

# Study of Morphological changes of Adrenals in Suicidal cases, An Autopsy-based Study at a Tertiary Care Centre at Odisha

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## Abstract

**Introduction:** Uncertainty and instability are the norm of today's work environment. Now-a-days suicidal cases account for more than a million deaths each year. This work has been undertaken to study the Morphological adaptive changes in adrenal gland in such stressful conditions.

**Aim & Objectives:** To correlate the Morphological adaptive changes in adrenal gland in response to chronic stress since it is a stress responding organ common to both the HPA axis & Sympathoadrenomedullary axis.

**Material & Methods:** The study was carried out from 5<sup>th</sup> April 2021 to 5<sup>th</sup> April 2023 at SCB Medical college, Cuttack, Odisha. Right and Left adrenals of hundred suicidal cases and twenty accidental cases (control) were studied.

**Results:** On Morphological Analysis it was found that Adrenal gland increases both in weight & dimensions in suicidal cases as compared to Accidental cases. A normal pattern of Adrenal gland is informative of receipt of sudden violence i.e accident.

**Conclusion:** The present study concludes and supports the idea that chronic stress as in suicide usually induces adrenal growth which may have implications for forensic people in revealing the cause of unknown deaths.

**Key words:** HPA axis, Stress, Suicide, Sympathoadrenomedullary axis.

## Introduction

The Adrenal gland reflects the functional changes of the stress system which leaves an imprint on the morphology of the gland. The body's reaction to a

stressor is part of our survival mechanism. Under stress, the ACTH is released into circulation by the anterior pituitary. ACTH reaches the adrenal cortex where it stimulates the endocrine cells to secrete the steroid hormone cortisol. The Zona fasciculata

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of adrenal cortex is rich in lipids which acts as the raw material for the synthesis of cortisol. Chronic stress leads to hypertrophy and hyperplasia of zona fasciculata<sup>1</sup>. There is positive correlation between adrenal weight and total cortical thickness in both Right and Left adrenal<sup>2</sup>. The proliferative effect of ACTH on adrenal is due to release of extracellular signal related kinases<sup>3</sup>. ACTH also induces expression of genes associated with cell cycle proliferation c-fos and c-jun<sup>4</sup>. Thus the bilateral enlargement of adrenal is mainly due to ACTH<sup>5</sup>.

Keeping in view of this present day situation where uncertainty and instability are the norm in today's work environment. Suicide is one of the ten leading causes of death in the world accounting for more than a million deaths annually. As per WHO, there is one suicidal death in 40 seconds throughout the world. India and China are responsible for 30% of all cases of suicide worldwide.

Therefore, the present research work has been undertaken to correlate and study the morphological adaptive changes in adrenal gland in stressful conditions as in case of suicidal deaths, because adrenal is a stress responding organ and reflects the functional changes of the stress system which leaves an imprint on the morphology of the gland.

### Materials and Methods

The present study was carried out from 5<sup>th</sup> April 2021 to 5<sup>th</sup> April 2023 at SCB Medical college, Cuttack, Odisha. Human adrenals of hundred suicidal cases & twenty accidental cases of different age groups were obtained from the Forensic Department after necessary formalities. Both Right & Left adrenals

were collected separately in plastic containers containing the fixatives i.e. 10% Formal saline. Both the adrenals were dissected out from the upper pole of the kidney. After removing the fat, gross inspection was done with the help of hand lens for congestion, hemorrhage and oedema.

### Inclusion Criteria

All established cases of suicide with prominent autopsy findings and relevant history.

### Exclusion Criteria

- Cases with extremes of age groups i.e. < 15 yrs and > 60 yrs.
- Cases with doubtful and insufficient history.
- Suicidal cases which were brought for Post mortem after 8hrs of death depending on the environmental temp. and cause of death.
- Pregnant ladies

### Morphological Analysis

After immersing the specimen in formalsaline for twelve hours, dimension i.e. Length, Breadth & Thickness of adrenals were measured using Vernier callipers.

The weight of adrenal was taken from Digital Weighing machine.

**Statistical Analysis:** Statistical analysis in this study comprises of one-way ANOVA with (Turkey's multiple comparison) test for comparing the dimensions of adrenal gland between suicidal and accidental cases. Chi-Square test is used for gross changes in adrenal gland.

