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Research Article

Impact of Thyroid Disorders on Clinical Parameters of Subjects Undergoing Coronary Artery Bypass Grafting

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ABSTRACT

The heart and the thyroid gland are two of the most vital organs of the human body. The optimum functioning of these two organs is essential for the well-being of the body. These two organs share a twin-way relationship. Mild deviation from the normal range of thyroid hormone levels affects the heart. Hence, thyroid disorders (TD) are suspected to be strongly associated with cardiovascular diseases (CVD), especially in cases undergoing coronary artery bypass grafting (CABG). Usually, thyroid disorders pose very subtle symptoms that go unnoticed and remain undiagnosed for a long period of time. In this study, we analyze the effect of thyroid disorder (hypothyroid and hyperthyroid) on the clinical vitals, and pre-operative, intraoperative and post-operative parameters of the subjects who had undergone CABG. Our analysis establishes that thyroid disorders, if not controlled, can be indicators of poor outcomes in subjects undergoing CABG. Regular monitoring and maintenance of thyroid hormones is imperative in subjects undergoing CABG.

Keywords: CVD, Hypothyroidism, Hyperthyroidism, CAD, CABG.

INTRODUCTION

Cardiovascular diseases (CVD) have emerged as the biggest cause of mortality globally. 'Cardiovascular diseases' are a broad term. CVDs include coronary artery disease (CAD) (Also known as coronary heart disease), peripheral artery disease (PAD), cerebrovascular disease and aortic atherosclerosis. [1] CAD is the most prevalent CVD; about 50% of all cases have CAD. This can lead to myocardial infarction (MI), and even heart failure. Coronary artery bypass grafting is the most accepted and practiced procedure of treatment for heart diseases.[2]

On the other hand, we have thyroid disorders (TD), which are the second most common endocrinal disease globally. The first one is the diabetes. Thyroid hormones (TH) play an important role in maintaining CV homeostasis. This involves cardio-physiological functions and maintenance of cardiac contractility by enzyme regulation. [3] Any alteration from the normal reference range in the thyroid hormone affects normal cardiac functioning.[3]

Epidemiological studies revealed that in half of the cases, thyroid disorders remain undiagnosed. Hence, it keeps adding to the developing cardiac disease.[2]

There are mainly two types of thyroid disorders (hypothyroidism or hyperthyroidism). Thyroid gland dysfunctions are found to be associated with cardiovascular risk factors. H ypothyroidism is profoundly associated with CVD, causing diseases like dyslipidemia and high blood pressure.[4] On the other hand, hyperthyroidism accelerates atrial fibrillation (AF), which later results in CVD (or even cause heart failure). [4] Thyroid disorders have recently risen exponentially, with a high estimated prevalence rate of 9 to 25% in adult female populations. Although many male subjects suffer from long-term thyroid disorders, female preponderance is observed.[2] Specifically, hypothyroidism is found to be more prevalent than hyperthyroidism among heart patients.[1] Along with this, studies have reported that any form of thyroid disorder can negatively affect the regulation of the cardiac system, may cause severe cardiac issues and may also lead to heart failures.[3]

MATERIALS AND METHODS

Study Protocol

The study involves human subjects. Therefore, ethical clearance from a registered Institutional Ethical committee of Medanta the Medicity, Gurugram, was attained. A draft of the study was presented before the committee; the study was evaluated critically and approved. Thereafter, informed consent was obtained from all the subjects participating in the study.

