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Change in weight and morphology of adrenal gland in cases of alleged suicidal deaths: A prospective study

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Abstract

Introduction: The adrenal gland consists of two parts, one is adrenal medulla which constitutes around 28 % of total mass of adrenal gland, and rest is known as adrenal cortex. The average weight of adrenal gland in healthy adults is around 4 g.

Aims & objective: In the present study weight and morphology of adrenal gland were studied and comparison between findings in suicidal deaths and non suicidal deaths was done.

Material and methods: The adrenals were collected from dead bodies brought for medico-legal autopsies conducted by the department of Forensic Medicine and Toxicology from Dec. 2015 to Sep. 2017. After removal, the weight of the gland was recorded, and then the gland collected was preserved in 10 % formalin for more than 2 weeks for fixation. After the period of fixation, grossing of gland was done and slides were prepared and studied.

Results: In study group, maximum weight of left adrenal gland was 6.2 grams and minimum was 4.2 grams while the maximum weight of right adrenal gland was 5.8 grams and minimum was 4 grams. In control groups, maximum weight of left adrenal gland was 5.5 grams and minimum was 3.9 grams and the maximum weight of right adrenal gland was 5.1 grams and minimum was 3.8 grams. There was a positive correlation between the weight of adrenal gland in suicidal group and control group (SD- 0.43, p=0.00). Also, in suicidal group, weight of left adrenal gland was more than the right adrenal gland and was statistically significant. Morphologically, in study group, 2 revealed significant pathological finding of medullary adrenalitis and adrenal abscess. In control group, 4 revealed significant finding of medullary adrenalitis, chronic adrenalitis and pheochromocytoma.

Keywords: Adrenal gland, suicide, weight, depression, morphology

Introduction

The name “suicidality”[1] tells about how suicidal thoughts (or suicidal ideation) or suicidal behaviour occurs. It includes cases of self-harm which can be fatal (suicide) or nonfatal (attempted suicide). The term suicide comes from Latin suicidium, (from suicaedere, “to kill oneself”) and it includes the complete act of self-killing. When the act of suicide is not complete it is called parasuicide or attempted suicide. Para-suicide does not include the habitual forms of self-destructive behaviour like self-mutilation, sensation seeking, or alcohol abuse. The interpretation of attempted suicide is very complicated because it is characterized by several aspects like amount of medical impairment, lethality of means adopted, and

level of suicidal intent.[1] The lives of the family members, friends and society had ripple effect, after each suicide as it takes the life of the individual prematurely. Each year, more than 1,00,000 people commit suicide in our country. There are many causes of suicides like professional problems, discrimination at working places, sense of isolation, abuse, violence, family problems, mental disorders, addiction to alcohol, financial loss, chronic pain etc. NCRB (National Crime Records Bureau) collects this data on suicides from police recorded suicide cases.[2]

In India, the rate of suicides has been evaluated by using mid-year projected population for the non-census years whereas for the census year 2011, the population of The Population Census 2011 was used. The number of suicidal cases in India during the period (2005–2015) has documented an increase of 17.3% (1,33,623 in 2015 from 1,13,914 in 2005). The number of suicides increased every year till 2011, afterward a decrease in the number of cases was observed till 2014 and it was again increased by 1.5% in year 2015 (1,31,666 cases in 2014 to 1,33,623 cases in 2015). The growth of population during last 10 years has increased by 14.2% and at the same time the rate of suicide increased by 2.9% (10.3 in 2005 to 10.6 in 2015). The rate of suicides is showing a mixed trend during the last 10 years (2005-2015), however, rate of suicides is showing decreasing trend since 2010.[2]

While the relationship between suicide and mental disorders (in particular, depression and alcohol use disorders) is well established in high-income countries, many suicides happen impulsively in moments of crisis with a breakdown in the ability to deal with life‟s stresses, such as financial problems, relationship break-ups, chronic pain, other family problems and illness.[3] In one study conducted in Chandigarh, a relation between adolescent students and suicidal ideation was done, in which students with academic problems and unsupportive environment at home perceived life as a burden and had higher rates of suicidal ideations.[4] It is estimated that around 30% of global suicides are due to pesticide self-poisoning, most of which occur in rural agricultural areas in low- and middle-income countries. Other common methods of suicide are hanging and firearms.[3]

