - 2018

BONAFIDE CERTIFICATE

This is to certify that the work embodied in this dissertation entitled **"THE STUDY OF INCIDENCE AND PATTERNS OF ADRENAL HAEMORRHAGE IN ALL DEATH CASES"** has been carried out by **Dr. G. AMRITHA SULTHANA, M.B.B.S,** a Post Graduate student under my supervision and guidance for her study leading to Branch XV M. D. Degree in Forensic Medicine during the period of May-2015 to May-2018.

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DECLARATION

I, **Dr. G. AMRITHA SULTHANA,** solemnly declare that this dissertation entitled **"THE STUDY OF INCIDENCE AND PATTERNS OF ADRENAL HAEMORRHAGE IN ALL DEATH CASES**" is the bonafide work done by me under the expert guidance and supervision of Dr.P.Parasakthi, M.D., Professor and Director, Institute of Forensic Medicine, Madras Medical College, Chennai–3.This dissertation is submitted to the Tamil Nadu Dr.M.G.R Medical University towards partial fulfilment of requirement for the award of M.D., Degree (Branch XV) in Forensic Medicine.

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ACKNOWLEDGEMENT

I am greatly obliged to the Dean, **Dr. R. Narayana Babu M.D.,** Madras Medical College and Rajiv Gandhi Govt. General hospital, Chennai-3 for allowing me to complete this study. I am greatly obliged to the then Dean, **Dr. R. Vimala M.D.,** Madras Medical College and Rajiv Gandhi Govt. General hospital, Chennai-3 for allowing me to conduct this study.

I would like to express my heart felt gratitude to my esteemed Professor & Director, **Dr.P.Parasakthi M.D.,** who has been a constant source of inspiration and encouragement.

I am especially thankful to my former Professor & Director, **Dr.V.Murugesan M.D.**, **D.A., F.C.C.P.,** Associate Professor **Dr.M.N.Rajamani Bheem Rao M.D.,** Honorary Professor **Dr.V.Sathyamoorthy M.D., Associate Professor, Dr.T.Vedanayagam M.D.,** for their valuable guidance in conducting the study and Assistant Professors, **Dr.S.Ramalingam M.D., Dr.R.Narendar M.D., Dr.M.Guhan M.D., Dr.T.Ezhilkothai M.D., Dr.S.Sylvia M.D**., Institute of Forensic Medicine, Madras Medical College, Chennai-3 for their interest and encouragement, in bringing out this dissertation for my MD exam.

I am deeply indebted to Prof. **Dr.Bharathi** and **Prof. Dr.Sudha Venkatesan** for their invaluable support.

I thank all my Colleagues & friends for their help in collecting material for my study. I thank the Almighty and my father **DR.A .GHOUSE KHAN** for everything what I am today. I thank my mother **Mrs. N.BEGUM JAN** for her faith and support all the time in all my endeavors. I thank my son **SAMEER** and my daughter **KHABIRA** for the unconditional love and immense support they shower on me.

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CERTIFICATE OF APPROVAL

To
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Dear Dr.G.Amritha Sulthana,

The Institutional Ethics Committee has considered your request and approved your study titled **"THE STUDY OF *INCIDENCE* AND PATTERNS OF ADRENAL HEMORRAGE IN ALL DEATH CASES ' NO. 14082016.**

The following members of Ethics Committee were present in the meeting hold on **02.08.2016** conducted at Madras Medical College, Chennai 3

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We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

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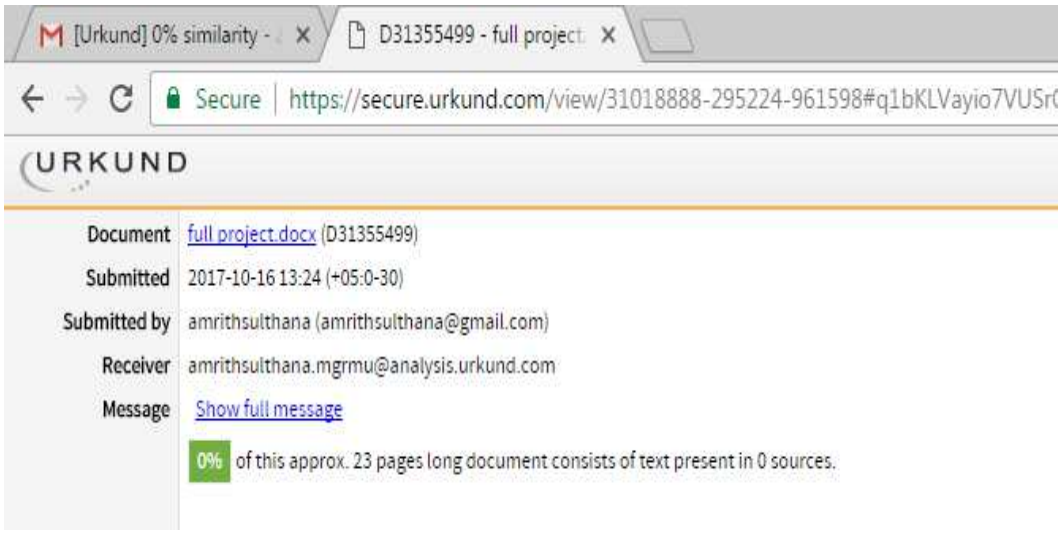
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INDEX

ABBREVIATIONS

ACTH	-	Adreno Cortico Tropic Harmone
DIC	-	Disseminated intravascular coagulation
DHEA	-	Dehydroepiandrosterone
DHEA	-	Dehydroepiandrosterone Sulfate
RAAS	-	Renin angio tensin aldosterone system
HIP	-	Heparin Induced Thrombocytopenia
Hpa	-	Hypothalamus-pitutary-adrenal
Nsaid	-	Non steroidal anti inflamatory drug
Dvt	-	Deep vein thrombosis
Pnmt	-	Phenylethanolamine N methyl transferase
Cbc	-	Complete blood count
Bun	-	Blood urea nitrogen
PRA	-	Plasma rennin activity
Crh	-	Corticotropin releasing harmone

INTRODUCTION

INTRODUCTION

Adrenal Hemorrhage (Bleeding Gland)

DEFINITION:

Adrenal gland haemorrhage is a pathologic description of macroscopic or microscopic intra adrenal haemorrhage either focal or diffuse.

Hemorrhage:

Bleeding or the abnormal flow of blood.

The term "hemorrhagic" comes from the Greek "haima," blood + rhegnumai," to break forth; a free and forceful escape of blood An adrenal hemorrhage is bleeding within the adrenal gland. A hemorrhage may be "external" and visible on the outside of the body or "internal," where there is no sign of bleed outside the body.

Adrenal hemorrhage is a life threatening condition which presents in a non specific manner leading to adrenal crisis. This variation in its presentation may further lead to shock and death if medical treatment is not commenced as soon as possible . It can occur in any person and of any age, but is mostly seen in the 40 to 80 years of age.The condition at times goes un noticed and remains undiagnosed and is only discovered on conducting a post-mortem. The bleeding in the adrenalgland may be unilateral or bilateral. If bleeding occurs on one side, the other gland will compensate with production and secretion of the necessary adrenal harmones. It is evidenced that some 15% of people who

die of shock have had an evidence of adrenal hemorrhage on both sides . Bilateral adrenal haemorrhage is rare and clnical diagnosis as its presentation is generally non specific. The early diagnosis is very important in bilateral adrenal haemorrhage as it may lead to acute adrenal Insuffciency which leads possibly to death.[1]

In a study done on post-mortem on a random sample of cases, 0.3-0.8% cases were reported to have adrenal haemorrage out of which 15% of the cases died due to shock and haemorrhage caused by bilateral adrenal haemorrhage.

Morbidity and Mortality

Adrenal crisis is associated with extensive bilateral adrenal hemorrhage whch is mostly fatal if not recognized immediately and treated promptly. On the other hand, acute adrenal insufficiency is quite uncommon in cases of unilateral adrenal haemorrhage.

Treatment of Patients with adrenal hemorrhage with stress-dose glucocorticoid either die due to any preexisting disease or other conditions which are associated with adrenal hemorrhage. Usually adrenal hemorrhage is associated with a 15% mortality rate based on studies done, but the mortality rate varies according to the severity of the underlying disease which may be associated with adrenal haemorrhage. In such a scenario, the mortality rate may increase.

In case of patients with Waterhouse-Friderichsen syndrome ,sepsis mostly occuring due to meningococal infection is evidenced with mortality rate of 55-60 % [2].

Although the mortality in bilateral adrenal haemorrhage is high, the people who survive suffer from chronic adrenal insuffciency. This warrants for the use of long term glucocorticoid replacement. But the need for mineralocorticoid replacement is not always necessary. In case of both acute and chronic adrenal insufficiency , Androgen replacement therapy may also be beneficial in women. Complete recovery is rarely reported in patients after an episode of adrenal crisis and extensive blateral adrenal haemorrage.

AGE

Adrenal haemorrhage is reported in almost any age group. But, adrenal haemorrhage due to non traumatic causes is mostly reported in the age group of 40- 80 years while traumatic adrenal hemorrhage are typically seen in 20 – 30 years age group.

Adrenal haemorrhage in children is mostly associated with Water House Freidrichson syndrome by which adults are affected infrequently. Adrenal hemorrhage in neonates is a specific entity to deal with.

Sex

In a male to female ratio, extensive bilateral adrenal hemorrhage is mostly seen in men with male-to-female ratio of 2:1, thus showing the increased prevalence among males .

Pathophysiology

Non traumatic cases associated with AH does not give a clear picture about the precise mechanisms leading to adrenal hemorrhage.

The adrenal gland has a limited venous drainage, in contrast with a rich arterial supply and hence is it is critically dependent on a single vein. In stressful situations, ACTH secretion increases by stimulating the adrenal arterial blood flow which causes haemorrhage. This adrenal gland has a limited venous drainage. Therefore, the haemorrhage caused in the above said condition, exceeds this capacity of venous drainage.

Adrenal vein thrombosis has been found to occur in association with sepsis, heparin-induced thrombocytopenia[3] primary antiphospholipid antibody syndrome, or disseminated intravascular coagulation (DIC). In several patients when they are not treated immediately extensive, bilateral adrenal hemorrhage may lead to acute adrenal insufficiency and adrenal crisis,

Findngs in the AH cases are nonspecific and they depend only on the underlying cause, whether unilateral gland is affected or bilateral and at the rate of which the gland is bleeding

Fever with more than 38^{o} C is usually present in 50-70% of patients with adrenal hemorrhage

- The adrenal haemorrhage, hematoma or insufficiency may result in raised temperature. This fever may vary in a spectrum from low grade to high grade fever with chills.

Patients in early extensive adrenal hemorrhage have been reported with tachycardia which may progress to shock in 40 -50% of case.

20% of patients with extensive, bilateral adrenal hemorrhage present with orthostatic hyptension. This finding hence not treated leads to supine hypotension and shock.

Exclusion of extensive adrenal haemorrhage cannot be done in the absence of shock

- In extensive bilateral adrenal hemorrhage shock may be due to one or more underlying conditions such as cardiovascular diseases, sepsis or hypovolemia in addition to acute adrenal insuffciency
- In Waterhouse-Friderichsen syndrome, the cytokine mediators of the immune system are activated. This leads to fatal complications like sepsis and shock.

Unilateral adrenal hemorrhage rarely presents with hypertension.

After several weeks of AH patient may present with loss of weight but is not usually common

Skin hyper pigmentation is rarely seen in adrenal hemorrhage cases. It indicates late recognition of adrenal haemorrhage.

In approximately 75% patients with Waterhouse-Friderichsen syndrome.

A Characteristic skin rash with a typical evolution occurs The rash consists of small, pink macules or papules. Initially they form petechial lesions later they fuse with each other to form a large plaque.

Some patients also present with signs of acute abdomen where the patient presents with guarding, rigidity, or rebound tenderness of abdomen. One of the causes of this finding may be due to retroperitoneal location of the adrenals.

20-40% patients are with Confusion and disorientation . These findings are nonspecific.

Dangers of Adrenal Hemorrhage

Functions of the adrenal gland is to be understood to know how adrenal hemorrhage impacts on the body. Different harmones are secreted by the adrenal gland which lies on the top of each kidney. Because the main harmones it produces and releases are involved in the stress response they are sometimes referred to as stress glands.

This includes:

- Epinephrine and norepinephrine are the catecholamines which play a major role for the fight or flight stress response.
- Cortisol is the main glucocorticoid that regulates the blood glucose levels, as well as blood pressure and metabolism of nutrients.
- Aldosterone is the main mineralocorticoid which plays an immense role for controlling the fluid and electrolyte balance.

These hormones are important for maintaining life and once the functions of gland is affected, production and secretion of the essential hormones are also disturbed

Bleeding in the Adrenal Gland

Injury is the most obvious cause of bleeding of adrenal gland. It usually affects only one gland as the other gland compensates for the loss of function. Symptoms are minor hence goes unnoticed. However, if bleeding occurs on both sides, then adrenal hormone level is dropped and is known as adrenal insufficiency.

It is known as adrenal crisis when the hormone levels become excessively low. Death can occur in a short period of time as important functions in the body are not regulated as normal by the adrenal hormones.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

- To make a statistical analysis of 100 death cases subjected to autopsy in the Institute of Forensic Medicine, Madras Medical College, Chennai-3.
- To conduct a detailed study of incidence and patterns of adrenal haemorrage sustained to the victim in all death cases
- To correlate causes of death associated with aderenal haemorrhage due to impact in cases of RTA and blunt injury, fall from height cases
- To draw conclusions regarding the manner of death.
- To identify age dependent variations in adrenal haemorrage.
- To identify mechanism dependent variations and patterns in adrenal haemorrage

PLACE OF STUDY	:	Institute of Forensic Medicine, Madras Medical College, Chennai – 3.
STUDY DESIGN	:	Prospective study
DURATION OF STUDY	:	1 year
SAMPLE SIZE	:	100 cases

SUBJECT SELECTION:

Study will be conducted on those cases sent for medicolegal autopsy to the Institute of Forensic Medicine, Madras medical college.

INCLUSION CRITERIA:

All medicolegal cases of death subjected to autopsy of various causes of death.

EXCLUSION CRITERIA:

All cases of decomposition.

MATERIALS AND METHODS

MATERIALS AND METHODS

- This Prospective study was conducted in the Institute of Forensic Medicine, Madras Medical College, Chennai-3, from August 2016 August 2017. One hundred cases were subjected to detailed postmortem examination.

- Apart from recording the nature and pattern of injuries, data regarding the site of primary impact, period of survival etc., was obtained from the investigating officers. In all the cases, the adrenal haemorrage was determined.

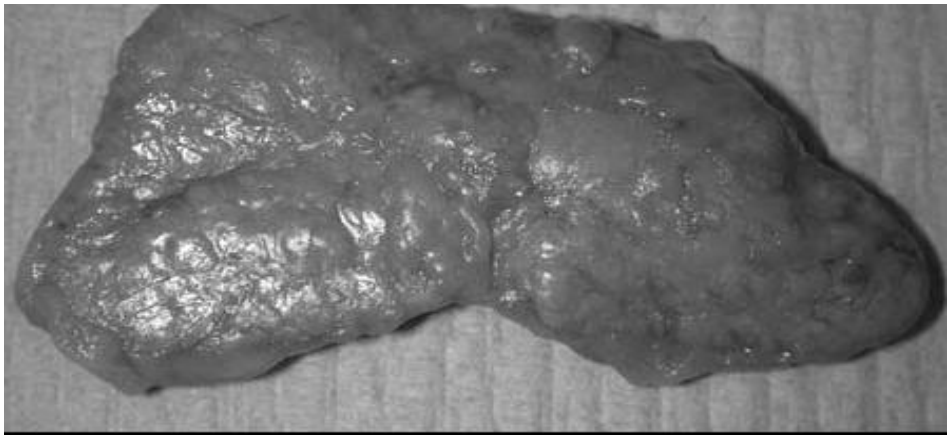
- Special effort were made to find out all causes of adrenal hemorrhage like infections, stress related disorders, cardiac diseases,

- A detailed examination was made out and data was entered in a proforma. Data includes incidence, patterns of hemorrhage in various cases.

- Autopsy was conducted by Letulle's method of an en masse removal of viscera and dissection of adrenal gland.

- Adrenal glands were sent for histopathological examination in all suspected cases. Photographs were taken wherever necessary.

- In case of treated patients, relevant clinical data was entered.