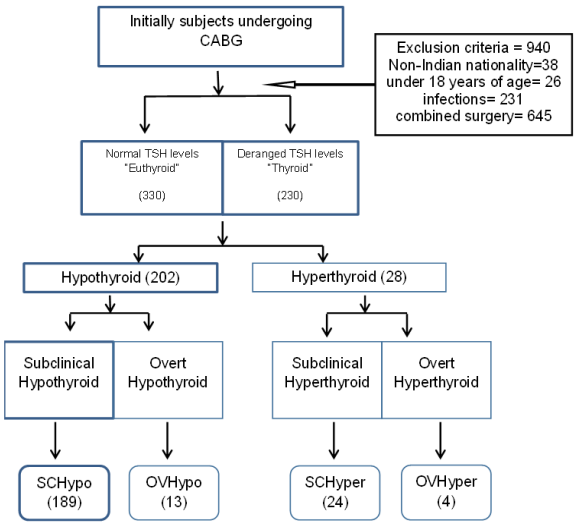

Fig. 1: Methodology flowchart

Sample and Data Collection

Thyroid hormone test and thyroid peroxidase autoantibody (TPO-Ab) were analyzed in a vitreous 3600 immunodiagnostic analyzer with the help of a pre-designed test reagent kit. A blood sample was drawn with the 2 mL syringe from the wrist artery, sealed immediately, loaded into the counter and run for 30 seconds. For biochemical tests, a robotic TC Automation ES Flex machine from 'Thermo Scientific' was used. Data was collected from the subjects using a pre-designed proforma. The subjects included in the study were selected according to the inclusion and exclusion criteria. Fig. 1 represents the flowchart of the methodology.

Inclusion criteria include subjects undergoing CABG, above the age of 18 years and who have signed the informed consent. Exclusion criteria include non-Indian nationality subjects who have developed some infections (decompensate liver failure, chronic kidney disease with eGFR<30, septicemia) or who had combined heart surgery.

Statistical Analysis

The quantitative data were recorded as percentages, mean and standard deviations. Qualitative and categorical data were represented as absolute numbers and proportions. We applied the Z test to compare the mean values of the outcomes. To check the associations between the parameters, cross tables were generated and chi-square tests were also applied wherever suitable.

RESULT

After the confirmation from the practicing endocrinologist and biochemical tests, the selected subjects were segregated into three groups; "Euthy" for subjects with normal thyroid hormone levels, "Hypo" for subjects suffering from hypothyroidism and "Hyper" for subjects suffering from hyperthyroidism. The observed and calculated values of mean and standard deviations of the three thyroid hormones are summarized in Table 1.

Demographic details, for instance such as age, gender, body mass index (BMI), existing comorbidity like diabetes mellitus (DM), hypertension (HT), chronic obstructive pulmonary disease COPD) and chronic kidney disease (CKD) in all three study groups are summarized in Table 2. It depicts the mean and standard deviation of the demographic details and the existing comorbidity. The table shows that the hyperthyroid group has the highest overall prevalence of the comorbidities.

Table 1: Mean and Standard deviation of the thyroid hormone levels in the three study groups

Thyroid hormone	*Euthy (303) (Mean ± SD)*	*Hypo (202) (Mean ± SD)*	*Hyper (28) (Mean ± SD)*
TSH	2.17 ± 0.9	9.5 ± 1.0	2.17 ± 0.9
FT3	2.96 ± 0.6	2.87 ± 0.6	2.96 ±0.6
FT4	1.34 ± 0.5	1.21 ± 0.4	1.34 ± 0.5

Clinical vitals of the selected subjects were noted before the surgery (pre) and consecutively for two days at the same time after surgery (postD1/D2). The vitals include systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), respiratory rate (RR) and body temperature (Temp). On examination of the clinical vitals, no statistically significant difference was noted. However, the slight difference noted can be clinically important. This implies that the pre-clinical vitals remain statistically insignificant by the presence of a deranged thyroid hormone level. This might be because of the fact that standardized medications are suitable and effective. Figs 2 and 3 represent the pre-clinical vitals in all three study groups.

Intraoperative parameters were also noted. These include the number of inotropes used and duration of their use, subjects that needed an Intra-aortic balloon pump, and number of on-pump surgeries. The details were also analysed by group wiser. The use of inotropes and their duration was observed to be significantly low in 'Euthy.' The use of intra-aortic balloon pump (IABP) was least in the 'Euthy' group and highest in the 'Hypo' group. A similar pattern was observed for on-pump surgery, which is highest in the 'Hypo' and lowest in the 'Euthy' group. However, these differences were not large but were clinically important. Fig. 4 depicts the comparative results of the intraoperative parameters between the subjects with and without thyroid disorder.

In addition to this, post-operative parameters were also analyzed. Post-operative outcomes are presented by parameters such as length of stay in the hospital (LOS), duration of stay in the intensive care unit (ICU), duration of ventilator support and duration of urinary catheter usage. Fig. 5 represents the differences in the post-operative outcomes among the three study groups.