Before a person commits suicide, he/she undergoes various kinds of physical and mental stress. The choice of method to commit suicide depends on the personality of the person. The method adopted for committing suicide should be effective, easily accessible, and should be painless. Some of the common methods employed for committing suicide are consumption of poison, jumping into the well, hanging, shooting, etc. “Hanging” (45.6%), consuming “Poison” (27.9%), “Self-Immolation” (7.2%) and “Drowning” (5.4%) were the most prominent means/mode of committing suicides.[2] The stress and the suicidal ideations in a person will result in the changes in the adaptive patterns of the person and will in turn change the way the endocrine glands function in the body. This resultant macroscopic and microscopic change in the adrenal gland will be the bone of contention in the present study. As this is a histopathological study a brief introduction of the adrenal gland is as follow

The adrenal gland (Photo 4) consists of 2 parts, one is adrenal medulla, which constitutes 28% of the mass of the adrenal gland, and the rest is made up by the adrenal cortex.The average normal adrenal weight in healthy adult is around 4g. The cortex of adrenal gland contributes normally 72% of total adrenal weight and it is not affected by body weight, sex and age.[5] The adrenal medulla is made up of interlacing cords of densely innervated granule-containing cells that abut on venous sinuses.[6] Two cell types can be distinguished morphologically: an epinephrine-secreting type that has larger, less dense granules; and a norepinephrine-secreting type in which

smaller, very dense granules. The adrenal cortex is divided into three zones. The outer zona glomerulosa is made up of whorls of cells that are continuous with the columns of cells that form the zona fasciculata. These columns are separated by venous sinuses. The inner portion of the zona fasciculata merges into the zona reticularis, where the cell columns become interlaced in a network. The zona glomerulosa makes up 15% of the mass of the adrenal gland; the zona fasciculata, 50%; and the zona reticularis, 7%.[7] The adrenocortical cells contain abundant lipid, especially in the outer portion of the zona fasciculata. All three cortical zones secrete corticosterone, but the active enzymatic mechanism for aldosterone biosynthesis is limited to the zona glomerulosa, whereas the enzymatic mechanisms for forming cortisol and sex hormones are found in the two inner zones. Furthermore, subspecialization occurs within the inner two zones, the zona fasciculata, secreting mostly glucocorticoids and the zona reticularis, secreting mainly sex hormones.[7]

Aims and Objectives

To study changes in weight and histopathological changes of adrenal glands in suicidal deaths and compare it with those in the non-suicidal deaths.

Material and methods

A total of 100 subjects were taken for the study out of which 50 were test subjects and 50 were controls. Test subjects included from the cases of death due to alleged suicide (hanging, poison, burns etc.), where as control cases included the death other than alleged suicide cases (death due to vehicles accidents and assaults etc.). The adrenals were collected from dead bodies brought for medico-legal autopsies conducted by the department of Forensic Medicine and Toxicology from Dec. 2015 to Sep. 2017.

Observations and Results

Age

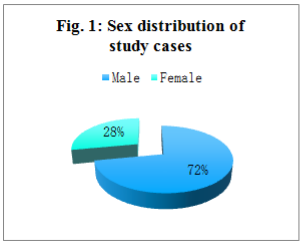
The 50 study cases (suicidal cases) and 50 control cases (non-suicidal cases) were included in this study with the age range from 12 to 90 years. The age wise distribution of the cases is shown in Table 1. It is clear from the table that age group 21 to 30 years was the commonest who committed suicide followed by the age group 31-40 and 11-20 yrs in the test subjects. The age group 41-50 followed by 21-30 and 31-40 was commonly involved in unnatural deaths in the control subjects. (Table. 1)