Infiltration of the surrounding structures is extremely unusual in adrenal tumours, but if identified during evisceration would require special dissection of the retroperitoneum

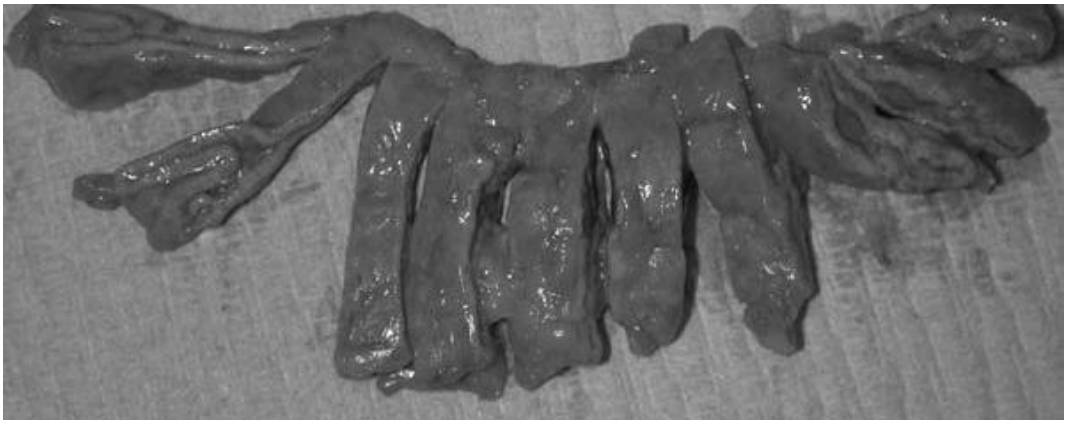
When no infltrative tumour is present, all attached fat should be pain stakingly removed from the glands using forceps and scissors if weighing is to to be accurate .the adrenals can be weighed and measured and any atrophy or hyperplasia assessed.

Average weight single stripped adrenal gland 5.5 g (upto 10 g)

Average size single stripped adrenal gland 4.5x3x0.5 cm

A significant reduction in gland weight indicates atrophy and is usually a consequence of systemic steroid therapy although may be due to previous adrenalitis. It should alert the prosecutor to look for other indications of steroid therapy and adrenal under function. A significant increase in gland weight ,in the absence of focal lesion ,indicates hyperplasia and should prompt the prosecutor to look for signs and associations of adrenal overfunction.

Figure given below shows the normal adrenal gland, stripped of all fat for weighing. (Courtesy of Mr. Dean Jansen, Whittington Hospital.)



Incomplete vertical slices should now be made. About 0.5 cm apart thus retaining continuity at one border to keep the gland intact .The cut surfaces can now be examined and any focal lesions identified. Focal lesions may be nodular hyperplasia or neoplasia.The neoplasia obviously including adenomas and carcinomas.Most such lesions are functional and should lead the prosecutor to look for other indications of gland. Over functions prompt a search and.destructive lesions such as tuberculosis and metastatic deposits also usually produce macroscopically identifiable lesions. These may be associated with underfunction of the gland and should prompt a search for the signs and associations of hyperadrenalism.

Standard routine histology should include a block of each adrenal gland even if no lesions are identified. Each adrenal gland should be weighed ,bisected vertically and sampled for histology .The adrenal glands are proportionately much larger in babies ,being approximately one third the size

of the kidneys.Adrenal haemorrhage can be seen in hypoxia ,and massive haemorrage seen in septicemia ,particularly due to meningococcus.

SPECIAL TECHNIQUES

If a localized adrenal tumour is present it should be weighed, sliced and examined, then appropriate blocks taken for histology.If the tumour is suspected to be a phaechromocytoma that is secreting adrenaline or noradrenaline, a slice of tumour should be placed in a 10 percent solution of potassium dichromate (ph5-6) for about 5 minutes. If either adrenaline or nor adrenaline are present, the tissue will become dark brown.The tissue can then be discarded or washed thoroughly before being fixed and retained

INDIVIDUAL ORGAN DISSECTION BY VIRCHOW'S METHOD

In this technique the organs are removed individually in sequence, isolated and actually dissected immediately after removal. This is said to be the most widely used evisceration technique world–wide.

The first step is to inspect the abdominal wall.Then assess the abdominal cavity and remove any fluid and establish its amount and appearance.The abdominal organs are inspected and palpated before any dissection takes place.It is suggested that the gastro intestinal tract be checked first ,including the appendix and mesenteric lymphnodes.Then ascess the spleen,liver,kidneys and pelvic organs.

The kidneys and adrenals are either removed together or each kidney is shelled out of its capsule followed by subsequent removal of adrenal glands,again begining on the left side.if the kidney and adrenal gland are to be removed together,the soft tissues medial to and above the left adrenal gland is cut into and a curved incison is made towards the lateral body wall .This is joined by a further curved incision extending along the lateral border of the kidney to meet at the lateral aspect of the superior cut described.The incisions should penetrate the peritoneum and perinephric pad of fat.The left hand is introduced into the hole produced lateral to the kidney and latter is grasped and elevated as the soft tissue dissecton is continued posteromedially.The left kidney and adrenal can now be held relatively free from all lateral and posterior attachments but medially the renal vessels and ureter are still attached. The adrenal gland on each side can now be dissected off and the perinephric fat cleared away.

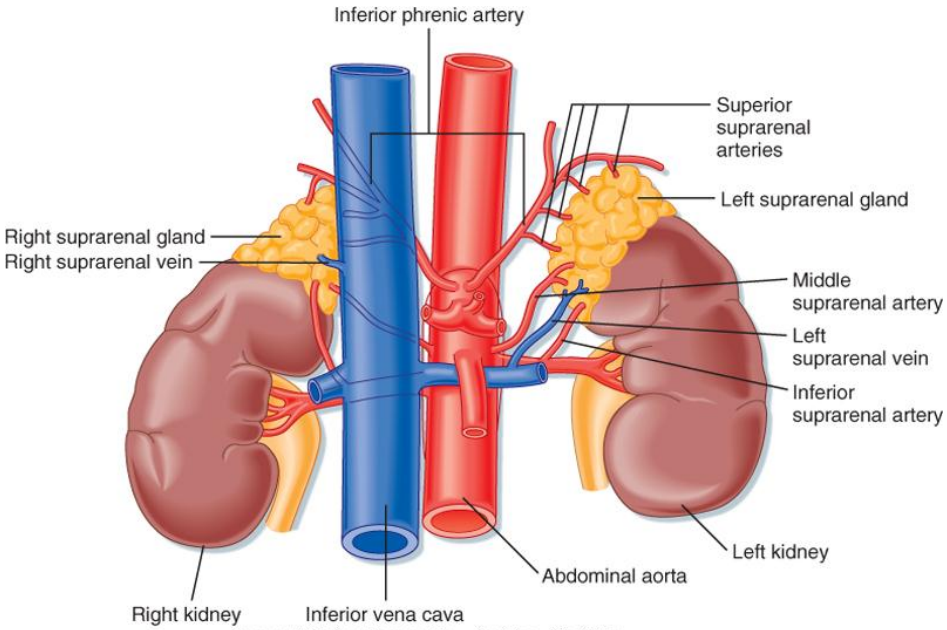
The second method involves the same lateral curved incison on each side but then the fingers are worked into the plane around the capsule which is naked and peeled back to expose the subcapsular surface .The kidneys are removed by peeling the capsules away medially to the hila and by cutting through the renal vessels and upper ureter.The capsules remain within the body the adrenals are dissected free from the overlying perinephric fat.

METHOD OF SAPHIR

The anatomical sites of the adrenal glands are obvious,but occasionally perinephric fat will obscure these glands and often they lie extremely close to another organ and they be inadvertently removed with the other organs or disrupted during retropertoneal dissection.If they do prove difficult to find then tracing along the adrenal veins should aid in identification.[4]First identify the renal vein as they enter the inferior vena cava on the right and left ,respectively. The right adrenal vein drains directly into the inferior venacava just above the right renal vein.The left adrenal vein is traced and opened from the left renal vein .The adrenal glands can now be removed after dissecting away the surrounding fat.

REVIEW OF LITERATURE

REVIEW OF LITERATURE



The Adrenal Gland

The adrenal glands are small sized yellowish organs which rest on the upper poles of each kidney in the Gerota fascia.The right adrenal gland is pyramidal in shape , and the left adrenal gland is cresentric, extending towards the hilum of the kidney. At one year of age, each adrenal gland weighs approximately one gram and this increases with age to a final weight of four to five grams.

The arterial blood supply is from three sources, with branches arising from the pherinic artery, the renal artery and the aorta.

Venous drainage flows into the inferior venacava directly on the right side and into the left renal vein on the left side.

Lymphatics drain medially into the aortic nodes.

In adults the adrenal gland plays a major role in the production of two structurally distinct classes of hormones: steroids and catecholamines. The catecholamine hormone epinephrine rapidly responds to stress such as hypoglycemia and exercise and also regulates multiple parameters of physiology, including energy metabolism and cardiac output.

Stress also plays a major role as secretagogue of the longer-acting steroid hormone cortisol. It regulates glucose utilization, and immune and inflammatory haemostasis, The adrenal glands regulate salt and volume haemostasis through the steroid hormone aldosterone. Finally, the adrenal gland secretes a large amounts of the androgen precursor dehydroepiandrosterone sulfate (DHEAS), which plays a major role in fetoplacental estrogen synthesis and as a substrate for peripheral androgen synthesis in women.

HISTORY

An Italian anatomist,named Bartolomea Eustachi gets the credit of first describing adrenal glands in 1563-4.[5][6] . The publications was a part of papal library and did not receive public attention, which was first received with Caspar Bartholin the Elder illustrations in 1611.[6] Related to the kidney the adrenal gland was named The term "adrenal" comes from *ad-* (Latin, "near") and *renes* (Latin"kidney")[38]. .Jean Riolan the Younger in 1629 termed "suprarenal", comes from Latin *supra* (Latin:*"above"*) and *renes*

(Latin: *kidney*). The suprarenal nature of the glands was not truly accepted till the 19th century, as anatomists clarified the ductless nature of the glands and their likely secretory role – prior to this, there was some debate as to whether the glands were indeed suprarenal or part of the kidney[6].

On the Constitutional and Local Effects of Disease of the Suprarenal Capsule, a publication in 1855 gave a recognition done by Thomas Addison a English physician. Addison described in his monography what the French physician George Trousseau later named it as Addison's disease, an eponym which is still used today for adrenal insufficiency and its related clinical manifestations.[7] In 1894, George Oliver and Edward Schafer ,English physiologists experimented with the action of adrenal extracts and recorded their pressor effects. In the following decades several physicians studied with extracts from the adrenal cortex to cure Addison's disease.[5] .In 1950 Nobel Prize in Physiology or Medicine were awarded to Edward Calvin Kendall, Philip Hench and Tadeusz Reichstein for their discoveries on the structure and effects of the adrenal hormones.

EMBRYOLOGY

The adrenal glands in a newborn baby are much larger in proportion to the body size than in an adult.[8] At the of age of three months the glands are four times more than the size of the kidneys. Due to the shrinkage of the cortex the size of the glands gradually decreases in size after birth. The cortex, which almost completely disappears by age of one, again developes from the age of

4–5. The glands weighs about 1 g at birth[9] and develop to an adult weight of about 4 grams each. [10]In a fetus the glands are first detected only after the sixth week of development. [9]

Detected at 6 weeks of gestation, the adrenal cortex is derived from the mesoderm of the posterior abdominal wall. Steroid secretion from the fetal cortex begins thereafter which predominates throughout life. Adult type zona glomerulosa and fasciculata are detected only in fetal life but they make up a small proportion of the gland and the zona reticularis is usually not present . The adrenal medulla is ectodermal in origin[9] which arises from the neural crest cells which migrate to the medial aspect of the developing cortex.

Adrenal glands are present with two heterogenous types of tissue. As a part of the sympathetic nervous system in the middle is the adrenal medulla, which produces adrenaline and noradrenaline and releases them into the blood stream,. Enclosing the medulla is the cortex, which gives rise to a variety of steroid hormones. As these tissues come from different embryological precursors they have distinct prenatal developmental pathways.

Adrenal medullary cells migrate from their present position and aggregate in the vicinity of the dorsal aorta which is a primitive blood vessel, which further activates the differentiation of these cells through the release of proteins known as BMPs. They further undergo a second migration from the dorsal aorta to form the adrenal medulla as well as other organs of the sympathetic nervous system. [39] Adrenal medullary cells are

called chromaffin cells because they contain granules that stain with chromium salts, a peculiar characteristic not present in all sympathetic organs. In the past Glucocorticoids produced in the adrenal cortex was thought to be responsible for the differentiation of chromaffin cells. But recent research suggests that BMP-4 which is secreted in the adrenal tissue is the mainly responsible for this, and that glucocorticoids just plays a role in the subsequent development of the cells.

Variability

The adrenal gland may be fused in the midline behind the aorta[9] or may not develop at all.. They also may be associated with other congenital abnormalities like failure of the kidneys to develop, or fusion of kidneys together.[9]. The gland may develop in an unusual location [9]or develop with a partial or complete absence of the cortex.

As the development of adrenals are closely associated with that of the kidneys, Anomalies of the adrenal gland may occur anatomically. Ipsilateral agenesis of the kidney is commonly associated with Agensis of an adrenal gland and fused kidney are usually associated with a fused adrenal gland.

Adrenal hypoplasia occurs in two forms

Absence of the fetal cortex or hypoplasia with poorly formed medulla.

Absence of permanent cortex with disorganized fetal cortex and medulla

Adrenal heterotopia denotes a normal gland in an abnormal location such as within the hepatic or renal capsules.

Adrenal crests or Accesory adrenal tissues usually comprises only of cortex but also seen in combination with medulla.In some cases it is mostly located in the spermatic cord or broad ligament but can be otherwise found anywhere in the abdomen.

Adrenal rests present intracranially have also been reported.

ANATOMY

The adrenal glands are bilateral structures which are situated in the retroperitoneum immediately above and are slightly medial to both the kidneys . In humans, they may also reffered as the suprarenal glands because they are present on the superior pole of each kidney. The adrenal glands have the same similarity to the pituitary in that they are derived from both neuronal tissue and epithelial tissue. Each adrenal gland has two different parts, each which has a unique function,. Both adrenal cortex and the medulla produce harmones.[9] The outer portion is called the adrenal cortex which develops from mesodermal cells are visible on the superior poles of the developing kidney. These cells called the epithelial endocrine cells form cords . The steroidogenic cells are formed from the cells of the cortex. In adults, Mineralocorticoids, glucocorticoids, and adrenal androgens are

produced by the adrenal cortex whch are composed of three zones namely the zona glomerulosa,zona fasciculate and zona reticularis.

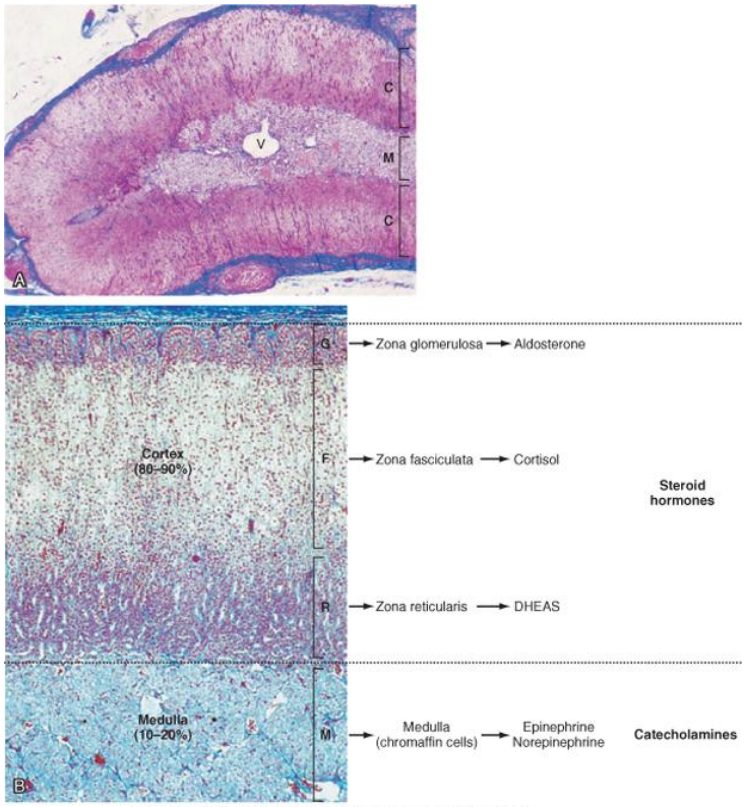
Soon after the cortex is formed, neural crest-derived cells along with the sympathetic ganglia, called chromaffin cells, migrate into the cortex and get encapsulated by cortical cells.The inner portion of the adrenalgland,is formed by chromaffin cells which is called the adrenal medulla. The chromaffin cells of the adrenal medulla have the potential to become postganglionic sympathetic neurons. Innervated by cholinergic preganglionic sympathetic neurons they can synthesize the catecholamine neurotransmitter norepinephrine from tyrosine. By adding a methyl group to norepinephrine. The enzyme phenyleth anolamine N-methyl transferase produce the catecholamine hormone epinephrine, a primary hormonal product of adrenal medulla.