Table 2: Demographic details of subjects in three study groups

Parameters	*Hypo (Mean ± Sd)*	*Hyper (Mean ± SD)*	*Euthy (Mean ± Sd)*
Age	61 ± 8	61.89 ± 8.58	60 ± 8
Male n (%)	164 (81%)	21 (75%)	272 (82.4%)
BMI	0.43 ± 0.09	0.40 ± 0.06	0.43 ± 0.08
DM	121 (59.9%)	20 (71.4%)	201 (60.9%)
HT	125 (61.8%)	18 (64.2%)	197 (59.6%)
COPD/Bronchitis	56 (27.7%)	11 (39.2%)	27 (8.1%)
CKD	10 (4.9%)	1 (3.5%)	14 (4.2%)

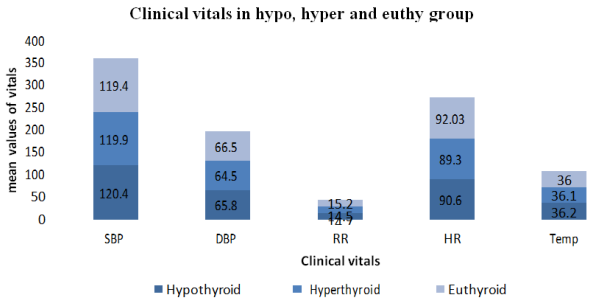

Fig. 2: Pre-clinical vitals in the three study group

LOS and ICU stay were at least 2 days less in the case 'Euthy' group, whereas no difference was observed in the 'Hypo' and 'Hyper' groups. Although there was no striking difference among the three groups still 'Euthy' group still exhibited reduced duration of use for ventilator support and urinary catheter. Undoubtedly, the 'Euthy' group had better outcomes as compared to subjects from the 'Hypo' and 'Hyper' groups.

DISCUSSION

Our findings revealed that pre-clinical vitals, intra-operative parameters and post-operative outcomes were affected by the presence of deranged thyroid status. Subjects with euthyroid status showed better results. However, the differences were not statistically significant but were clinically relevant. Although the presence of deranged thyroid status may be a predictor of poor outcomes after CABG,[5] still, it still cannot be rendered as an independent indicator of poor post-operative outcomes of subjects undergoing CABG.

Our results were similar to Weinberg *et al.*,[6] They conducted a comparative, retrospective, match control study with 59 subjects each in the hypothyroid and euthyroid groups. They compared many study parameters, including ICU stay, hospitalization, use and duration of inotropes, etc. They observed no statistically significant difference among the study groups and concluded that a separate surgery could not be suggested for the subjects with deranged thyroid hormone levels.

Similarly Avci *et al.*,[7] examined effect of subclinical hypothyroidism (SH) on the outcomes of subjects with CABG. They also observed that LOS and ICU stays were significantly longer in the subjects with (SH) as compared to euthyroid subjects. They also reported that the use of inotropes, their duration, episodes of renal failure, and arrhythmia were also higher in the subjects with SH. Hence they concluded that SH negatively affects the outcomes of CABG. It was also supported by Vacante *et al.*[8] They reviewed hypothyroidism as a predictor of surgical outcomes in elderly subjects. In their review, they strongly recommend maintaining euthyroid status in the pre-operative phase and delaying the surgical in case it is not maintained. Longer duration of ICU stay and LOS were also reported by Villavicencio *et al.*[9] and Joe *et al.*[10] in their