## Results

**Table 1: AGE DISTRIBUTION OF DEATH CASES**

| Age Group (Yrs.) | Suicidal     |            | Accidental   |            |
|------------------|--------------|------------|--------------|------------|
|                  | No. of Cases | Percentage | No. of Cases | Percentage |
| 15-30            | 43           | 43.00      | 12           | 60.00      |
| 31-45            | 47           | 47.00      | 4            | 20.00      |
| 46-60            | 10           | 10.00      | 4            | 20.00      |
| Total            | 100          | 100.00     | 20           | 100.00     |

Data depicted in **Table-I** represent the age-wise distribution of suicidal and accidental cases. It is evident that the age Grade representing (31-45 years)

has highest incidence of suicidal cases accounting for (47%), the 2nd highest incidence accounting to (43%) is of younger age group i.e. 15-30 years and least

incidence of suicidal cases in older age group i.e. 46 to 60 years. But in case of accidental cases, the younger

age group represent the highest percentage i.e. 60% which is explained by their unstable state of mind.

**Table 2: GENDER DISTRIBUTION OF DEATHS**

| Sex    | Suicidal     |            | Accidental   |            |
|--------|--------------|------------|--------------|------------|
|        | No. of Cases | Percentage | No. of Cases | Percentage |
| Male   | 58           | 58.00      | 18           | 90.00      |
| Female | 42           | 42.00      | 2            | 10.00      |
| Total  | 100          | 100.00     | 20           | 100.00     |

Data depicted in the table-2 represent the sex-wise distribution of both suicidal and accidental cases.

It is evident that the incidence of suicide and accident is higher among males than their female counterparts.

**Table 3: AGE-WISE GENDER DISTRIBUTION OF DIFFERENT DEATHS**

| Cases      | Male       |            |            | Female     |            |            |
|------------|------------|------------|------------|------------|------------|------------|
|            | 15-30 Yrs. | 31-45 Yrs. | 46-60 Yrs. | 15-30 Yrs. | 31-45 Yrs. | 46-60 Yrs. |
| Suicidal   | 18         | 34         | 6          | 25         | 3          | 4          |
| Accidental | 10         | 4          | 4          | 2          | 0          | 0          |

This table depicts the age-wise gender distribution of both suicidal and accidental cases. It is evident that the number of suicidal case is maximum

in males of middle age group and in females of younger age group. Accidental death was observed to be maximum in young males.

**Table 4: Adrenal Weight (gms) of Suicidal and Accidental males of different age groups**

| Laterality |      | 15 - 30 Yrs.    |                   | 31 - 45 Yrs.    |                  | 46 - 60 Yrs.   |                  |
|------------|------|-----------------|-------------------|-----------------|------------------|----------------|------------------|
|            |      | Suicidal (n=18) | Accidental (n=10) | Suicidal (n=34) | Accidental (n=4) | Suicidal (n=6) | Accidental (n=6) |
| Left       | Mean | 6.50*†          | 5.20*             | 6.10*†          | 5.00             | 5.9†           | 4.9              |
|            | ±    | ±               | ±                 | ±               | ±                | ±              | ±                |
|            | SE   | 0.07            | 0.04              | 0.34            | 0.10             | 0.14           | 0.05             |
| Right      | Mean | 6.50*†          | 5.20*             | 6.10*†          | 4.90             | 5.8†           | 4.9              |
|            | ±    | ±               | ±                 | ±               | ±                | ±              | ±                |
|            | SE   | 0.07            | 0.05              | 0.05            | 0.06             | 0.17           | 0.14             |

\* P<0.001; Suicidal Young Vs. Suicidal Elder

†: P<0.001; Suicidal Vs. Accidental deaths of respective age groups

This table shows the weight of adrenal glands of both suicidal and accidental cases among the male individuals.

The young age group (15-35 years) show a higher weight than the other two age groups. The

adrenal weights of both sides in accidental and suicidal death cases were compared age wise. There was a significant difference among these groups (P < 0.001).

A highly significant difference (P< 0.001) was observed among the suicidal deaths of three different age groups by using Post Anova test.