In humans, the right adrenal gland is pyramidal in shape, and the left is semilunar and somewhat bigger[11] The gland is usually about 5x3 cm in size, and the combined weight in an adult human ranges from 7 to 10 grams.[12] .They are yellowish in colour[11]

Adrenal gland lies in the renal fascia,surrounded by a fatty capsule which also surrounds the kidneys. A weak connective tissue seperates the glands from the kidneys. The adrenal glands are attached to the crura of the diaphragm by the renal fascia and are present directly below the diaphragm [13].

Adrenal cortex

Microscopic picture of adrenal gland showing its different layers.From above downwards are the zona glomerulosa,zona fasciculate,zona reticularis. In the centre of the Medulla central adrenomedullary vein is seen.



Koeppen & Stanton: Berne and Levy Physiology, 6th Edition.

The outermost layer of adrenal gland is the adrenal cortex.In the cortex are present the three layers named ‘ zones’.When viewed microscopically each layer has a distinct appearance and unique function.[14]

The adrenal cortex plays a major role in producing harmones namely aldosterone,cortisol,and androgens. [11]

ZONA GLOMERULOSA

Zona glomerulosa is the outermost layer of the adrenal cortex It is present under the fibrous capsule of the gland. The Cells in this layer form oval groups. They are separated by thin strands of connective tissue and carry wide capillaries.[15]

This layer is the main site of production of aldosterone which is a mineralocorticoid, by using the enzyme aldosterone synthase[16][17]. Aldosterone play a major role in the long-term regulation of blood pressure.[18]

ZONA FASCICULATA

Situated in between the zona glomerulosa and the zona reticularis is the zona fasciculata. Cells in this layer produce glucocorticoids such as cortisol[19]. 80% of the volume of the cortex[20] is occupied by zona fascculata. In the zona fasciculata cells are arranged in columns which are radially oriented towards the medulla. These cells contain abundant mitochondria and numerous lipid droplets and a complex smooth endoplasmic reticulum[15].

ZONA RETICULARIS

Zona reticularis is the innermost cortical layer which lies directly closer to the medulla. It produces the androgens, such as

Dehydroep iandrosterone (DHEA), and DHEA sulfate (DHEA-S), as well as androstenedione which is the precursor of testosterone in humans.[26] Its small cells form irregular clusters and cords which are separated by capillaries and connective tissue. It contain small quantities of cytoplasm, lipid droplets and sometimes show brown lipofuscin pigment[15].

ADRENAL MEDULLA

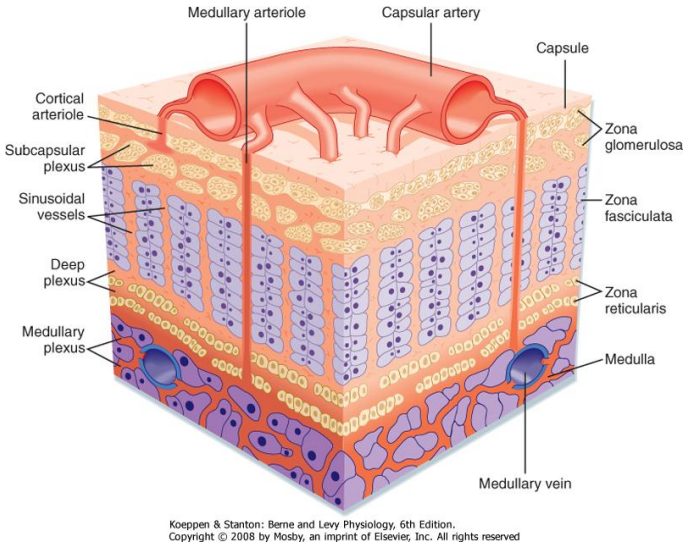
The adrenal gland consist of an inner medulla and an outer cortex . The chromaffin cells of the medulla are responsible for the body's catecholamines, adrenaline and noradrenaline, and are released About 20% of the cells noradrenaline and 80% adrenaline are produced here.[19] . As it is innervated by preganglionic nerve fibers, the adrenal medulla can also be considered as a specialized sympathetic ganglion. [21] Sympathetic nervous system via preganglonic fibres drives the adrenal medulla originating in thoracic spinal cord, from vertebrae T5–T11[20]

Adrenal medulla lacks distinct synapses unlike the other sympathetic ganglia and releases its secretions directly into the blood. Adrenomedullary catecholamines are secreted into blood and act as hormones.

Instead of being secreted near a target organ and acting as neurotransmitters Although circulating epinephrine is derived entirely from the adrenal medulla, only about 30% of the circulating norepinephrine comes from the medulla. The remaining 70% is released from the postganglionic sympathetic nerve terminals and diffuses into the vascular system.

Because the adrenal medulla is not the sole source of catecholamine production, this tissue is not essential for life.

BLOOD SUPPLY



Blood flow through the adrenal gland. Capsular arteries give rise to sinusoidal vessels that carry blood centripetally through the cortex to the medulla.

The adrenal glands has one of the greatest blood supply rates where up to 60 small arteries may enter each gland[22] per gram of tissue of an organ:. Each gland is supplied usually by three arteries :[11]

- The superior suprarenal artery is a branch of the inferior phrenic artery
- The middle suprarenal artery is a direct branch of the abdominal aorta
- The inferior suprarenal artery is a branch of the renal artery
- Within the capsule of the adrenal glands. the blood vessels supply a network of small arteries

Thin strands of the capsule entering the glands carry blood to them.[11]

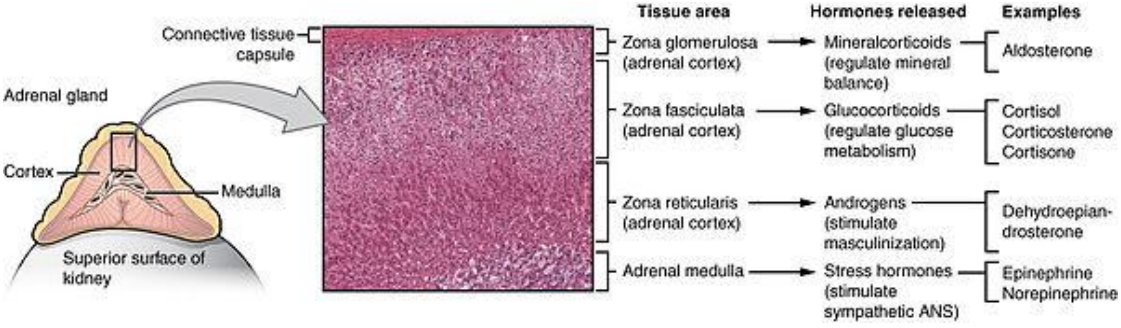
Suprarenal veins drain venous blood from the glands which is usually present one for each gland: [11]

In the inferior vena cava drains drains the right suprarenal vein

In left renal vein or the left inferior phrenic vein.drains the left suprarenal vein.

An unusual type of blood vessel is the central adrenomedullary vein, in the adrenal medulla. The structure of central adrenomedullary vein is different from the other veins in that the smooth muscle present in its tunica media are arranged in conspicuous, longitudinally oriented bundles.[20]

FUNCTION



Different hormones are produced in different zones of the cortex and medulla of the Adrenal gland. Light microscopy at magnification × 204.[23]

The adrenal glands are endocrine glands which produce a variety of hormones including adrenaline and the steroids, cortsol and aldosterone [24] Each gland has an outer cortex which produces steroid hormones.. The adrenal

cortex further is divided into three zones: zona glomerulosa, the zona fasciculata and the zona reticularis.[20]

The adrenal cortex produces three main types of steroid harmones:

Mineralocorticoids ;Glucocorticoids and Androgens

CORTICOSTEROIDS

Corticosteroids produced from the cortex of the adrenal gland are a group of steroid hormones from which they are named.[25] According to their actons they are named as Mineralocorticoids like aldosterone produced in the zona glomerulosa function by regulatng blood pressure and electrolyte balance as well as blood volume.[26]

The glucocorticoids such as cortisol and corticosterone are produced in the zona fasciculata. They influence regulation of metabolism of proteins, fats and glucose.[27]. and immune system suppression.

Androgens which are converted to fully functional sex hormones in the gonads and other target organs are produced by the innermost layer of zona reticulars.[27]

Steroidogenesis, the production of steroid harmones involves a number of reactions and processes which take place in cortical cells.[28] Catecholamines, adrenaline and noradrenaline, produced by the adrenal medulla function to produce a rapid response in stress situations through out the body . Dysfunctions of the adrenal gland takes place due to a number of endocrine diseases. Insufficient production of cortisol is associated

with Addison's disease and overproduction of cortisol leads to cushings syndrome. Dysregulation of endocrine control mechanisms leads to a genetic disease called congenital adrenal hyperplasia . [27][28] When searching for other diseases[30] in medical imaging a variety of tumours arising form adrenal tissue is commonly found.

A mineralocorticoid, aldosterone is produced by the adrenal gland which regulates the "mineral" balance and blood volume.In the kidneys the action of aldosterone is on the collecting ducts and distal convoluted tubules increases the reabsorption of sodium and the excretion of both hydrogen ions and potassium.[18] 2% of filtered sodium in the kidneys is reabsorbed by aldosterone.Under normal glomerular filtration rate it is nearly equal to the entire sodium content in human blood .[21] Sodium retention takes place as a response of distal colon and sweat glands in the aldosterone receptor stimulation.

The two main regulators of aldosterone production are. Angiotensin II and extracellular potassium,[19] The amount of sodium in the body also affects the extracellular volume, in turn influencing the blood pressure. Due to which the effects of aldosterone in sodium retention is important in the regulation of blood pressure.[10]

Glucocorticoids

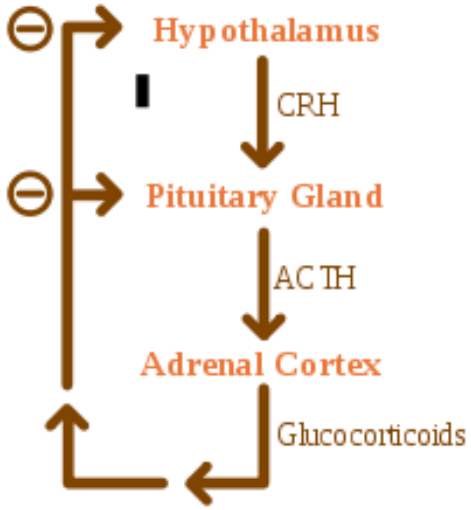
In humans, cortisol is the main glucocorticoid. Corticosterone plays this role in species that do not create cortisol. Glucocorticoids plays a major role

on metabolism by Increasing the circulating level of glucose as their name suggests Leading to an increase in the mobilization of amino acids from protein and the stimulation of synthesis of glucose from these amino acids in the liver . In addition they also increase the levels of free fatty acids which the cells can use as an alternative to glucose for obtainng energy.The effects of Glucocorticoids not related to the regulation of blood sugar levels, includes the suppression of the immune system and also a potent anti-inflammatory effect. Cortisol decreases the absorption of calcium in the gastrointestinal tract and reduces the capacity of osteoblasts to produce new bone tissue[10] The adrenal gland produces a basal level of cortisol but can also secrete bursts of the hormone in the response to adrenocorticotropic hormone (ACTH) from the anterior pituitary. Cortisol is not evenly released during the day – its concentrations in the blood is lowest in the evening and highest in the early morning due to the circadian rhythm of ACTH secretion.[10]The action of the enzyme 11β-HSD on cortisol produces an inactive product called cortisone . The reaction catalyzed by 11β-HSD is reversible, and it means that it can convert administered cortisone into cortisol, the biologically active hormone[10].

A number of enzymes of the cytochrome P450 family that are located in the inner membrane of mitochondria,involves in the initial part of conversion of cholesterol into steroid hormones .Transport of cholesterol from the outer to the inner membrane is done by steroidogenic acute regulatory protein and is a rate-limiting step in steroid synthesis.[31]

The adrenal gland layers differ by function, Each layer having distinct enzymes which produce different harmones and from a common precursor.[27] The first and foremost enzymatic step in the production of steroid hormones is the cleavage of cholesterol side chain, a reaction which forms pregnenolone and is a product that is catalyzed by the enzyme P450scc, and is also known as *cholesterol desmolase*. Further modifcaton takes place after the production of pregnenolone a specific enzyme of each cortical layer. Enzymes involved in this process are mitochondrial ,microsomal P450s and hydroxysteroid dehydrogenases. To form the functional hormones a number of intermediate steps in which pregnenolone is modified several times is usually required .[28] These Enzymes are involved in a number of endocrine diseases which catalyze reactions in these metabolic pathways . For example Deficiency of 21-hydroxylase, an enzyme involved in an intermediate step of cortisol production. ,results in the the development of most common form of congenital adrenal hyperplasia .[31]

REGULATION



NEGATIVE FEEDBACK IN THE HPA AXIS

Glucocorticoids is under the regulatory influence of hypothalamus-pituitary-adrenal (HPA) axis. Adrenocorticotropic hormone(ACTH), a hormone released into the bloodstream by the anterior pituitary stimulates Glucocorticoid synthesis.In turn,the presence of corticotropin-releasing hormone (CRH), which is produced by neurons of the hypothalamus stimulates the production of ACTH.. ACTH acts first on the adrenal cells by increasing the levels of StAR within the cells, and all steroidogenic P450 enzymes. HPA axis is also an example of a negative feedback system, where cortisol itself acts as a direct inhibitor of both ACTH synthesis and CRH . HPA axis also interacts with immune system through increased secretion of ACTH in the presence of certain molecules of the inflammatory response.[27]

The renin–angiotensin–aldosterone system (RAAS) mainly regulates mneralocorticoid secretion. Sensors of blood pressure which are in the juxtaglomerular apparatus of kidneys releases enzyme renin into blood, which starts a cascade of reactions which lead to formation of angiotensin II. Angiotensin receptors which are present in the cells of the zona glomerulosa recognize the substances, upon binding they promote the release of aldosterone.[33]

ADRENALINE AND NORADRENALNE

The catecholamines Adrenaline and noradrenalines are water-soluble compounds which have a structure made of an amine group and

catechol group. The adrenal glands is responsible for the maximum adrenaline that circulates in the body, and a minimum of circulating noradrenaline. [34]Adrenal medulla contains a dense network of blood vessels which releases these harmones.Adrenaline and noradrenaline which act at adrenoreceptors throughout the body has effects that include an increase in blood pressure and heart rate.[34]Acts of adrenaline and noradrenaline are responsible for the fight or flight response which is characterised by a quickening of breathing and heart rate and an increase in blood pressure, as well as constriction of blood vessels in many parts of the body. [35]

FORMATION

Catecholamines are produced from chromaffin cells in the medulla of the adrenal gland, or tyrosine, a non-essential amino acid derived from food and also produced from phenylalanine in the liver. Enzyme tyrosine hydroxylase first converts tyrosine to L-DOPA in the synthesis of catecholamine. L-DOPA is further converted to dopamine before it gets turned into noradrenaline. In the cytosol noradrenaline is converted to epinephrine by the action of enzyme phenylethanolamine N-methyltransferase (PNMT) and is stored in granules.

Glucocorticoids are produced in the adrenal cortex which stimulate the synthesis of catecholamines and increases the levels of tyrosine hydroxylase and PNMT[27][14] The activation of the sympathetic nervous system stimulates catecholamine release. The adrenal gland are innervated by the Splanchnic nerves of sympathetic nervous system .It evokes the release of catecholamines from the storage granules when actvated by stimulating the opening of calcium channels in the cell membrane.[36]

ANDROGENS

The male sex hormones, or androgens, the most important of which is DHEA is produced by the cells in zona reticularis of the adrenal gland Generally , these hormones do not have an direct effect in the male body, and they are converted to more potent androgens such as DHT andtestosterone or

as estrogens in the gonads and acts in this way as a metabolic intermediate.[37]

CLINICAL SIGNIFICANCE

ADRENAL GLAND DISORDER

The normal function of adrenal gland may be impaired in conditions like infections, tumors, genetic disorders and autoimmune diseases and due to side effect of medical therapy. These disorders affect the gland either resulting in dysregulation of hormone production leading to an excess or insufficiency of adrenal hormones and related symptoms or directly

CORTICOSTEROID OVERPRODUCTION

CUSHING'S SYNDROME

Glucocorticod excess might results in Cushing's syndrome .It can be due to prolonged treatment with glucocorticoids or may be as a result of an underlying disease which produces alterations in the HPA axis or excess production of cortisol. The causes can be classified into ACTH-independent or ACTH-dependent. Most common cause of endogenous Cushing's syndrome ,pituitary adenoma which leads to an excess production of ACTH. The disease produces a variety of signs and symptoms which also includes obesity, increased blood pressure, diabetes, osteoporosis,excessive body hair , depression and, most distinctively, stretch marks in the skin which is caused by its progressive thinning.[27][29]

PRIMARY ALDOSTERONISM

Primary aldosteronism is a result of excess production of aldosterone in the zona glomerulosa. Primary aldo steronism is due to bilateral hyperplasia which is excessive tissue growth of the glands, or aldosterone-producing adenomas, a condition also called Conn's syndrome. Primary aldosteronism results in hypertension , sodium retention electrolyte imbalance and increasing potassium depletion[29] .