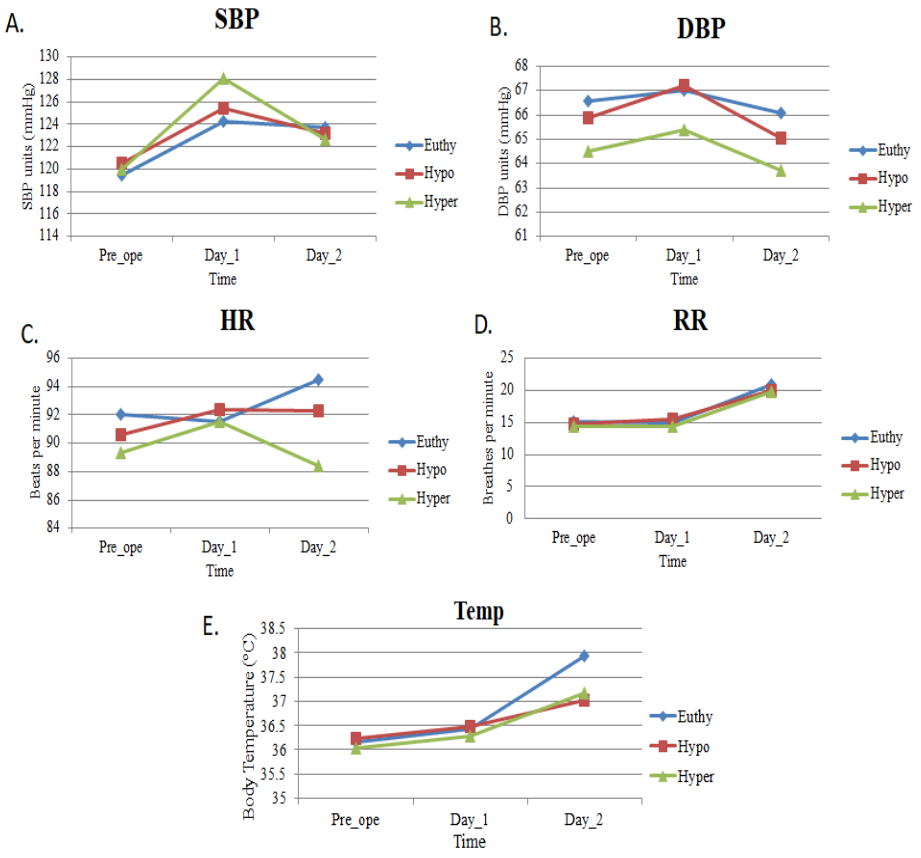

Fig. 3: Changes in the pre-clinical vitals: SBP (A), DBP (B), HR (C), RR (D) and Temp (E) during Pre-ope and Post-ope

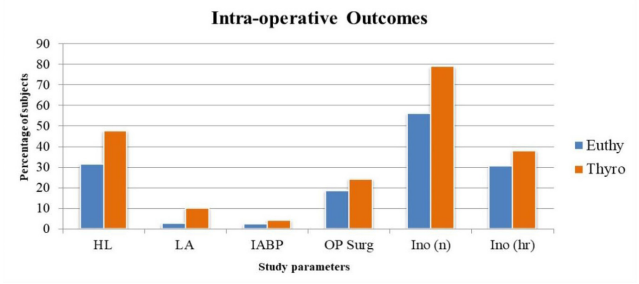

Fig. 4: Intraoperative parameters in 'Euthy' group *vs* Thyroid subjects

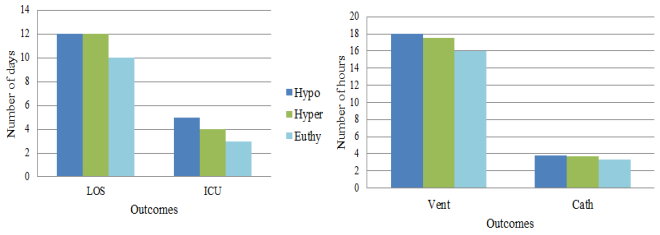

Fig. 5: Post-operative outcomes in the three study groups

respective studies, wherein they compared subjects with thyroid disorder to euthyroid subjects

Our results also coincide with that of the Tarcin *et al.*[11] To evaluate the effect of thyroid disorder on the mortality and morbidity of subjects undergoing CABG, they examined 37 subjects with known thyroid disorder and 11 control subjects, all of them had undergone CABG. Very similar to our reported results, No significant differences in the study parameters (duration of intubation, need for inotropic support, ICU stay and LOS) were reported. Nevertheless, health complications such as episodes of breathlessness and arrhythmia were less frequent in the non-thyroidal group.

In addition to this, our results were also supported by the proofs from Lin *et al.*[12] They organized a nationwide population-based study to investigate the prognosis of hypothyroidism after CABG. They also concluded that hypothyroidism is associated with ventilator support and prolonged hospital stay.

CONCLUSION

Although the presence of thyroid disorders affects post-surgery outcomes of subjects undergoing CABG, it may not act as an independent predictor for adverse outcomes. Ignored and deranged thyroid hormone levels can cause severe complications in the post-operative phase. To avoid major issues and unpleasant outcomes, it is recommended to maintain thyroid hormone levels in the pre-operative and post-operative phases. Precautionary regular monitoring of thyroid hormones is imperative even after surgery.

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CONFLICT OF INTEREST

The authors have no conflict of interest.

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