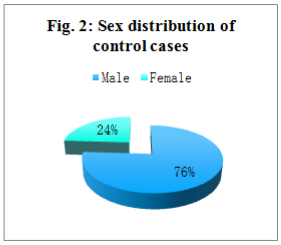
Table 1 Age wise distribution of cases

Age Group	Study Cases	Percentage	Control Cases	Percentage
11-20 years	10	20%	6	12%
21-30 years	15	30%	9	18%
31-40 years	10	20%	9	18%
41-50 years	7	14%	12	24%
51-60 years	5	10%	7	14%
61-70 years	3	6%	4	8%
71-80 years	0	0	2	4%
81-90 years	0	0	1	2%

Sex:

Of the 50 study cases, 36(72%) were male and 14(28%) were females and of the 50 control cases 38(76%) were males and 12(24%) were females.





Manner of death

The test and the controls were chosen as per the manner of death i.e., 50 suicidal cases

and 50 (unnatural and natural) sudden deaths. Of the 50 suicidal cases, 32 were of

hanging (64%), 17 of poisoning (34%) and only 1 case (2%) was of accidental burns. Of

the 50 non- suicidal cases, 31 were of accidents (62%), 18 were of natural deaths (36%)

and only 1 case (2%) was of homicide (Table 4).

Table 2: Manner of death

Group	Manner of death (n=100)	No. of cases	Percent	% of Total Deaths
Suicidal deaths (N= 50)	Burns Hanging Poisoning	1 32 17	2% 64% 34%	1% 32% 17%
Non Suicidal Deaths (N= 50)	Accidental Homicidal Natural	31 1 18	62% 2% 36%	31% 1% 18%

Finding in adrenal gland:

Weight of left adrenal gland:

The weight of left adrenal gland (grams) in study and control cases. In study cases maximum weight is 6.2 grams and minimum is 4.2 grams. In control cases maximum weight is 5.5 grams and minimum is 3.9 grams.

The mean weight of the left adrenal gland in the suicidal group was 5.00 grams and the standard deviation was 0.48grams whereas the mean weight of the left adrenal gland in the non-suicidal group was 4.51 grams and the standard deviation was 0.39 grams (Table 3). The P value comes out to be 0.00 which is less than 0.05, so there was a significant difference between the weight of the left adrenal gland in the suicidal and the non- suicidal group.

Table 3: Weight of left adrenal gland

Left adrenal weight	N	Mean	Std. Deviation	P value
Suicidal	50	5.00	0.48	0.00
Non-Suicidal	50	4.51	0.39	

Weight of right adrenal gland:

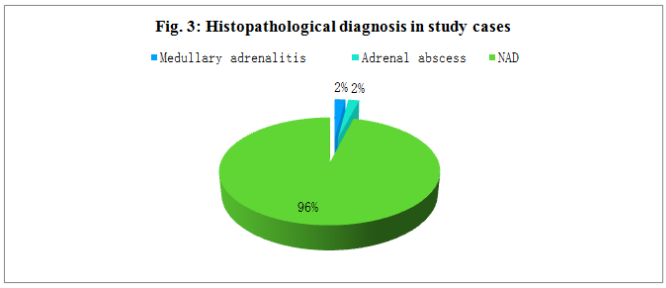
The weight of right adrenal gland (grams) in study and control cases. In study cases maximum weight is 5.8 grams and minimum is 4 grams. In control cases maximum weight is 5.1 grams and minimum is 3.8 grams. The mean weight of the right adrenal gland in the suicidal group was 4.86 grams and the standard deviation was 0.43 grams whereas the mean weight of the right adrenal gland in the non-suicidal group was 4.39 grams and the standard deviation was 0.30 grams (Table 4). The P value comes out to be 0.00 which is less than 0.05, so there was a significant difference between the weight of the right adrenal gland in the suicidal and the non- suicidal group.