ADRENAL INSUFFICIENCY

Adrenal insufficiency is the deficiency of glucocorticoids which occurs in about 5 in 10,000 of the general population.[29] The Disease is classified as *primary adrenal insufficiency* which includes addisons dsease or genetic causes that directly affect the adrenal cortex. If it is due to the hypothalamic-pituitary-adrenal axis arisng outside the gland it is then called as *secondary adrenal insufficiency*.

ADDISON'S DISEASE

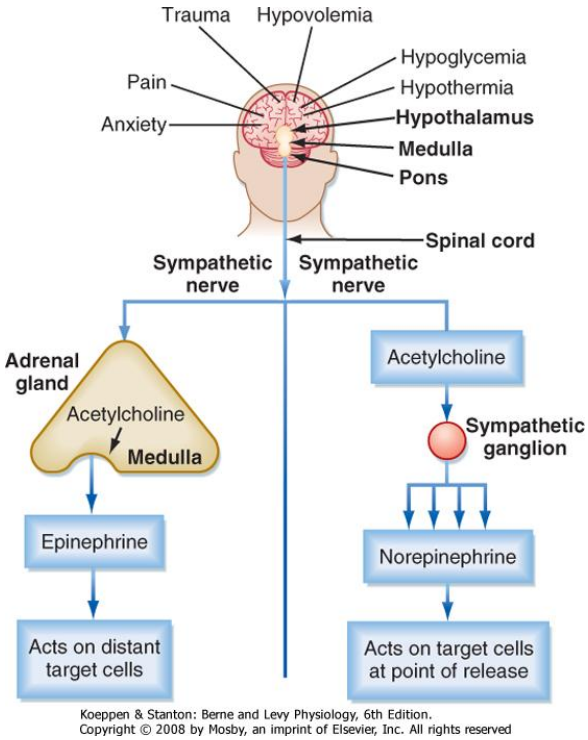
Addison's disease refers to primary hypoadrenalism, a deficiency in glucocorticoid and mineralocorticoid production in the adrenal gland. Addison's disease is most commonly an autoimmune condition where the body produces antibodies against cells of the adrenal cortex in the western world . But worldwide the disease is more frequently caused by infection most importantly from tuberculosis. A distinctive feature in Addison's disease is

hyperpigmentation of the skin associated with other nonspecific symptoms such as fatigue[27]

A complication usually seen in untreated Addison's disease and other types of primary adrenal insufficiency is the adrenal crisis which is a medical emergency resulting in low glucocorticoid and mineralocorticoid levels causng hypovolemic shock and other symptoms such as vomiting and fever. Progressively an adrenal crisis can lead to stupor and coma.[27]The treatment of adrenal crises includes the application of hydrocortisone injections[40].

CAUSES

(Modified from Young B et al: Wheater's Functional Histology, 5th ed. Philadelphia, Churchill Livingstone, 2006.)



The causes of both unilateral and bilateral adrenal hemorrhage may overlap.

Unilateral Adrenal Hemorrhage

- Blunt trauma
- Abdominal surgery of organs or structures near the adrenal gland
- Cancer of the adrenal gland
- Long term use of NSAIDs (non-steroidal anti-inflammatory drugs)
- Pregnancy without complications
- Unknown causes (idiopathic)

Bilateral Adrenal Hemorrhage

Bilateral adrenal haemorrhage is a rare cause of adrenal failure. Clinical features are non-specific and therefore a high index of suspicion must be maintained in patients at risk. Predisposing factors include

- Infections
- Heart diseases like congestive cardiac failure or a myocardial infarction
- Cirrhosis
- Pancreatitis
- Inflammatory bowel disease
- Severe abdominal injury
- Pregnancy complications like toxemia of pregnancy and spontaneous abortion.

- Surgery like coronary artery bypass, hip replacement and intracranial procedures.
- Bleeding disorders like thrombocytopenia, vitamin K deficiency, and use of blood thinning drugs.
- Vascular disorders including deep venous thrombosis (DVT), pulmonary embolism and stroke.
- Cancer spread from another site to the adrenal glands.
- Use of ACTH for treatment of certain diseases.
- Waterhouse-Friderichsen syndrome

Adrenal Hemorrhage Symptoms

It is rare to have no symptoms of an adrenal hemorrhage. Even when only one gland is affected, the symptoms related to bleeding are still present although there is no sign of adrenal insufficiency. It is, however, often misdiagnosed. Not all of the symptoms below will be present in every case of adrenal hemorrhage. The presentation is largely dependent on whether it is unilateral or bilateral bleeding, the extent of the bleed, duration of blood loss and degree to which the adrenal gland function is affected.

- Abdominal pain or flank pain. Sometimes it may present with pelvic or lower back pain.
- Fever
- Rapid heart rate
- Low blood pressure

- Weight loss
- Skin hyperpigmentation
- Fatigue
- Weakness
- Dizziness
- Muscle aches
- Joint pains
- Nausea and vomiting
- Loss of appetite
- Diarrhea

Additioal symptoms may be due to the underlying disease.

Adrenal Hemorrhage Diagnosis

Clinical examination and medical history are helpful but will not conclusively indicate a hemorrhage. The main diagnostic tests to diagnose an adrenal hemorrhage are imaging studies such as :

- CT (computed tomography) scan
- MRI (magnetic resonance imaging)
- Ultrasound

Additional investigations like blood tests may help to indicate the severity of the adrenal insufficiency as

well as other important biological markers to possibly indicate the cause or extent of dysfunction. This includes :

- Complete blood count (CBC)
- Urea and electrolytes
- Blood glucose
- Adrenal hormone levels – cortisol, ACTH, aldosterone, renin
- ACTH challenge

Adrenal Hemorrhage Complications

Severe bleeding of both adrenal glands can lead to acute adrenal insufficiency which is known as adrenal crisis. It can be fatal unless it diagnosed early and treated immediately. When adrenal hemorrhage occurs with conditions like Waterhouse-Friderichsen syndrome, then the fatality rate is very high. Death from bleeding itself is not common unless there is a penetrating wound with excessive blood loss. Adrenal insufficiency can become chronic but is not necessarily permanent. These chronic cases can be managed fairly effectively with glucocorticoids.

Other frequent causes include hemorrhagic diatheses due to anticoagulant use or thrombocytopenia ,thromboembolic disease which include antilso commonly seen inphospholipid antibody syndrome, blunt trauma, as well as ACTH therapy.

- Waterhouse-Friderichsen syndrome or purpura fulminans represents hemorrhagic necrosis of several organs along with adrenal hemorrhage and patents present with a haemorragic skn rash.

DIAGNOSTIC CONSIDERATIONS

Spontaneous adrenal hemorrhage may occur in otherwise uncomplicated pregnancy in the absence of preeclampsia, trauma, or sepsis. Hence adrenal hemorrhage should be considered in the differential diagnosis of abdominal or flank pain in pregnant women.[41]

A study by Diolombi et al indicated that the diagnosis of adrenocortical adenomas can be difficult in the setting of diffuse (>25%) hemorrhage of the adrenal glands, because malignancy and hemorrhage each cause marked adrenal enlargement.[42]

DIFFERENTIAL DIAGNOSES

- The differential diagnosis for adrenal haemorrhage includes tumors Adrenal incidentaloma, Adrenal neuroblastoma and Carcinoma of the adrenal gland
- Other differential diagnosis includes acute conditions like cute abdomen, Adrenal Crisis, Pheochromocytoma and septic shock

SYMPTOMS OF ADRENAL HAEMORRAGE

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- Fever
- Rapid heart rate
- Low blood pressure
- Weight loss
- Skin hyperpigmentation
- Fatigue
- Weakness
- Dizziness
- Muscle aches
- Joint pains
- Nausea and vomiting
- Loss of appetite
- Diarrhea

Additional symptoms may be due to the underlying disease.

ADRENAL HEMORRHAGE DIAGNOSIS

LABORATORY STUDIES.

Clinical examination and medical history are helpful but will not conclusively indicate a hemorrhage. The main diagnostic tests to diagnose an adrenal hemorrhage are imaging studies such as :

- CT scan
- MRI
- Ultrasound

Additional investigations like blood tests may help to indicate the severity of the adrenal insufficiency as well as other important biological markers to possibly indicate the cause or extent of dysfunction.

This includes :

- Complete blood count
- Urea and electrolytes
- Blood glucose
- Adrenal hormone levels – cortisol, ACTH, aldosterone, renin
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ADRENAL HEMORRHAGE TREATMENT

Emergency medical attention is needed for acute adrenal hemorrhage with replacement of fluid and electrolytes, vital function support and restoring adrenal hormones. Medication is used to replace the deficient glucocorticoids normally secreted by the adrenal glands. This is only necessary in bilateral adrenal hemorrhage where there are signs of adrenal insufficiency.

The following medication may be used :

- Hydrocortisone
- Prednisone
- Dexamethasone
- Fludrocortisone

Surgery is not usually necessary unless the hemorrhage is a result of severe trauma. In these cases surgical procedures will focus on controlling bleeding, closing the penetrating wounds and attending to any other associated injuries. In cases of cancer, the adrenal gland will most likely need to be

removed. With proper management and treatment directed at the cause, the bleeding may cease spontaneously in non-traumatic cases without the need for surgery

IMAGING STUDIES

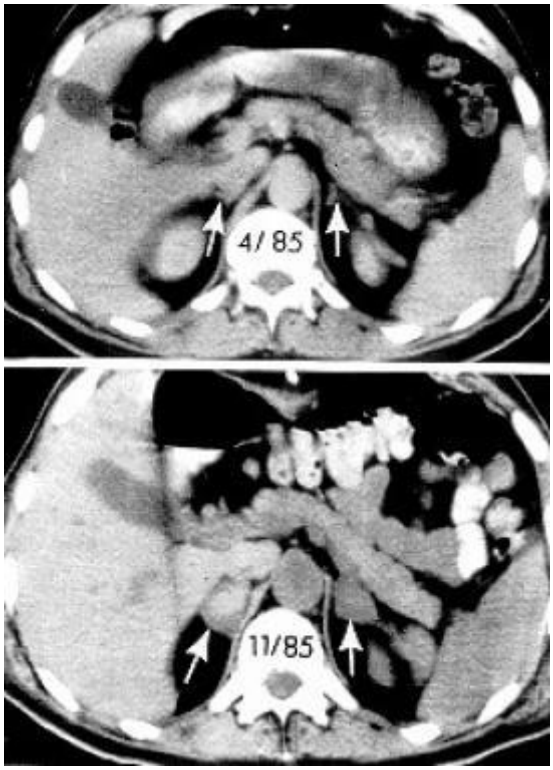
Computed Tomography SCANNING

CT scanng of the adrenals is the best choice of study to demonstrate adrenal hemorrhage in a hospital.[43] but it is possible only in hemodynamically stable patients.

In case of adrenal hemorrhage CT shows enlargement of adrenals that whch may show asymmetry in cases of bilateral adrenal hemorrhage. They have high attenuation without contrast enhancement .

In cases of trauma and presence of AH a streaky appearance of the perirenal fat frequently seen on the posterior aspect of the gland. [44] It is not specific finding for traumatic adrenal hemorrhage. hemorrhage is also seen in perirenal space, with perinephric hematoma formation,

CT scans are shown below.



C T abdomen showing normal adrenal glands which was viewed several months before the onset of hemorrhage (upper panel) and an enlarged adrenal gland 2 weeks after an episode of bilateral adrenal hemorrhage (lower panel). This figure shows the attenuation of the adrenal glands, indicated by arrows

MRI

Magnetic resonance imaging to exclude the presence of malignant tumors or pheochromocytomas, [44[43] Compared to CT the use of MRI in adrenal hemorrhage is less.

.

ULTRASONOGRAPHY

Doppler ultrasonography is used in neonate in case of adrenal hemorrhage and it may reveal the presence of AH also in utero.

Ultrasonographic imaging of adrenal hemorrhage may show hyperechoic masses with a central echogenic area in the gland.

PROCEDURES

Percutaneous biopsy is extremely helpful in diagnosing the presence of metastatic disease assocated with adrenal hemorrhage which suggestive features which appear on CT scans.

HISTOLOGIC FINDINGS

Histopathological examination of tissues in case of an adrenal haemorrhage shows extensive hemorrhagic necrosis of all adrenal cortical cell layers, along with adrenal medullary cell necrosis. The hemorrhage may be extend into the perirenal fat and perirenal space.

Other common findings include adrenal vein thrombosis and retrograde migration of medullary cells into the zona fasciculata. In contrast, vasculitis has been observed rarely in cases of adrenal hemorrhage which suggests that it has a limited role in the pathogenesis of adrenal hemorrhage.

In a chronic stage the hematoma becomes organized as a fibrous capsule which forms around the adrenal hemorrhagic area. Hemosiderin-laden macrophages are present in the capsule and they digest the cell debris. In a

few months following acute adrenal hemorrhage, fibrous tissue slowly replaces the hemorrhagic areas.

TREATMENT & MANAGEMENT

MEDICAL CARE

As acute adrenal haemorrhage can result in acute adrenal insufficieny, it is imperative to evaluate the patient as inpatient to avoid any untoward incidents. Usually, most of these patients present with acute illness due to the acute adrenal haemorrhage and are admitted in hospital due to the acute presentation

The patients who are asymptomatic and are diagnosed with adrenal mass incidentally can be treated as out patient

Medical therapies are used to replace adrenal function, to provide support to vital function and to treat the underlying conditions, and to correct the fluid, electrolyte, and red cell mass deficits.

SURGICAL CARE

Adrenalectomy either open or laparoscopic may be performed.

- Non traumatic adrenal haemorrhage doesnot warrant surgical management, it is done onlyn in patients with primary adrenal tumors or in extensive retroperitoneal hemorrhage which is secondary to adrenal hemorrhage.
- In traumatic adrenal hemorrhage cases, surgery may be necessary for the treatment of associated injuries and controlling of haemorrhage

COMPLICATIONS

Adrenal crisis possibly occurs in cases of bilateral adrenal hemorrhage. As the proportion of patient developing this condition are not much documented, the prevalence is controversial.

Adrenal haemorrhage may result in secondary retroperitoneal haemorrhage and has been reported in few cases.

ADRENAL HEMORRHAGE FOLLOW-UP

PATIENT EDUCATION

These patients must wear an identification bracelet to let other know about their condtion in case of emergency.

These patients must increase their glucocorticod dose whenever there is acute stress or trauma.Patients with chronic adrenal insufficiency should be trained to self-inject with hydrocortisone 100 mg intramuscularly and inform medical personels immedietly.

ANALYSIS AND RESULTS

ANALYSIS AND RESULTS

Suspected cases with adrenal hemorrhage subjected to autopsy at RGGGH mortuary from august 2016 to July 2017 were taken into consideration for the study.

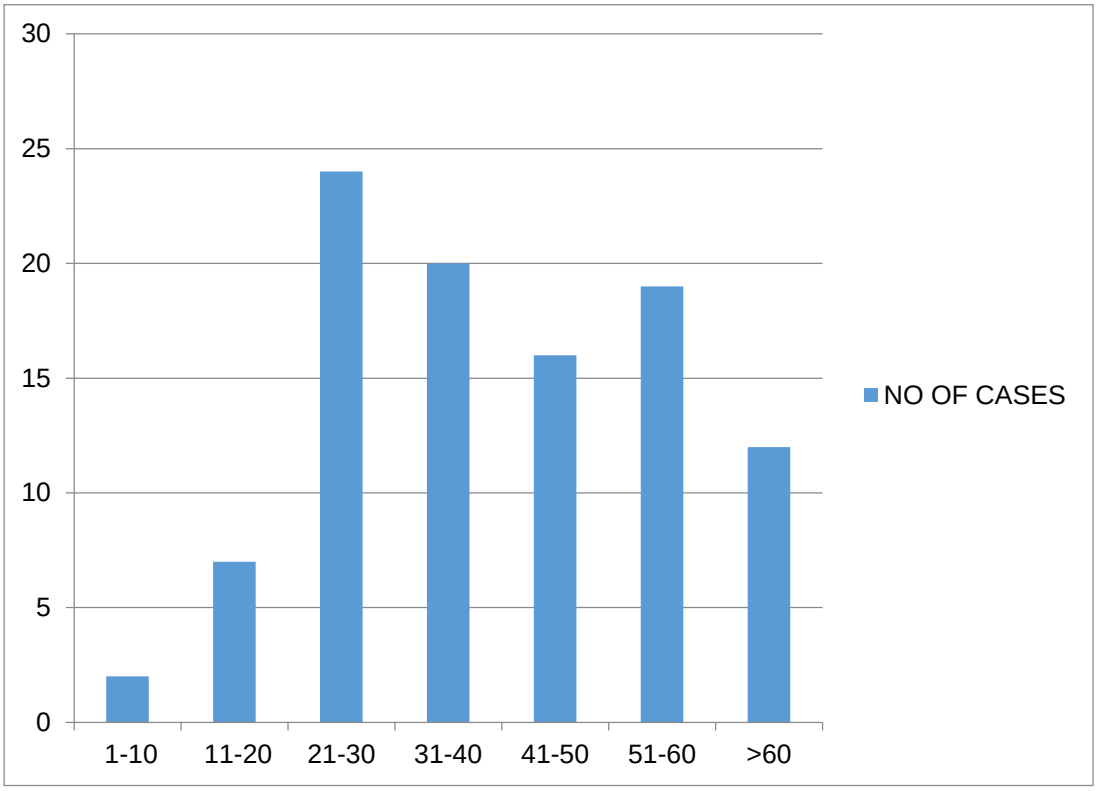
The observation and results are as follows

AGE DISTRIBUTION OF STUDY POPULATION

AGE	NO OF CASES
0-10	2
11-20	7
21-30	24
31-40	20
41-50	16
51-60	19
>60	12

In this study of 100 death cases of various underlying causes 2% cases were in the age group of 1-10 years ,7% were in age group of 11-20 years, 24 %were in the age group of 21-30 years,20% were in the age group of 31-40 years,16 %were in the age group of 41-50 years, 19% were in the age group of 51 to 60 years and 12 %were in the age group of more than 60 years .

