

# EVALUATION OF ROLE OF SUPEROXIDE DISMUTASE IN NON-TOXIC THYROID NODULES

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## ABSTRACT

Thyroid epithelial cells produce moderate amounts of Reactive Oxygen Species (ROS) under normal conditions that are physiologically required for the synthesis of thyroid hormones. However, in case of a diseased thyroid gland they may be produced in amounts much higher than normal. This excess production of ROS can cause an oxidant/antioxidant imbalance resulting in oxidative stress and damage of cells. The human antioxidant defense mechanism consists of various enzymatic and non-enzymatic components which are responsible for the quenching of ROS. The present study is aimed at comparing the activity of antioxidant enzyme- Superoxide Dismutase (SOD) from blood of patients with benign and malignant thyroid nodules of non-toxic group and healthy controls in order to evaluate the possibility of presence of excess oxidative stress and its role in development of thyroid cancer.

**Key words:** Oxidative stress, Superoxide dismutase, Thyroid cancer

## INTRODUCTION

Thyroid nodules are discrete, structurally distinct lesions within the thyroid gland separate from the surrounding tissue (Polyzos *et al.*, 2007). They may be toxic or non-toxic. Although most of them are benign, cancer should be suspected with the presence of thyroid nodules (Polyzos *et al.*, 2007; Gharib *et al.*, 2010). It is well established that non-toxic nodules have a greater potential to turn malignant. A solitary dominant nodule is more likely to represent a malignancy than a single nodule in a multinodular gland (Barroeta *et al.*, 2006). Thyroid cancer is the most common form of endocrine malignancy and its incidence has been growing steadily during the last decade (Albores-Saavedra *et al.*, 2007; Davies *et al.*, 2006; Hodgson *et al.*, 2004). Oxidative stress (OS) is defined as a misbalance between the production of oxidants and antioxidant defences. The most important oxidants are the reactive oxygen species (ROS). ROS are considered important factors in the pathogenesis of different diseases including cancer (Bankson *et al.*, 1993). Amongst them, most important are superoxide anion and hydroxyl radical that are molecules characterized by high chemical reactivity due to presence of an unpaired electron in the external orbital. The thyroid gland is an organ of oxidative nature. In human thyroid cells production of moderate amounts of hydrogen peroxide is essential for Thyroid Peroxidase (TPO) catalysed hormone synthesis (Poncin *et al.*, 2010). Apart from

hydrogen peroxide other free radicals produced from iodine and tyrosine residues add to potential oxidative stress. The antioxidative defence mechanism of the gland comprises both antioxidative enzymes and free radical scavengers. Superoxide dismutase (SOD) is an antioxidant enzyme which helps in breaking down superoxide anion, one of the most harmful free radicals produced in the body. The purpose of the current study is to evaluate the activity of superoxide dismutase in the blood of patients with benign and malignant thyroid nodule and try to find its association with disease condition.

## Materials and Methods:

Out of total 54 individuals, non-toxic thyroid nodules (31 benign and 9 malignant) and 14 controls, screened from the outpatient department of Ramakrishna Mission Seva Pratishthan, were included in the study. The study was approved by the institutional ethics committee. The age and sex of patients and controls were matched. The controls were free from any systemic diseases. Blood samples (fasting) were collected by venous arm puncture into EDTA vacutainers after getting informed consent. Diagnosis was confirmed by biochemical, radiological and cytopathological tests. SOD from whole blood was estimated spectrophotometrically by the method of Marklund and Marklund (1974). All values are expressed as Mean+SD.

**RESULTS**

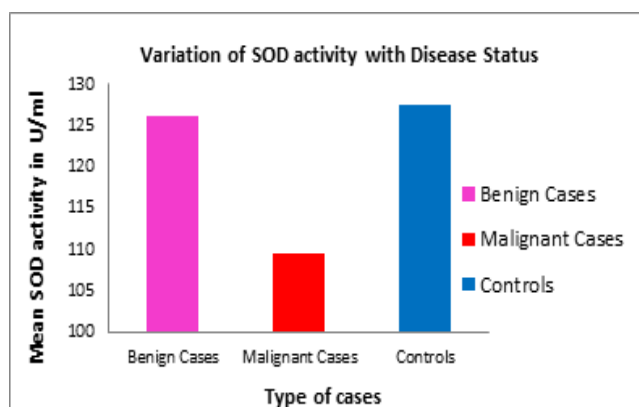
**Table 1: Number, Age and Sex of Cases and Control**

|                         | Cases* |        | Control |        |
|-------------------------|--------|--------|---------|--------|
|                         | Male   | Female | Male    | Female |
| Number                  | 14     | 26     | 6       | 8      |
| Age (yrs)<br>(mean ±SD) | 40±15  | 39±11  | 44±15   | 41±13  |

\* 31 benign and 9 malignant cases

**Table 2: Activity of Superoxide Dismutase in Blood**

| SOD activity in Cases (U/ml)<br>(mean ± SD) |                | SOD activity in Controls (U/ml)<br>(mean ± SD) |
|---|----------------|--|
| Benign                                      | Malignant      |  |
| 126.21 ± 6.891                              | 109.41 ± 6.495 | 127.42 ± 5.594                                 |



**Fig.1. chart representing the variation of mean SOD activity with disease status amongst benign cases , malignant cases and healthy controls.**

Table 1. Represents the age and sex distribution of cases and controls. Out of the 40 cases 26 were female and 14 were male indicating that the incidence of non-toxic thyroid nodules is much higher in case of females than in male subjects. Table 2. Shows the mean SOD activities determined from the blood of cases and controls. Fig.1 represents the variation in activity of SOD with disease status. The activity of SOD in benign cases was found to be almost similar to that of controls whereas that of the malignant cases was found to be lower than controls and benign cases.

**DISCUSSION AND CONCLUSION**

Oxidative stress and an impaired antioxidant defence

mechanism have been long associated with tissue damage and development of various diseases. Decreased activity of antioxidant enzymes Catalase and Superoxide Dismutase have been demonstrated in various pathological diseases including Cancer (Oberley *et al.*, 1984). Another study by (Felt *et al.*, 1976) reported decreased activity of superoxide dismutase and unaltered catalase activity in thyroid tumour tissue. Lowered activities of these enzymes can also be related to increased malondialdehyde levels in blood of patients with thyroid cancer. It has also been established that oxidative stress is common in thyroid tissues and may also have an active role in proliferation of thyroid tumors (Yanagawa *et al.*, 1999; Fujita *et al.*, 2002 & Durak *et al.*, 1996, reported an increase in MDA levels and decrease in activity of enzymatic antioxidants in cancerous thyroid tissues compared to non cancerous ones. A study in 1996 also reported that incase of thyroid diseases non-toxic nodular goitres, thyroid carcinomas and follicular adenoma the highest level of lipid peroxidation was found in thyroid carcinomas and follicular adenomas. This was accompanied by increased activity of antioxidant enzymes like SOD, GPx and Catalase , particularly incase of thyroid carcinomas (Sadani *et al.*, 1996). In our current study it was found that there was a significant decrease in the activity of Superoxide Dismutase in the cases with malignant thyroid nodules when compared to benign cases and controls. However, the SOD activity in benign cases and controls was almost similar. This indicates the presence of chronic oxidative stress in the malignant cases which may have a possible role in the development of cancer.

**Conflict of interest:**

None declared

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