

Silent Thyroid Function Abnormalities in Patients Undergoing Coronary Angiography

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Abstract

Background: Iodine is an essential element in the formation of thyroid hormones, the body may encounter situations in which high iodine load occur in the body like doing the contrast studies using the iodine-containing contrast media. In most people, this iodine load is well-tolerable; however, in some others, this may result in derangements in the thyroid function, from which hyperthyroidism is the most common. **Objective:** The objective of the study is to determine the subclinical changes in the thyroid functions in a cohort of patients with coronary artery disease (CAD) undergoing coronary angiography (CAG) and/or percutaneous coronary intervention (PCI). **Materials and Methods:** In this pilot study, a total of 101 patients with CAD undergoing CAG and/or PCI were recruited during the year 2018. All cases had normal thyroid function tests including (thyroid-stimulating hormone [TSH], free T4, and free T3) preprocedural. Six weeks after CAG/PCI serum TSH, free T4 and T3 were assessed again. **Results:** No significant differences were observed in levels of TSH, free T4, and free T3 between preprocedures (CAG/PCI) and after 6 weeks with *P* values (0.645, 0.135, and 0.807), respectively. In addition, no difference was found between the subgroup of CAG versus PCI. **Conclusion:** In euthyroid patients undergoing CAG/PCI minimal changes could occur in thyroid function. However, these changes are of limited significance in the short term.

Keywords: Coronary angiography, percutaneous coronary intervention, thyroid function tests

INTRODUCTION

Iodine is an essential element for thyroid hormone synthesis; however, exposure to iodine may have deleterious effects on thyroid function tests (TFTs). High iodine levels may occur in certain circumstances due to exposure to iodine-containing drugs such as amiodarone, eye drops, ointments, sclerotic agents, toothpaste, multivitamin preparations, and iodine-containing contrast agents which are recently becoming an important source of high iodine load. This load is usually well-tolerated by most of the individuals because the normal thyroid gland has the ability to hold this high amount of iodine, but in some other individuals, this load may result in derangement in the thyroid function.^[1-6]

When there is excess iodine in the body, the thyroid gland inhibits the organification by a mechanism known as the acute Wolff–Chaikoff effect. This Wolff–Chaikoff effect occurs when isopeptide(s) are synthesized inside the thyroid gland that temporarily inhibits thyroid peroxidase enzyme and protein synthesis, decreasing thyroid hormone production, this effect usually lasts for a few days.^[2] However, when a high level of iodine level persists, there will be a resumption of the

normal thyroid hormone production, this is called the escape phenomenon, i.e., escaping from the acute Wolff–Chaikoff effect. Failure to escape from this acute Wolff–Chaikoff effect will result in iodine-induced hypothyroidism, which may be temporary or permanent.

Most contrast agents contain iodine concentrations between 320 and 370 mg/mL which tolerable in healthy people but may be risky for certain group of at-risk individuals such as those who have underlying thyroid diseases, previous thyroid surgery, the fetus *in utero* due to high transplacental passage of iodine, old people from areas of iodine deficiency such as some parts of Europe where the percentage of iodine deficiency may reach 57% of the population while this is very low in the American population which may be around

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Submission: 24-07-2019 **Accepted:** 12-08-2019 **Published Online:** 25-09-2019

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How to cite this article: Mohammad AM, Joma JA, Qasim BA, Yousif AH. Silent thyroid function abnormalities in patients undergoing coronary angiography. *Med J Babylon* 2019;16:220-3.