AGE DISTRIBUTION OF STUDY POPULATION



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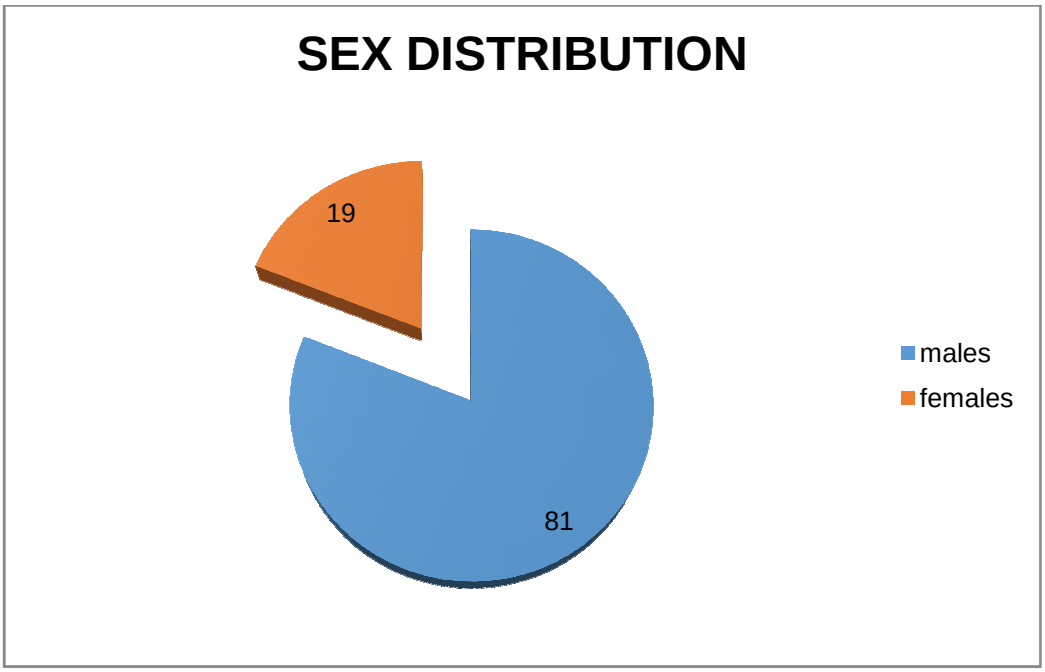
SEX DISTRIBUTION OF STUDY POPULATION

SEX	NO OF CASES
MALE	81
FEMALE	19
TOTAL	100



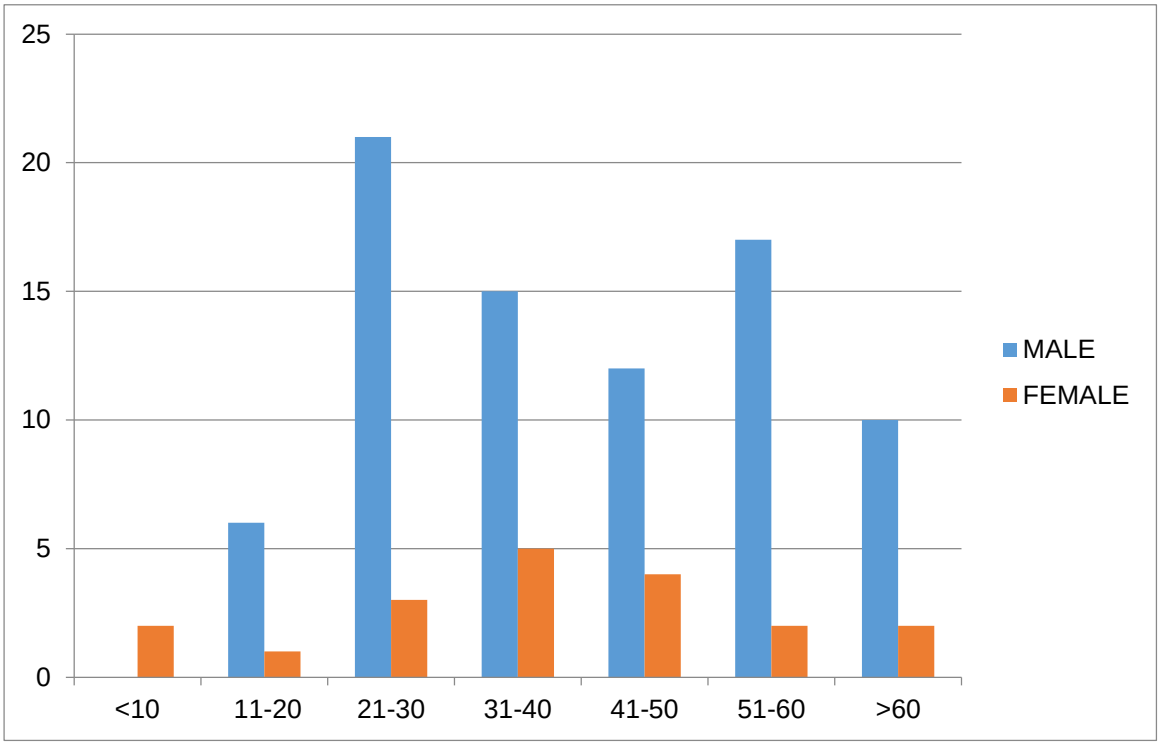
In the study population of 100 death cases the contribution for the study with suspected adrenal hemorrhage was 81% in males and 19% in female

AGE AND SEX DISTRIBUTION OF STUDY POPULATION

AGE IN YEARS	MALE	FEMLAE	TOTAL
<10	0	2	2
11-20	6	1	7
21-30	21	3	24
31-40	15	5	20
41-50	12	4	16
51-60	17	2	19
>60	10	2	12
TOTAL	81	19	100

In the study population 81% cases were male and 19% cases were female. Among men 15/81 belong to the age group of 31-40 years and 17/81 belong to the age group of 51-60 years .among women 5 /19 belonged to the age group of 31-40 years 4/19 among 41-50 years.

AGE AND SEX DISTRIBUTION OF STUDY POPULATION



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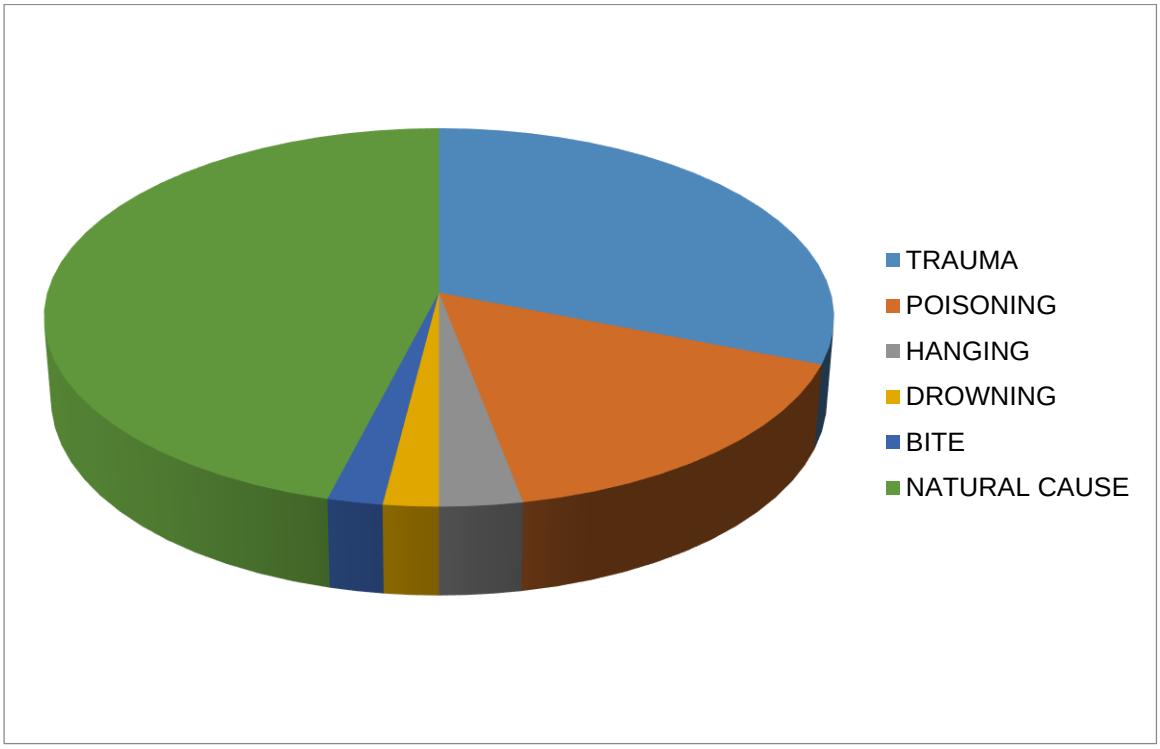
Distribution of study population based on various causes

CAUSE OF DEATH	NO OF CASES
TRAUMA	31
POISONING	16
HANGING	3
DROWNING	2
BITE	2
NATURAL CAUSE	46
TOTAL	100

Different causes were taken into consideration such as natural causes, trauma,hanging ,poisoning and unknown bites for study purpose out of which the contribution of natural cause was 46 and that of traumatic injury was 31 ,poisoning contributed to 16 cases ,hanging 2 cases and unknown bites 2 cases.

Distribution of study population based on various causes



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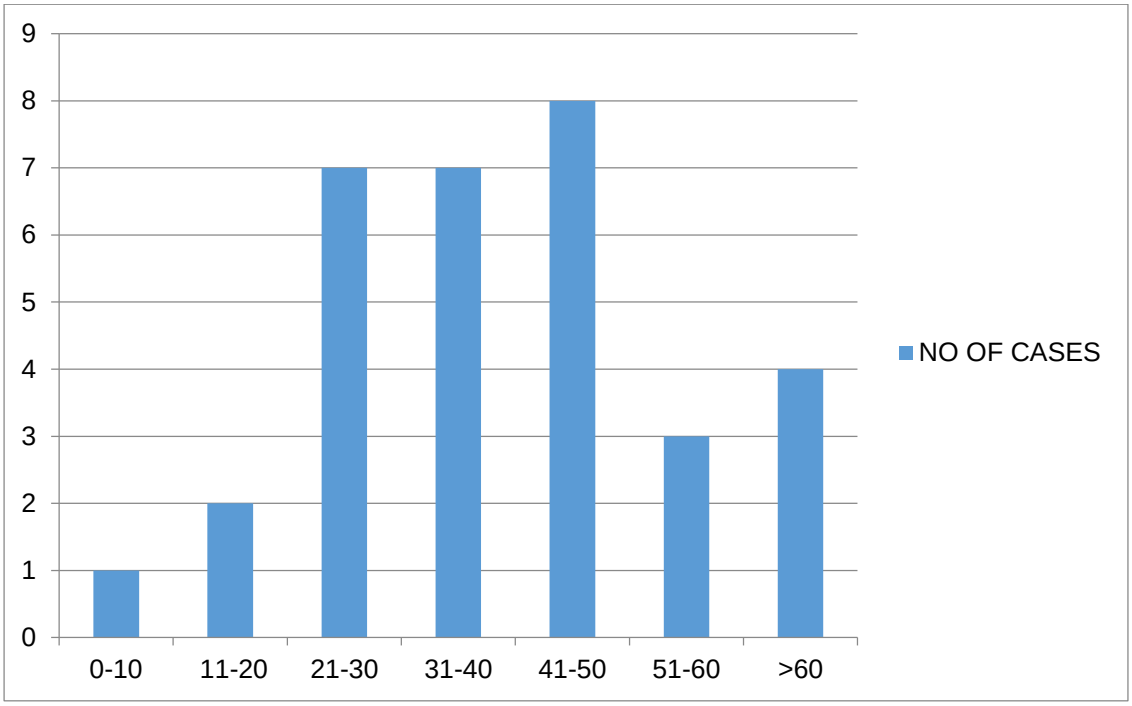
Distribution of study population based on presence of adrenal hemorrhage

AGE	NO OF CASES
0-10	1
11-20	2
21-30	7
31-40	7
41-50	8
51-60	3
>60	4
TOTAL	32

In our study population 32% cases had adrenal haemorrhage among them 1 belonged to 0-10 age group,2 belonged to 11-20 age group,7 belonged to 21-30 age group 7 belonged to 31-40 age group 8 belonged to 41-50 age group 3 belonged to 51-60 age groupl, and 4 belonged to .>60 age group.

Distribution of study population based on presence of adrenal hemorrhage



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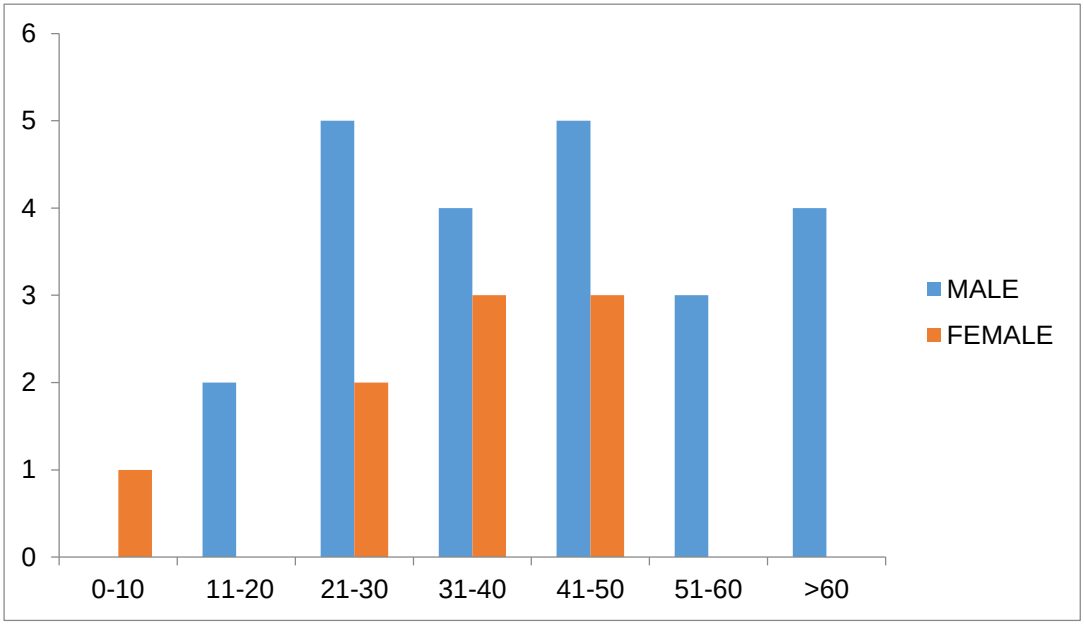
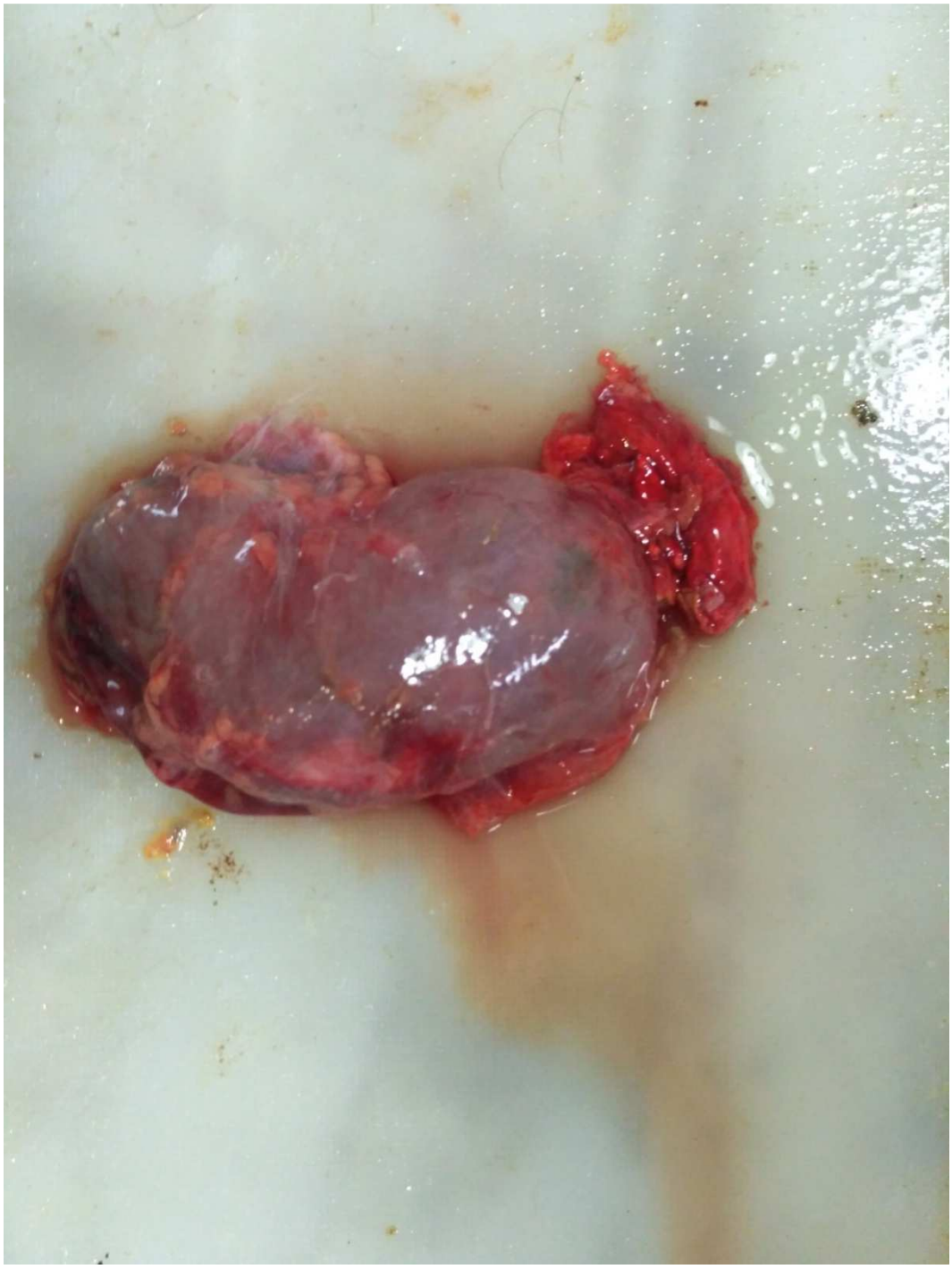
AGE AND SEX DISTRIBUTION OF CASES WITH ADRENAL HEMORRHAGE