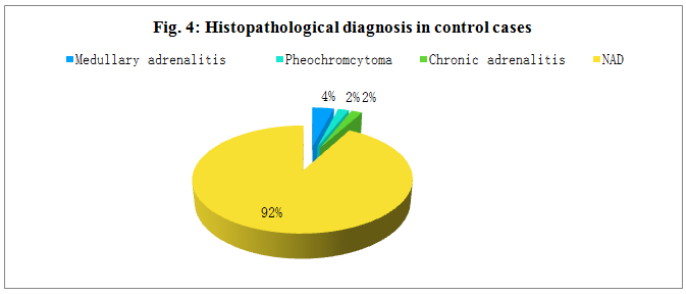
Table 4: Weight of right adrenal gland

Right adrenal weight	N	Mean	Std. Deviation	P value
Suicidal	50	4.86	0.43	0.00
Non-Suicidal	50	4.39	0.30	

Histopathological changes in adrenal gland

Of the total 100 cases, six (6%) revealed significant pathological findings and the rest 94 (94%) were histologically normal. Of the 50 study cases, only 2 (4%) revealed significant pathological findings (Fig.3). The conditions that were diagnosed histopathologically were medullary adrenalitis in one case (2%) and adrenal abscess in one case (2%). The diagnosis of medullary adrenalitis (Photo 1) was labelled when lymphomononuclear cell infiltration with lymphoid follicles and destruction of adrenal parenchyma was present. A case that showed focus of necrosis of the adrenal parenchyma with dense neutrophilic infiltration was diagnosed as adrenal abscess. Out of 50 control cases, two cases (4%) shows medullary adrenalitis, one case (2%) showed changes of chronic adrenalitis and one case (2%) reveals pheochromocytoma which is a benign tumor (Fig. 4).





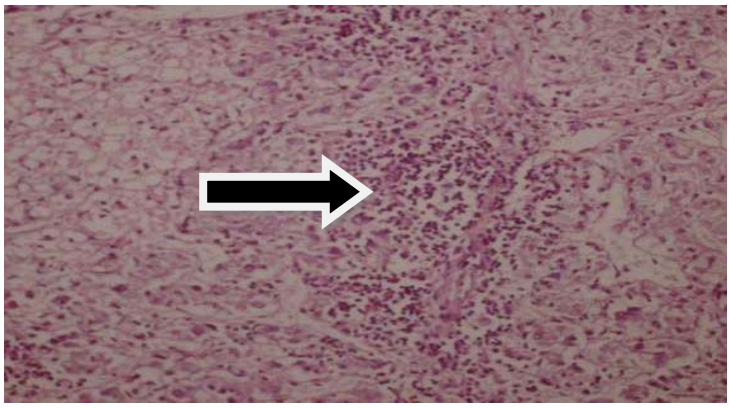


Photo 1: Photomicrograph showing medullary adrenalitis, lymphomononuclear cell infiltration with lymphoid follicles and destruction of Adrenal parenchyma (H&E, X200).

Discussion

In our study, weight of both left and right adrenal gland was measured and was compared between the two groups as well as bilateral variation was also studied. There was significant variation in the mean weight of left adrenal glands in suicidal and non- suicidal group. Similarly there was difference in mean weight of right adrenal glands in suicidal and non-suicidal group. There was significant difference in the mean weight of left and right adrenal gland in the suicidal group, whereas there was no difference in the mean weight of left and right adrenal gland in the non-suicidal group.

The findings of increase in the mean weight of adrenal glands in the suicidal group as compared to non-suicidal group, are consistent with findings of the studies done by Dumser, et al,[8] Szigethy, et al,[9] Dorovini, et al,[10] Amsterdam, et al,[11] Sarkar, et al,[12] Patra, et al,[13] Willenberg, et al,[14] Rubin, et al,[15] but are not consistent with the study done by Stein, et al.[16]

Dumser, et al[8] studied 79 cases of which 42 were of suicide and 37 were control cases. In the suicidal cases, mean combined weight of both adrenal gland was 11.01 g (SD=3.02), which was significantly higher (p=<0.001)

than the mean combined weight of both adrenal glands in control cases.