**Table 5: Adrenal Length (mm) of Suicidal and Accidental(males) death cases of different age groups**

| Laterality |      | 15 - 30 Yrs.       |                      | 31 - 45 Yrs.       |                     |
|------------|------|--------------------|----------------------|--------------------|---------------------|
|            |      | Suicidal<br>(n=18) | Accidental<br>(n=10) | Suicidal<br>(n=34) | Accidental<br>(n=4) |
| Left       | Mean | 56.32*†            | 50.95                | 53.53†             | 49.95               |
|            | ±    | ±                  | ±                    | ±                  | ±                   |
|            | SE   | 0.52               | 0.21                 | 0.24               | 0.68                |
| Right      | Mean | 56.36*†            | 51.10                | 53.32†             | 49.75               |
|            | ±    | ±                  | ±                    | ±                  | ±                   |
|            | SE   | 0.44               | 0.18                 | 0.21               | 0.18                |

\* P<0.001; Suicidal Young Vs. Suicidal Elder

†: P<0.001; Suicidal Vs. Accidental deaths of respective age groups

The suicidal cases of 46-60 yrs did not show any significant differences in length, breadth and thickness as compared to the accidental deaths (Data not shown) .

MS1LTLT - Mean length of left adrenal in younger age group suicidal case

MA1LTLT - Mean length of left adrenal in younger age group accidental case

MS1LTRT - Mean length of right adrenal in younger age group suicidal case .

MA1LTRT - Mean length of right adrenal in younger age group accidental case

MS2LTLT - Mean length of left adrenal in middle age group suicidal case

MA2LTLT - Mean length of left adrenal in middle age group accidental case

MS2LTRT -- Mean length of right adrenal in middle age group suicidal case

MA2LTRT - Mean length of right adrenal in middle age group suicidal case

MS3LTLT - Mean length of left adrenal in older age group suicidal case

MA3LTLT -- Mean length of left adrenal in older age group accidental case

MS3LTRT - Mean length of right adrenal in older age group suicidal case.

MA3LTRT- Mean length of right adrenal in older age group accidental case

Similarly the abbreviations used for breadth and thickness are MS1BHLLT, MA1BHLLT, MS2BHLLT- - - -

**Table 6: Adrenal Breadth (mm) of Suicidal and Accidental ( males ) death cases of different age groups**

| Laterality |      | 15 - 30 Yrs.       |                      | 31 - 45 Yrs.       |                     |
|------------|------|--------------------|----------------------|--------------------|---------------------|
|            |      | Suicidal<br>(n=18) | Accidental<br>(n=10) | Suicidal<br>(n=34) | Accidental<br>(n=4) |
| Left       | Mean | 46.84*†            | 41.32                | 44.61†             | 41.20               |
|            | ±    | ±                  | ±                    | ±                  | ±                   |
|            | SE   | 0.30               | 0.24                 | 0.19               | 0.33                |
| Right      | Mean | 46.71*†            | 41.15                | 44.54†             | 41.08               |
|            | ±    | ±                  | ±                    | ±                  | ±                   |
|            | SE   | 0.28               | 0.28                 | 0.18               | 0.18                |

\* P<0.001; Suicidal Young Vs. Suicidal Elder

†: P<0.001; Suicidal Vs. Accidental deaths of respective age groups

This table shows the breadth of adrenal glands of both suicidal and accidental cases among the male individuals.

**Table 7: Adrenal Thickness (mm) of Suicidal and Accidental (males) death cases of different age groups**

| Laterality |      | 15 - 30 Yrs.    |                   | 31 - 45 Yrs.    |                  |
|------------|------|-----------------|-------------------|-----------------|------------------|
|            |      | Suicidal (n=18) | Accidental (n=10) | Suicidal (n=34) | Accidental (n=4) |
| Left       | Mean | 16.34*†         | 11.38             | 14.21†          | 10.70            |
|            | ±    | ±               | ±                 | ±               | ±                |
|            | SE   | 0.32            | 0.24              | 0.13            | 0.19             |
| Right      | Mean | 15.66*†         | 11.54             | 14.11†          | 10.83            |
|            | ±    | ±               | ±                 | ±               | ±                |
|            | SE   | 0.24            | 0.23              | 0.15            | 0.15             |

\* P<0.001; Suicidal Young Vs. Suicidal Elder

†: P<0.001; Suicidal Vs. Accidental deaths of respective age groups

This table shows the thickness of adrenal glands of both suicidal and accidental cases among the male individuals.

The adrenal thickness of accidental and suicidal death cases were significantly (P < 0.001) different as compared age wise.