AGE GROUP	MALE	FEMALE
0-10	0	1
11-20	2	0
21-30	5	2
31-40	4	3
41-50	5	3
51-60	3	0
>60	4	0
TOTAL	23	9

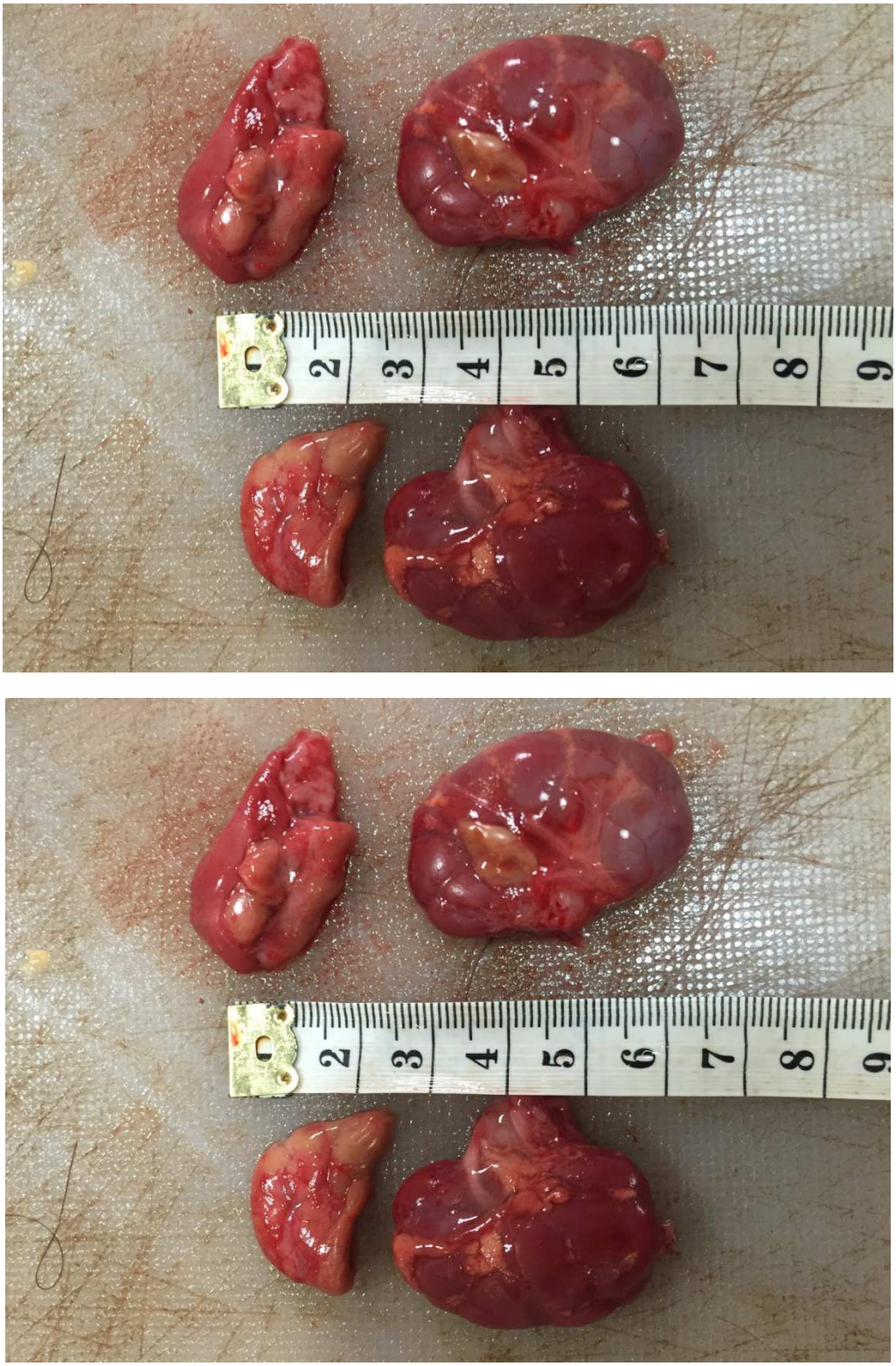


In the study populationof 31% out of which 23 %cases were males and 9 % cases were females and among the females maximum number of cases were 3 whi ch were in the age group of 31-40 and maximumnumber of cases among the males were in the age group of 21-30 and least in the age group of 0- 10

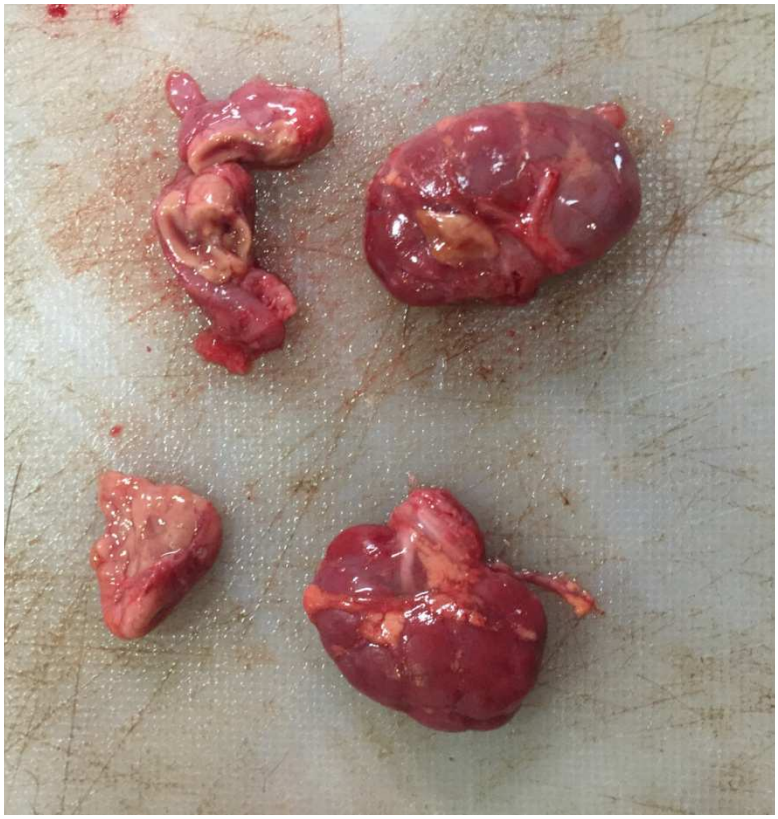
PHOTOS

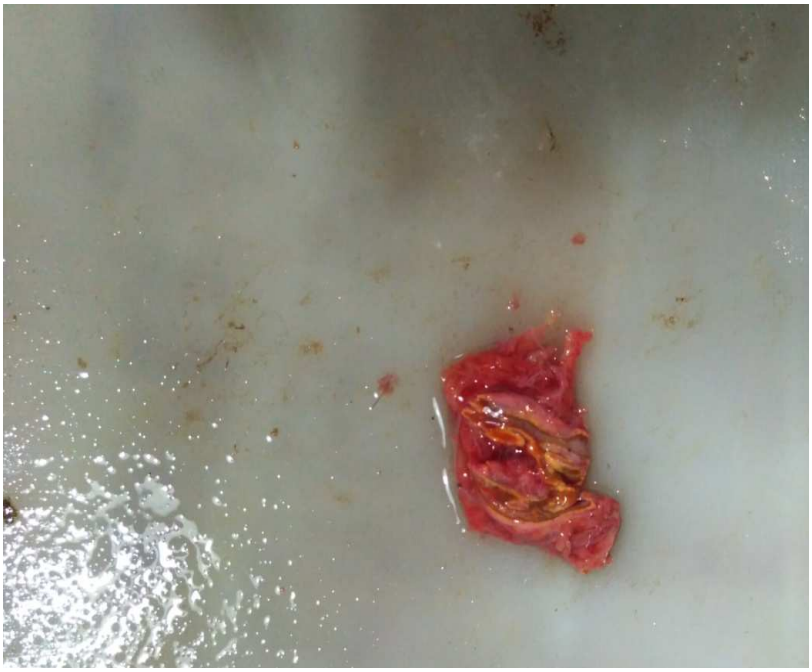


PICTURE OF KIDNEY AND ADRENAL GLAND IN AN ADULT

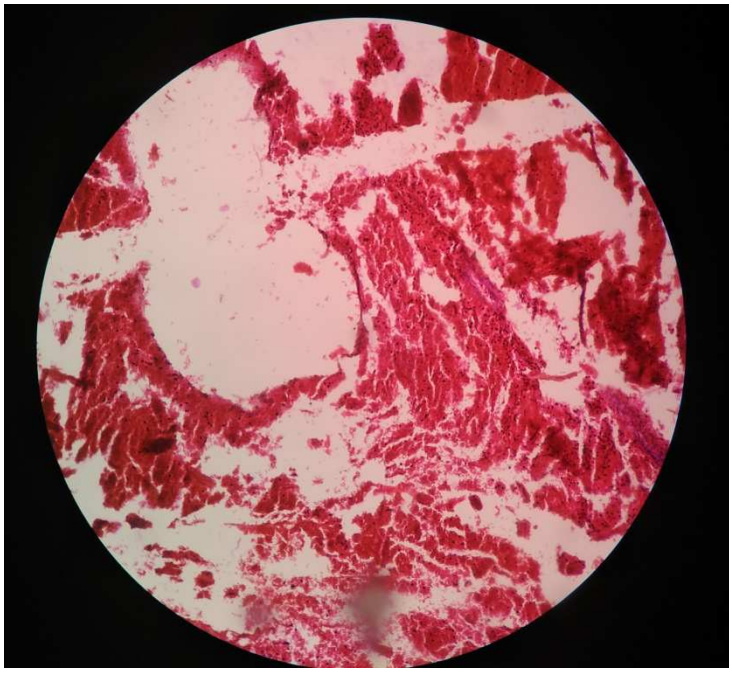


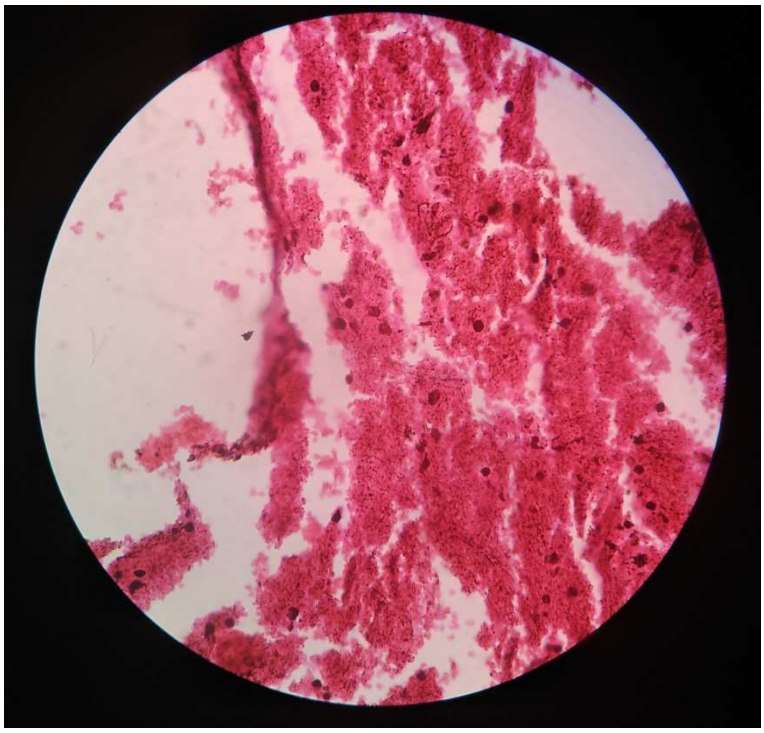
MACROSCOPIC PICTURE OF ADRENAL GLAND IN A 7 MONTH OLD FOETUS SHOWING AN INCREASED SIZE OF ADRENAL GLAND IN COMPARISION TO THE KIDNEY