In Szigethy, et al[9] study, the mean weight of both adrenal glands was significantly higher than that of control group. Also, the weight of left adrenal gland was higher than right adrenal gland in suicidal group.

Dorovini, et al[10] selected 16 violent suicidal cases and 10 cases who died suddenly. The mean plus SD of combined weight of both left and right adrenal glands was significant higher for violent suicidal groups (m=9.77, SD=1.74 g) than for the cases who died suddenly (m=7.74, SD=0.82 g) (t=4.05, df=22.75, p<.001). They concluded that mean weight of both adrenal glands in suicidal group was higher than control group.

In the Amsterdam, et al[11] study, computed tomography was used to assess the adrenal volume in depressed patients and healthy volunteers. In 50 percent of depressed cases the adrenal volumes was in excess of the 95th percentile value than that of the healthy volunteers.

In Sarkar, et al[12] study, the mean weight of right adrenal gland in suicidal group was 9.57 grams and for control group was 6.64 grams. For left adrenal gland, mean weight for suicidal group was 10.06 grams and for control group was 7.13 grams. The mean and SD for both left and right adrenal glands were significantly higher in suicidal group than control.

Patra, et al[13] compared the weights of adrenal gland in suicidal and non-suicidal group. The mean and SD of weight of adrenal glands were significantly higher in suicidal group than controls (p<0.001).

Willenberg, et al[14] found significant enlargement of adrenal cortex to 158.8% with SD=29.8% and p=<0.01 in the victims of suicidal deaths as compared to non-suicidal group.

Rubin, et al[15] revealed that mean adrenal volume was increased by 70% in suicidal cases and was significantly higher than in control cases.

Stein, et al[16] evaluated 118 sudden death cases which includes both suicidal and non- suicidal cases. No statistically significant difference was found in mean weight between suicidal and non-suicidal cases which is in contrast to the results obtained in our study.

In the present study, of the 50 study/suicidal cases, only one case (2%) showed changes of medullary adrenalitis and in 1 case (2%) left adrenal gland showed adrenal abscess. However, in 50 non suicidal/control cases, 2 cases (4%) showed changes of medullary adrenalitis, 1 case (2%) showed changes of chronic adrenalitis and only 1 case (2%) was diagnosed as pheochromocytoma. These finding are not consistent with study by Szigethy, et al,[9] Patra, et al.[13]

Patra, et al[13] studied 100 suicidal and 20 control cases. He concluded that with chronic stress as in suicide which induces adrenal growth, lipid depletion and sinusoidal prominence is present on histopathological examination.

Conclusion

This prospective study was conducted on 50 suicidal cases and 50 control cases brought in mortuary under department of Forensic medicine and Toxicology in alliance with the department of Pathology, GMCH, Chandigarh.

The interpretations of results in the present study are as follows:

1. 30% of study/suicide cases were in the age group of 21-30 yrs, followed by 20% in both 11-20 yrs and 31-40 yrs. On the other hand, in control groups, 24% were in 41-50 yrs, 18% both in 21-30 yrs and 31-40 yrs.

2. The mean age of the 'suicidal' group was 34.56+14.60 yrs whereas the mean age of the non-suicidal group was 42.82+17.43 yrs.
3. Out of the 50 suicidal cases, 4 cases (8%) had previous history of suicidal attempt.
4. In study group, 64% cases were of hanging, 34% cases of poison and 2% cases were of burn. Out of 50 control cases, 62% died from accident, 36% had died natural death and 2% were of homicide.
5. The mean weights of both left and right adrenal glands in study group and control group show significant statistical variations. The p value was <0.00, which is highly significant
6. Also, in suicidal group, weight of left adrenal gland is more than right adrenal gland and is statistically significant.
7. Medullary adrenalitis and adrenal abscess was present in 4% cases in suicidal group. Medullary adrenalitis 4%, one case of chronic adrenalitis and one case of pheochromocytoma was revealed in control groups.

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