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DOI:
10.4103/MJBL.MJBL_49_19

9.8% of the population, and patients taking other goitrogens such as lithium containing compounds. These contrast media contain little amount of iodine but may cause a significant effect in such risky patients.^[1,6-10] This iodine-induced thyroid dysfunction may be in the form of hyperthyroidism, which is called the Jöð-Basedow phenomenon which is more common than hypothyroidism, and in some patients, there is autoimmune thyroid destruction.^[1,9,11] Other adverse effects of iodine-containing contrast agents may include allergic and nonallergic reactions which previously called anaphylactoid reactions, and also there is a risk of renal injury which occurs particularly in the diabetics, the elderly, patients with dehydration, and patients with congestive heart failure.^[12]

The aim of this study was to determine the subclinical changes in the thyroid functions in a cohort of patients with coronary artery disease (CAD) undergoing coronary angiography (CAG) and/or percutaneous coronary intervention (PCI).

MATERIALS AND METHODS

This is a cross-sectional study that was done in the Azadi Heart center in Duhok, Iraqi Kurdistan, Iraq, on patients with CAD who underwent CAG and/or PCI. The cases were collected from June 2018 to February 2019. We measured the free T3, free thyroxin (T4), and thyroid-stimulating hormone (TSH) in 101 consecutive patients prior to the procedure and 6 weeks after the procedure.

Cases with a history of preexisting thyroid disease, having abnormal TFTs, and patients using drugs affecting TFT or containing iodine such as amiodarone were excluded from the enrolment.

The ethical approval of this study was gained from the Kurdistan Board of Medical Specializations, Erbil, Iraq, with a reference number 560 at 10/10/2018. The statistical calculations using the Statistical Package for Social Sciences (SPSS 25:00 IBM: Chicago, IL, USA) were done. $P < 0.05$ was considered statistically significant.

RESULTS

The majority of the involved patients with CAD were between 50 and 60 years as shown in Figure 1.

The association between the coronary intervention and thyroid function abnormalities showed no significant differences were observed in levels of TFTs between preprocedures (CAG/PCI) and after 6 weeks with P values (0.645, 0.135, 0.807), respectively. In addition, no difference was found between the subgroup of CAG versus PCI as shown in Table 1.

In correlating the level of the TSH separately before and after the intervention, there was no significant relation [Table 2 and Figure 2].

After correlating the levels of the three thyroid hormones after the procedure, there was also no significant change and correlation of TFTs, as shown in Table 3.

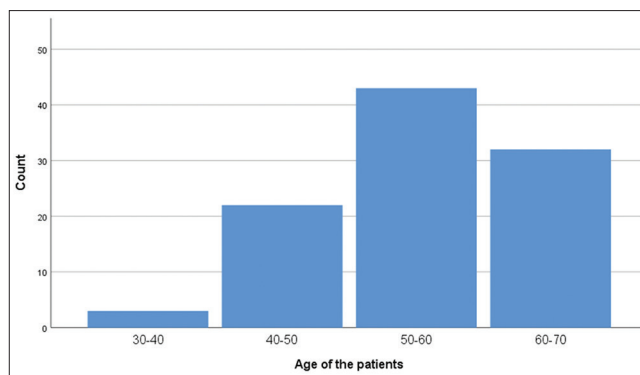


Figure 1: Age distribution of the involved patients (below picture)

Table 1: Number of patients involved in each group and the relation with the thyroid function status before and after the procedure ($n=100$)

	<i>n</i>	Frequency (%)	Significant (two-tailed)
Preintervention			0.559
Coronary angiography	74	74	
PCI	26	26	
Postintervention	100		0.520
Coronary angiography	74	74	
PCI	26	26	

PCI: Percutaneous coronary intervention

Table 2: Thyroid stimulating hormone level correlation before and after the intervention

Correlations		
	TSH before intervention	TSH after intervention
Spearman's rho		
Correlation coefficient	1.000	-0.071
Significant (two-tailed)		0.481
<i>n</i>	100	100

TSH: Thyroid stimulating hormone

Table 3: Relation between the dependent variable (the iodine-containing contrast) and the level of the thyroid hormones after the intervention

	Standardized coefficients (β)	<i>t</i>	Significant
TSH	0.047	0.462	0.645
T4	-0.163	-1.508	0.135
T3	0.026	0.245	0.807