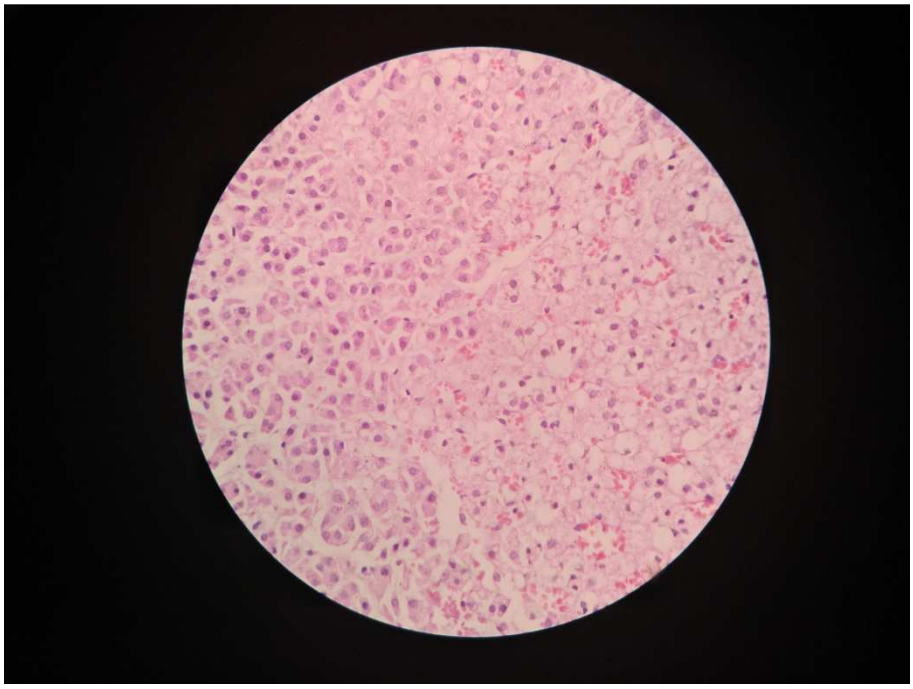
DSSECTED ADRENAL GLAND

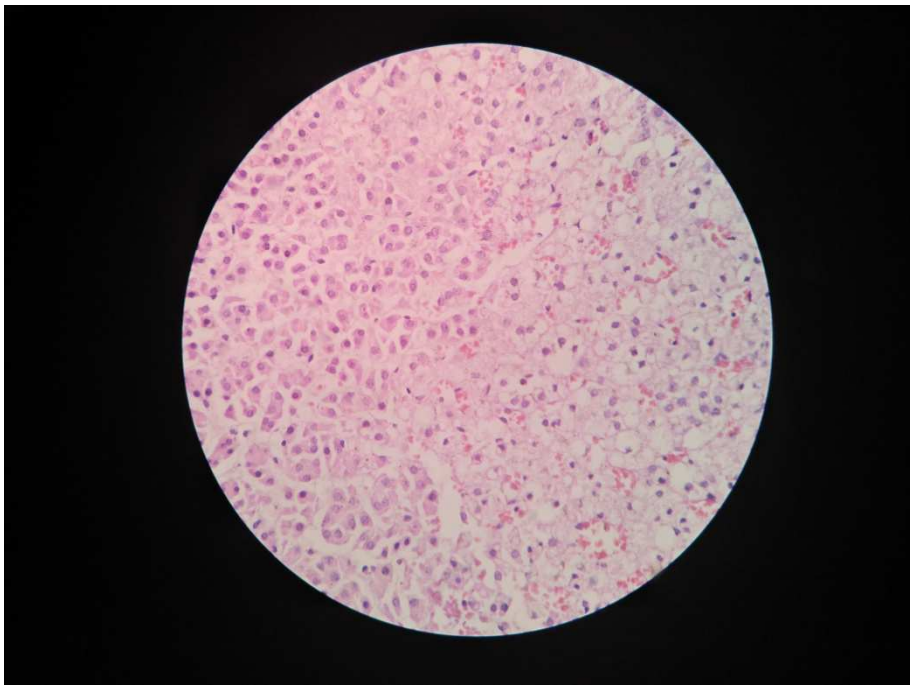




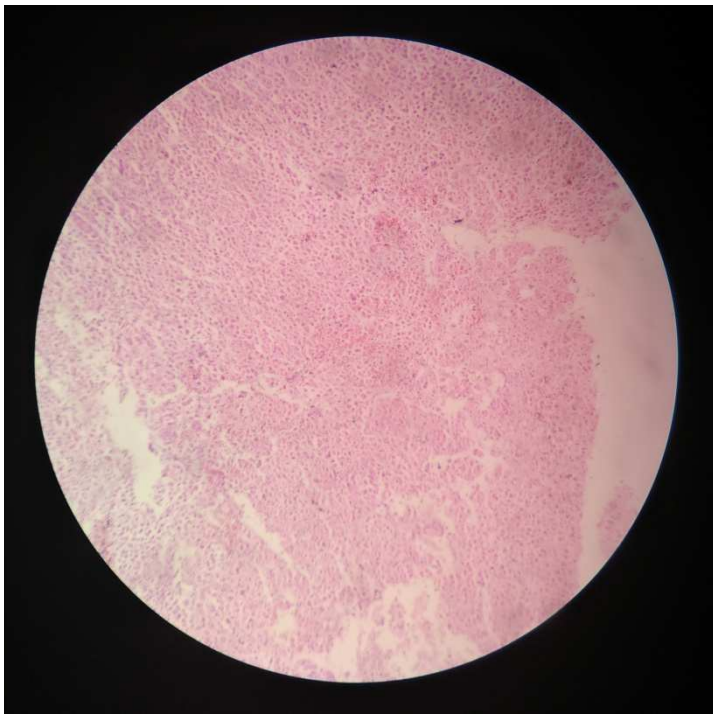
SECTION OF ADRENALS WITH FEW CONGESTED VESSELS AND EXTENSIVE ADRENAL HAEMORRAGE WITH HAEMPRRAGIC INFARCTION

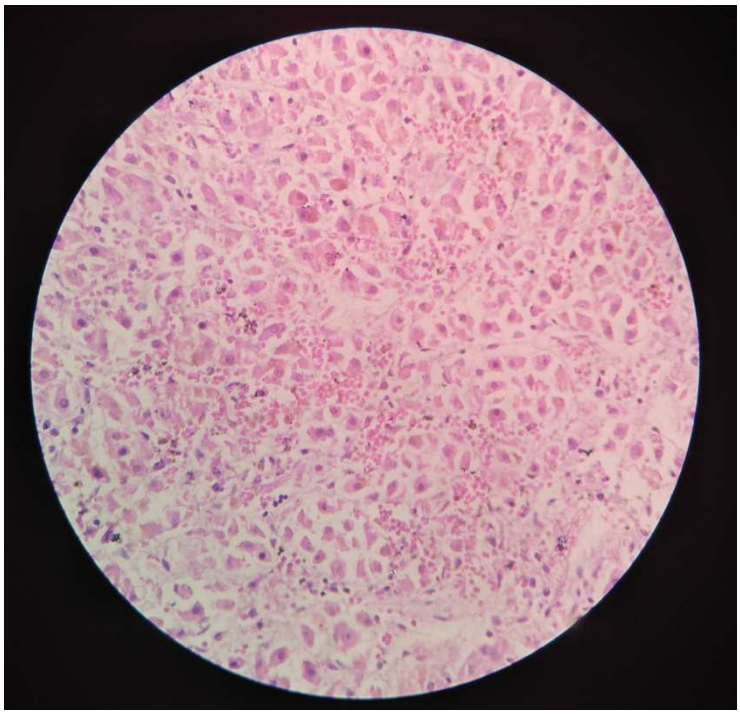
SECTION OF ADRENAL PARENCHYMA WIYH FEW CONGESTED VESSELS AND EXTENSIVE HAEMORRAGE AND HAEMORRAGIC INFARCTION

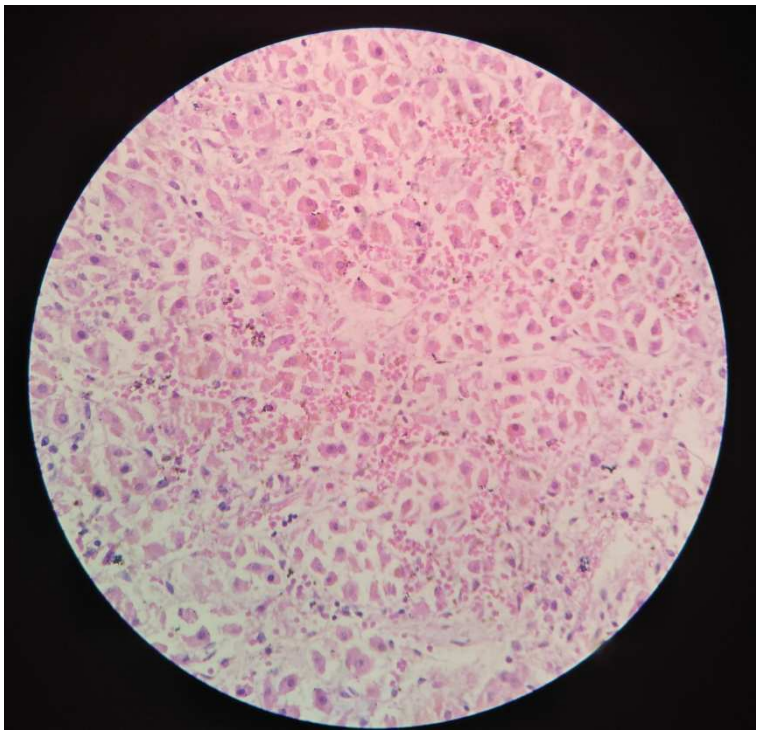


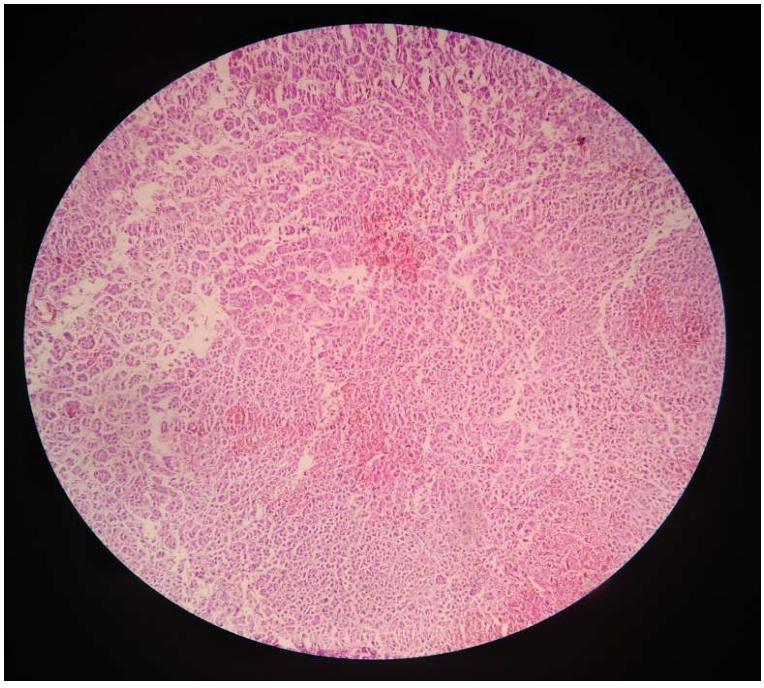


ADRENAL PARENCHYMA WITH FEW CONGESTED VESSELS AND TINY FOCI OF HAEMORRAGE









SECTION OF ADRENAL PARENCHYMA WITH FEW CONGESTED VESSELS AND TINY FOCI OF HAEMORRHAGE

DISCUSSION

DISCUSSION

ADRENAL HAEMORRAGE is a rare yet, potentially life threatening event that occurs in both traumatic conditions and non traumatic conditions .Itis a rare but serious illness carrying a high mortality rate

In our study adrenal haemorrage was present in 32 cases Out of 100 cases which were subjected to postmortem in the study period for one year from august 2016- July 2017 and the suspected cases with adrenal haemorrage were subjected to autopsy .

Adrenal haemorrage can be divided into two types traumatic and non traumatic .Traumatic injury results from direct or indirect injury to adrenal gland and its adjacent structures and non traumatic was due to various other underlying causes.

To our knowledge adrenal haemorrhage is an autopsy finding in most of the cases .It is observed that maximum number of cases were contributed by traumatic injury .It is observerd that maximum traumatic injury cases resulting in adrenal haemorrage were in the age group of 21-30 years and least seen in the age group of 0-10 years.

Among the distribution of adrenal haemorrage traumatic cause played a major role of contributing 16 cases out of the 32 cases.

According to D.R.Rao etal[1] mostly ,extensive bilateral adrenal haemorrhage were seen in the elderly people of age group 40- 80 years at the time of acute event . Patients with traumatic adrenal cases were present

typically in the second to third decade of life and thus my study well corelated with the previous study

Whereas in a retrospective and prospective study done by YI XF etaal n44 cases adrenal haemorrage occurred mainly in male aged 20-40 years

Among the distrbution of cases ,Males contributed to a majority,of 81% of cases and females contributed to 19% of cases, out of which males contributed 23 cases and women by 9 cases.Among men ,17 belonged to the age group of 51-60 years and among women 3 women belonged to 31-40 years and another 3 women belonged to the age group of 41—50 years

50 %mortality rate is being reported in adrenal haemorrhage associated with heparin induced thrombocytopenia according to the journal of royal society of medicine January 1993 page number 618

Different causes such as natural causes ,trauma,hanging ,poisoning and unknown bites were taken into consderation for study purpose. Out of which the contribution by natural cause was 46 and that of traumatic injury was 31 ,poisoning contributed to 16 cases ,hanging 2 cases and unknown bites 2 cases.

On observation of these cases, adrenal haemorrage was present in 13 cases were of various natural causes;16 cases were of traumatic nature; 10 cases of poisoning ;two cases of hanging and one case of unknown bite.

According to DR.Nicholas A.Trtos 50 % [72] of cases of bilateral adrenal haemorrhage were associated with acute stressful illness such as infections ,congestive cardiac failure,myocardial infarction,complications of pregnancy etc. In a study done by kallien o and koljonenv, maximum number of cases were males and all of them were beyond 30 years of age group.

CONCLUSION

CONCLUSION

A prospective study of incidence and patterns of adrenal haemorrage in all death cases was done during the period of August 2016 to July 2017 from the medicolegal autopsies conducted at the Institute of Forensic Medcine ,Madras Medical college Hospital Chennai -03

Out of the 2704 cases 100 cases were subjected to medicolegal autopsy. The adrenal glands were dissected and sent for histopathological examinaion from the Institute of Forensic Medicine, Madras Medical College.

During that period adrenal haemorrhage was made out in 32 cases out of the 100 cases both microscopically and macroscopically From this study the following conclusions could be drawn

1. Most of the deaths were due to trauma associated with adrenal haemorrhage (16cases)
2. Most of the deaths were due to traumatic cause in which associated adrenal haemorrhage was present and were in the age group of 21-30 years (5 cases)
3. The least number were in the age group of 0-10 years(1)
4. The incidence of adrenal Haemorrage in trauma had a male preponderance compared to that of females with 15 cases in males and one case in females
5. Incidence of adrenal haemorrhage was 32 among the 100 cases
6. *Incidence* of adrenal haemorrhage due to trauma was 16 out of 32 cases

7. Increased Incidence of adrenal haemorrhage in men (23 out of 32 cases)
8. Natural cause of death including brought dead cases had a male preponderance
9. In the 46 cases of death due to Natural causes adrenal haemorrage was present in 13 cases

According to this study, adrenal haemorrhage was present in 32 cases which concludes that AH has to be ruled out irrespective of mode and manner of death in all cases.

RECOMMENDATIONS

RECOMMENDATIONS

According to the journal of royal society of medicine adrenal apoplexy has been termed the silent killer but forgotten would be more appropriate as it rarely figures in the differential diagnosis of shock

This study concludes that adrenal hemorrhage contributes to the cause of death in most of the cases. This proves the fact that the adrenal glands are of intrinsic importance in the physiological response to stress, responsible for maintenance of blood pressure and electrolyte homeostasis.

In critically ill patients, unrecognised and untreated adrenal insufficiency is usually fatal and as the presentation of acute adrenal insufficiency is variable and non-specific.

The diagnosis of adrenal insufficiency resulting from adrenal hemorrhage is often overlooked because of the nonspecific nature of the clinical presentation. Most of the adrenal hemorrhage cases were diagnosed only at post-mortem examination. So a high degree of clincal suspicion is recommended. Investigations like seum cortisol level, ultrasound, CT and MRI may be used for the diagnosis. Bilateral AH is a rare entity of adrenal insufficiency and typically presents with nonspecific clinical features. Thus, a high index of clinical suspicion should be present to make a timely diagnosis of AH for patients with risk factors. Fever and hypotension in the appropriate clinical setting needs further investigation Although the diagnosis of AH is infrequently made while the patient is alive,appropriate imaging technique are

useful for establishing a timely diagnosis .In severe physical stress or sepsis AH may be a marker of severe,pre terminal physiologic stress and poor outome. Early diagnosis and corticosteroid replacement with aggressive management of the precipitating pathology are essential to enable a successful outcome.