**Table 8: Naked Eye Examination**

| Gross features | Suicidal    | Accidental  | Chi-square | P Value |
|----------------|-------------|-------------|------------|---------|
| Oedema         | 50 (50.00%) | 10 (50.00%) | 0          | >0.05   |
| Congestion     | 63 (63.00%) | 12 (60.00%) | 0.06       | >0.05   |
| Haemorrhage    | 83 (83.00%) | 9 (45.00%)  | 13.45      | <0.001  |
| Colour (Red)   | 97 (97.00%) | 3 (15.00%)  | 80.69      | <0.001  |

The above table depicts the gross changes of adrenal glands in both suicidal and accidental death cases. Chi-Square test revealed that the oedematous changes and congestion of adrenal glands are not associated with the type of death.

However, the incidence of haemorrhage in suicidal and accidental death (83% and 45% respectively), red colour of adrenal glands in (suicidal 97% and accidental 15% respectively) differ significantly P < 0.001). It revealed that the incidences of these two events are strongly associated with type of death.



**Fig 1: Removal of Congested and Haemorrhagic Adrenal in Suicidal Case**



**Fig 2: Removal of Normal Adrenal in Accidental Case**

## Discussion

It is well known that adrenal is the target gland in HPA axis and plays an important role in stress modulation. There was a positive correlation between adrenal weight and total cortical thickness of both left and right adrenal gland providing direct evidence that increased adrenal weight is due to cortical hypertrophy.<sup>2</sup>

Probably, the reason or maximum sufferers in the age group of 15-45 years is due to frustration, early marriage, sudden emotional outburst, failure to cope with stress and strain of life at a younger age, poverty, unemployment etc. HPA and sympathicoadrenomedullary axes are the systems mainly involved in maintaining homeostasis during the stress response, and the adrenal is an essential stress responding organ common to both systems.<sup>6</sup>

The adrenal gland is subject to dynamic structural changes including cellular proliferation and death. These two processes must be balanced to ensure the integrity and function of the adrenal gland.<sup>7</sup> Several theories have been proposed to explain the cellular replacement in the different zones of adrenal cortex. On one hand migration theory describes cell proliferation in the external part of the cortex, their migration and differentiation from glomerular zone to fascicular zone and from there to reticular zone where they end up degenerating and dying.<sup>8</sup>

In the rat, more recent immunohistochemical studies have demonstrated an undifferentiated zone between the zona glomerulosa and zona fasciculata which is proposed as a stem cell zone.<sup>9</sup> According to the transformation theory, transformation may occur locally either between glomerular and fascicular or between fascicular and reticular zones. When chronic intermittent stress of enough intensity is applied, an increase in the size of adrenal gland is observed which is independent of its relative body mass index.<sup>10</sup>

Studies by several works closely corroborates with our findings. A study conducted by who studied a group of 42 suicidal victims and 31 control cases of sudden death and reported a significant increase in adrenal weight in the suicidal group.<sup>11-12</sup> Also the study of with our findings who stated that under chronic stress conditions, there is increased adrenal weight, due to hypertrophy and hyperplasia of the cortex.<sup>6</sup>

There was an increased adrenal weight due to the effect of prolactin during pregnancy. For this reason, we have excluded the pregnant ladies from our study as their increased adrenal weight might be due to increased prolactin level. A number of studies on adrenal dimensions with respect to stress have been put forth by several workers which closely corroborates with our findings.<sup>13</sup>

## Conclusion

Considering the basic role of adrenal in coping up with stress, the human model of morphological study of adrenal gland has been taken up to correlate the morphological (adrenal weight and dimension) features in the confirmed suicidal cases. There was a significant increase in adrenal weight and dimension of suicidal cases as compared to the accidental cases of corresponding age groups,-- which probably serves the testimony to its adaptation to the stress factors. This project is a humble attempt in this field within the scope available. Further works in this regard is needed in showing more light on the medico-legal problems occurring from time to time. Thus this present study concludes and supports the idea that chronic stress induces adrenal growth, which may have implications for the forensic people in revealing the cause of unknown deaths.

## Compliances of Authors

Conflict of interest

SP, PKP, BR and MP declare that they have Conflict of interest: No

Informed consent

All procedures followed were in accordance with the ethical standards of the responsible committee (institutional and national) and with the Helsinki Declaration of 1975 as revised in 2008 and Institutional ethics committee clearance was obtained.

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