TSH: Thyroid stimulating hormone

DISCUSSION

In this study which is the first study, up to our knowledge, from the area revealed no significant risk to thyroid functions in euthyroid patients who were undergoing CAG and PCI after exposure to radiographic contrast material. In addition, the risk was also not differ significantly between the subgroup of

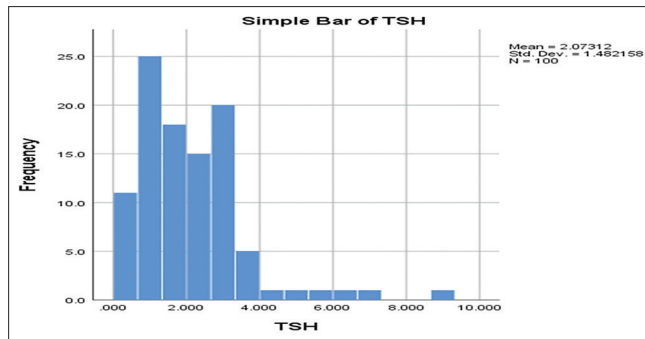


Figure 2: Levels of the thyroid-stimulating hormone after the intervention

cases undergoing diagnostic angiography or therapeutic, i.e., PCI patients.

A routine test for thyroid function before performing the procedures utilizing contrast is not recommended even in localities where iodine deficiency is common like our locality, but postcontrast TFT monitoring is advisable for high-risk individuals.^[8]

In euthyroid individuals, the risk of postcontrast hyperthyroidism is very low ranging from 0% to 2.7% and the hypothyroidism is much lower after a single exposure to the contrast agents. In addition, such risks are usually transient and resolve spontaneously within 9 months. A higher rate of such silent risks has been estimated by some studies.^[13-15]

In agreement to the above results, an Italian study that was done on 1600 patients undergoing CAG showed that only 1.9% of them developed hyperthyroidism and the same has been found in another study done in the United States on 56 patients. In line with our findings, other studies found no significant changes in the TFTs after the utilizing of radiographic contrast agent.^[7,16,17]

However, performing contrast study in patients who are known to have thyrotoxicosis have been shown to cause acute exacerbation in the minority of such patients, so awareness is needed in this group of patients because some may need hospitalization until the acute exacerbation subsides.^[18] Symptomatic patients may require treatment until their symptoms resolve, and the hyperthyroidism may be treated with short-term use of beta-blockers only without antithyroid medications except in those who have persistent and severe symptoms. Prophylactic treatment before the exposure is usually not recommended by most of the authors as this effect is transient, mild, and resolves spontaneously in most patients.^[1,9]

Some authors recommend the oral intake of 1.4 g of perchlorate before the procedures using contrast materials. This agent prevents the uptake of the iodine by the thyroid gland, thus preventing the high buildup of iodine load inside the thyroid gland.^[19] The systematic performance of TFTs before CAG and percutaneous CAG is not a standard of care in most of the pieces of literature; and generally, it is not recommended. However, this may be directed to the selected patients at risk or patients having subclinical thyroid dysfunction.^[20-23]

Long-term follow-up of those patients who developed thyroid dysfunction after contrast studies showed that some of them may have permanent thyroid dysfunction, particularly hypothyroidism. So that, the follow-up is recommended for patients at risk for up to 2 years, and their physicians should be aware of complications of iodine-containing contrast agents and report them precisely.^[16,24] Despite the absence of significant association between the utilizing of contrast agent in coronary angiographic procedures we do not recommend to generalize such results in our area because the pilot design of this study with a small sample size of cases and relatively short-term follow-up.

CONCLUSION

From results of this study we can conclude that In euthyroid patients undergoing CAG/PCI, minimal changes could occur in thyroid function and these changes are of limited significance in short term.

Acknowledgment

In addition to our thanks to the staff of Azadi Heart Center for their logistic help in doing this study, we would like to thanks Dr. Ayad Ahmed for his help in performing the statistics of this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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