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Sl. no	PM. NO.	AGE	SEX	CASE	CAUSE OF DEATH	DATE AND TIME OF ADMISSION	DATE AND TIME OF DEATH	DATE AND TIME OF POSTMORTEM	GROSS FINDINGS	MICROSCOPIC FINDINGS	INJURY TO ADJACENT ORGANS	INJURY TO THE KIDNEY	ADRENAL HEMORRHAGE
1	1534/16	62	male	brought dead	coronary artery heart disease	15/07/16 1415Hrs	brought dead 15/07/16 1415Hrs	16/07/16 1325Hrs	congested	No Haemorrhage	no injuries	no injury	present
2	1539/16	50	male	brought dead	coronary artery heart disease	16/07/16 1057Hrs	brought dead 16/07/16 1200Hrs	17/07/16 1010Hrs	extensive Haemorrhage	extensive area of Haemorrhage and haemorragic infarction	injuries	no injury	present
3	1609/16	48	male	brought dead	natural cause	18/07/16 1150Hrs	08/07/17 1710Hrs	09/07/16 1530Hrs	congested	Haemorrhage	no injuries	no injury	Haemorrhage present
4	1617/16	19	male	poisoning	organo phosphorous poisoning	27/07/16 1040Hrs	27/07/16 2040Hrs	29/07/16 1410Hrs	congested	No Haemorrhage	no injuries	no injury	absent
5	1635/16	65	male	snake bite	snake bite	24/07/16 1609Hrs	01/08/16 1736Hrs	02/08/16 1110Hrs	congested	No Haemorrhage	no injuries	no injury	absent
6	1638/16	22	male	poisoning	paraquat poisoning	25/07/16 0317Hrs	01/08/16 1845Hrs	02/08/16 1340Hrs	congested	No Haemorrhage	no injuries	no injury	absent
7	1640/16	24	male	poisoning	paraquat poisoning	01/08/16 2112Hrs	02/08/16 0900Hrs	02/08/16 1545Hrs	congested	congested	no injuries	no injury	congested
8	1653/16	30	male	TTA	multiple injuries	10/07/16 0410Hrs	10/07/16 1030Hrs	04/08/16 1100Hrs	congested	Haemorrhage	yes	yes	present
9	1660/16	60	male	rta	multiple injuries	24/07/16 1227Hrs	04/08/16 0425Hrs	05/08/16 1500Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
10	1661/16	60	male	natural cause	cerebral abscess	25/07/16 1625Hrs	02/08/16 2230Hrs	06/08/16 1005Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
11	1662/16	56	male	rta	head injuries	03/08/16 1837Hrs	05/08/16 0815Hrs	06/08/16 1310Hrs	normal in sze	No Haemorrhage	no injuries	no injury	absent
12	1663/16	51	male	rta	head injuries	27/06/16 1619Hrs	06/08/16 0700Hrs	06/08/16 1350Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
13	1684/16	63	male	fall from height	blunt injury abdomen and head	05/08/16 1428Hrs	08/08/16 0930Hrs	09.08.16 1010Hrs	congested	No Haemorrhage	no injuries	no injury	congested
14	1737/16	70	male	natural cause	intestinal obstucton	14/08/16 0005Hrs	14/08/16 1900Hrs	16/08/16 1210Hrs	congested	No Haemorrhage	no injuries	no injury	congested
15	1752/16	39	male	RTA	multiple injuries	17/08/16 1750Hrs	17/08/16 1900Hrs	18/08/16 1155Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
16	1753/16	70	male	natural cause	pneumona		07/08/16 2030Hrs	18/08/16 1210Hrs	normal n size	No Haemorrhage	no injuries	no injury	absent
17	1754/16	41	male	RTA	multiple injuries	13/08/16 1010Hrs	17/08/16 1900Hrs	18/08/16 1255Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
18	1755/16	62	male	TTA	multiple injuries	16/08/16 0957Hrs	18/08/16 0400Hrs	18/08/16 1310Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
19	1756/16	55	male	natural cause	pulmonary edema	16/08/17 1625Hrs	18/08/16 0805Hrs	18/08/16 1330Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
20	1762/16	25	male	natural cause	asphyxia due to aspration	18/08/16 1150Hrs	18/08/16 1240Hrs	19/08/16 1040Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
21	1785/16	47	female	natural cause	pericardial tamponade	20/08/16 1506Hrs	20/08/16 1815Hrs	21/08/16 1310Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
22	1787/16	40	male	natural cause	cerebrovascular dsease	20/07/16 1405Hrs	20/08/16 1708 Hrs	21/08/16 1400 Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
23	1794/16	58	male	accidental fall	head injuries	21/08/16 0038 Hrs	21/08/16 1845Hrs	22/08/16 1405Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
24	1795/16	28	male	rta	head injuries	14/08/16 1554Hrs	22/08/16 1000Hrs	22/08/16 1535Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
25	1796/16	48	female	RTA	multiple injuries	15/08/16 2300Hrs	22/08/16 1950Hrs	23/08/16 1010Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
26	1798/16	20	male	rta	multiple injuries	19/08/16 0127Hrs	22/08/16 1305Hrs	23/08/16 1210Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
27	1799/16	32	male	RTA	multiple injuries	20/08/16 1753Hrs	23/08/16 0524Hrs	23/08/16 1310Hrs	shattered	yes	yes	yes	present
28	1800/16	25	male	fall	head injuries	17/08/16 0921Hrs	22/08/16 1310Hrs	23/08/16 1410Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
29	1801/16	79	male	natural cause	aspration pneumontis	20/08/16 1100Hrs	21/08/16 2130Hrs	23/08/16 1510Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
30	1802/16	75	female	natural cause	cerebrovascular dsease	21/08/16 2314Hrs	23/08/16 0630Hrs	23/08/16 1610Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
31	1809/16	54	male	rta	head injuries	16/08/16 1632Hrs	24/08/16 1530Hrs	24/08/16 1340Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
32	1813/16	60	male	natural cause	pneumona	07/08/16 0800Hrs	07/08/16 2300Hrs	25/08/16 1040Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
33	1815/16	27	male	rta	head injuries	24/08/16 1223Hrs	24/08/16 2000Hrs	25/08/16 1320Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
34	1817/16	41	male	RTA	multiple injuries	12/08/16 2325Hrs	24/08/16 1700Hrs	25/08/16 1500Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
35	1818/16	50	male	natural cause	coronary artery heart disease	15/08/16 1452Hrs	15/08/16 1525Hrs	26/08/16 1005Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
36	1820/16	46	male	natural cause	cerebrovascular dsease	07/08/16 2015 Hrs	07/08/16 2015Hrs	26/06/16 1105Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
37	1822/16	21	female	natural cause	aspration pneumontis	26/08/16 0550 Hrs	26/08/16 0550Hrs	26/08/16 1210Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
38	1823/16	35	male	poisoning	organo phosphorous poisoning	25.08.16 0443Hrs	26/08/16 0440 am	26.08.16 1340Hrs	congested	congested	no injuries	no injury	congested

39	1824/16	51	male	natural cause	coronary artery heart disease	26/08/16 0300 Hrs	26/08/16 0300Hrs	26/08/16 1410Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
40	1838/16	55	male	RTA	multiple injuries	18/08/16 2207Hrs	27/08/16 1615Hrs	28/08/16 1310Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
41	1839/16	45	male	natural cause	cerebrovascular dsease	27/08/16 0530 Hrs	27/08/16 0530Hrs	28/08/16 1310Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
42	1840/16	25	male	poisoning	organo phosphorous poisoning	27/08/16 1050Hrs	27.08.16 1420Hrs	28/08/16 1410Hrs	congested	Haemorrhage present	no injuries	no injury	present
43	1842/16	37	male	RTA	multiple injuries	10/07/16 1030Hrs	28/08/16 0530Hrs	28/08/16 1510Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
44	1844/16	36	male	hanging	asphyxia	27/08/16 1220Hrs	28/08/16 2015Hrs	29/08/16 1015Hrs	normal in size	No Haemorrhage	no injuries	no injury	present
45	1845/16	50	male	natural cause	coronary artery heart disease	28/08/16 1305 Hrs	28/08/16 1305Hrs	29/08/16 1105Hrs	normal in size	No Haemorrhage	no injuries	injury	present
46	1862/16	25	male	rta	blunt injury abdomen wth pertonitis	28/08/16 0932Hrs	29/08/16 1500Hrs	30/08/16 1140Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
47	1871/16	24	male	poisoning	zinc phosphide	29/08/16 1441Hrs	30/08/16 1340Hrs	31/08/16 1420Hrs	normal in size	Haemorrhage present	no injuries	no injury	present
48	1990/16	27	female	poisoning	polydolpoisoning	06/09/16 1242Hrs	13/09/16 1545Hrs	15/09/16 1110Hrs	normal in size	Haemorrhage	no injuries	no injury	present
49	1993/16	23	female	poisoning	supervasmol poisonng	13/09/16 1651Hrs	13/09/16 1800Hrs	15/09/16 1315Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
50	2008/16	34	male	brought dead	malignant tumour right lung	15/09/16 0000Hrs	15/09/16 0025Hrs	16/09/16 1330Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
51	2040/16	57	male	brought dead	coronary artery heart disease	20/09/16 0700 Hrs	20/09/16 0900 Hrs	20/09/19 1300 Hrs	normal in size	Haemorrhage	no injuries	no injury	present
52	2070/16	45	female	brought dead	aspiration pnemonitis	23/09/16 0600 HRS	23/09/16 0630 Hrs	23/09/16 1020Hrs	normal in size	Haemorrhage	no injuries	no injury	present
53	2181/16	57	female	poisoning	tablet poisoning	22/09/16 1209Hrs	09/10/16 1330Hrs	10.10.16 1340Hrs	normal in sze	No Haemorrhage	no injuries	no injury	absent
54	2196/16	18	female	poisoning	crohns disease	07/10/16 1253Hrs	11/10/16 0500Hrs	12/10/16 1240Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
55	2221/16	21	male	poisoning	zinc phosphide	13/10/16 1749Hrs	15/10/16 0845Hrs	16/10/16 1010Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
56	2231/16	28	male	brought dead	non traumatic sdh	17/10/16 1730Hrs	17/10/16 0730Hrs	18/10/16 1600Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
57	2245/16	45	male	rta	head injuries	23/09/16 1000Hrs	23/09/16 1030Hrs	20/10/16 1520Hrs	normal in sze	No Haemorrhage	no injuries	no injury	absent
58	2449/16	68	male	brought dead	coronary artery heart disease	19/11/16 1745Hrs	19/11/16 1845Hrs	20/11/16 1220Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
59	2508/16	35	female	bee sting	head injuries	23/11/16 1717Hrs	26/11/16 2300Hrs	27/11/16 1040Hrs	normal in sze	congested	no injuries	no injury	present
60	2636/16	35	female	brought dead	aspiration of food particles	11/12/16 1700Hrs	11/12/16 1745Hrs	14/12/16 1540Hrs	normal in size	congested	no injuries	no injury	absent
61	2675/16	60	female	natural cause	coronary artery heart disease	17/12/16 1435Hrs	18/12/16 1320Hrs	19/12/16 1430Hrs	normal in sze	congested	no injuries	no injury	absent
62	2710/16	37	male	brought dead	pneumonitis	24/12/16 0150Hrs	24/12/16 0630Hrs	24/12/16 1420Hrs	normal n size	congested	no injuries	no injury	absent
63	2762/16	67	male	rta	multiple injuries	14/12/16 0100Hrs	30/12/16 05.00Hrs	31/12/16 1010Hrs	normal in size	Haemorrhage present	no injuries	no injury	absent
64	2769/16	22	male	brought dead	aspiration of food particles	26/12/16 0115Hrs	26/12/16 0215Hrs	31/12/16 1430Hrs	congested	congested	no injuries	no injury	present
65	37/17	56	male	brought dead	myocardial infarction	03/01/17 23.00Hrs	04/01/17 0045Hrs	04/01/17 1410Hrs	congested	Haemorrhage present	no injuries	no injury	present
66	130/17	48	male	poisoning	tablet poisoning acute kidney injury	05/01/17 18.45Hrs	18/01/17 1045Hrs	19/01/17 1040Hrs	normal in size	Haemorrhage present	injuries present	injury	present
67	429/17	23	male	brought dead	aspiration of food particles	26/02/17 0800Hrs	26/02/17 0900Hrs	26/02/17 1410Hrs	normal in size	Haemorrhage	no injuries	no injury	absent
68	430/17	39	male	poisoning	steatohepatits chronic liver disease	25/02/17 1117Hrs	25/02/17 2010Hrs	26/02/17 1440Hrs	normal in size	Haemorrhage present	no injuries	no injury	present
69	550/17	27	male	poisoning	paraquat poisoning	15/02/17 0210Hrs	15/03/17 0925Hrs	16/03/17 1240Hrs	congested	Haemorrhage present	no injuries	no injury	present
70	607/17	1	female	btought dead	paracetamol toxcity	25/03/17 1400Hrs	25/03/17 1410Hrs	25/03/17 1500Hrs	congested	Haemorrhage present	no injuries	no injury	present
71	729/17	36	female	natural cause	brain stem Haemorrhage	08/04/17 0157Hrs	08/04/17 1710Hrs	09/04/17 1230Hrs	congested	No Haemorrhage	no injuries	no injury	absent

72	833/17	31	female	natural cause	sepsis pneumonia	15/04/17 0348Hrs	21/04/17 1745Hrs	22/04/17 1505Hrs	congested	congested and Haemorrhage present	no injuries	no injury	present
73	890/17	39	male	fall from height	multiple injuries	16/04/17 1625Hrs	30/04/17 1530Hrs	01/05/17 1010Hrs	normal in size	congested	no injuries	no injury	congested
74	1038/17	54	male	brought dead	organo phosphorous poisoning	17/05/17 2200Hrs	18/05/17 1300Hrs	19/05/17 1010Hrs	normal in size	congested	no injuries	no injury	absent
75	1222/17	20	male	brought dead	pulmonary edema	08/06/17 0630Hrs	08/06/17 0730Hrs	09/06/17 1310Hrs			no injuries	no injury	absent
76	1273/17	32	male	natural cause	cardiomagaly	15/06/17 0550Hrs	16/06/17 0145Hrs	16/06/17 1010Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
77	1276/17	20	male	natural cause	hepato renal disease	21/06/17 1435Hrs	15/06/17 0650Hrs	16/06/17 1230Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
78	1315/17	12	male	brought dead	aspiration of food particles	04/07/17 1845Hrs	21/06/17 1535Hrs	21/06/17 1300Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
79	1430/17	23	male	brought dead	myo cardial infarction	04/07/17 2330Hrs	04/07/17 1945Hrs	06/07/17 1240Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
80	1469/17	26	male	rta	blunt injury head and chest	17/07/17 1200Hrs	10/07/17 0030Hrs	10/07/17 1410Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
81	1520/17	21	male	poisoning	brought dead	23/07/17 0620Hrs	18/07/17 0545Hrs	18/07/17 1500Hrs	congested	Haemorrhage and focal infarcton	no injuries	no injury	congested blood vessels and Haemorrhage and focal infarcton
82	1554/17	46	male	brought dead	drowning	23/07/17 0320Hrs	22/07/17 0730Hrs	23/07/17 1410Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
83	1556/17	32	male	brought dead	pulmonary edema	20/07/17 1506Hrs	23/07/17 0420Hrs	23/07/17 1610Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
84	1568/17	36	female	RTA	head injuries	24/07/17 0300Hrs	24/07/17 1300Hrs	25/07/17 1010Hrs	normal in size	tiny foci of Haemorrhage	no injuries	no injury	parenchyma wth congested vessels and tiny foci of Haemorrhage
85	1597/17	18	male	RTA	head injuries	24/07/17 1905Hrs	27/07/17 0430Hrs	28/07/17 1010Hrs	normal in size	Tiny foci of Haemorrhage and heamorraglc Infarcton	out	no injury	parenchyma with few congested vessels and tiny foci of Haemorrhage and haemorragic infarcton
86	1601/17	58	male	RTA	head injuries	26/07/17 1506Hrs	28/07/17 0005Hrs	28/07/17 1240Hrs	congested	congested	no injuries	no injury	few congested vessels no Haemorrhage
87	1603/17	40	male	RTA	effects of multple injuries	30.07.17 0550Hrs	28/07/17 0420Hrs	28/07/17 1520Hrs	Normal in size	Tiny foci of Haemorrhage	no injuries	no injury	parenchyma with few congested vessels and tiny foci of Haemorrhage
88	1616/17	44	male	natural cause		29/07/17 0930Hrs	30/07/17 0655Hrs	30/07/17 1215Hrs		No Haemorrhage	no injuries	no injury	absent
89	1634/17	27	male	RTA	effects of head injuries	01/08/17 0700Hrs	31/07/17 1810Hrs	01/08/17 1250Hrs	Normal in size no Haemorrhage	No Haemorrhage	no injuries	no injury	parenchyma with few congested vessels and tiny foci of Haemorrhage
90	1636/17	32	male	brought dead	coronary artery heart disease	02/08/17 1444Hrs	01/08/17 0800Hrs	01/08/17 1420Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
91	1653/17	30	male	snake bite	snake envenomation	29/07/17 0344Hrs	02/08/17 1600Hrs	03/08/17 1230Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
92	1663/17	59	male	brought dead	coronary artery heart disease	01/08/17 1220Hrs	04/08/17 1230Hrs	05/08/17 1005Hrs	normal in size	No Haemorrhage	congested	no injury	numerou congested vessels and tny foc of Haemorrhage
93	1664/17	40	male	rta	head injuries	04/08/17 1930Hrs	04/08/17 2230Hrs	05/08/17 1105Hrs	normal in size	No Haemorrhage	congested	no injury	numerous congested vessels and no evdence of Haemorrhage

94	1666/17	64	male	natural cause brought dead	coronary artery heart disease	05/08/17 2015Hrs	04/08/17 1930Hrs	05/08/17 1245Hrs	congested	No Haemorrhage	congested	no injury	numeros congested vessels and focal haemorragic infarcton
95	1668/17	52	male	hanging	asphyxa	02/08/17 1815Hrs	05/08/17 0915Hrs	05/08/17 1310Hrs	congested	No Haemorrhage	no injuries	no injury	numerous congested vessels and tiny focal Haemorrhage
96	1670/17	24	male	hanging	asphyxa	25/06/17 1036Hrs	04/08/17 1335Hrs	05/08/17 1430Hrs	congested	No Haemorrhage	no injuries	no injury	congested
97	1700/17	34	male	drowning	drowning	07/08/17 1320Hrs	09/08/17 1105Hrs	09/08/17 1200Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
98	1708/17	45	female	fall from height	head injuries	23/05/17 1600Hrs	09/08/17 2330Hrs	10/08/17 1050Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
99	1859/17	54	male	brought dead	aspiration due to food partcles	29/08/17 1241Hrs	28/08/17 1950Hrs	29/08/17 1410Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent
100	1873/17	80	female	natural cause	sepsis pneumonia	06/09/17 1830Hrs	30/08/17 2030Hrs	31/08/17 1410Hrs	normal in size	No Haemorrhage	no injuries	no injury	absent