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Complications and Risk Factors of Thyroid Gland Surgery at the Yaounde University Teaching Hospital from 2013 to 2015

Complications et facteurs de risque des thyroïdectomies opérées au CHU de Yaoundé de Juin 2013 à Juillet 2015

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RÉSUMÉ

Introduction. La thyroïdectomie est régulièrement pratiquée en Chirurgie générale et ORL. Les patients opérés pour thyroïdectomie arrivent tardivement en consultation et sont porteurs de volumineuses masses. Cela implique-t-il plus de complications post-opératoires? Quels sont les facteurs de risque associés à ces complications ? **Méthodologie.** Nous avons réalisé une étude cas-témoins (Juin 2013-Juillet 2015) en ORL au CHU de Yaoundé. Tous les patients opérés d'une thyroïdectomie et qui avaient donné leur consentement éclairé étaient inclus dans l'étude. Les données socio-démographiques, cliniques et chirurgicales ont été collectées et analysées. Les patients ayant présenté une complication (Cas) étaient comparés aux autres (Témoins) pour les facteurs de risque. Le rapport de côtes et l'intervalle de confiance à 95% ont été calculés. **Résultats.** Nous avons colligés 90 cas de thyroïdectomies. 17 patients (18,9%) ont développé des complications post-opératoires. 7 (7,8%) hématomes dont 2 étaient compressifs et ont nécessité une reprise chirurgicale ; 8 cas (8,8%) de paralysie récurrentielle dont 3 ont été trachéotomisés et un seul a gardé une paralysie bilatérale permanente. 2 patients ont présenté des crises de tétanie, traités avec succès par du calcium. Les facteurs de risque après analyse étaient la présence d'un prolongement intra-thoracique et le score TIRADS >= 4. **Conclusion.** L'incidence des complications transitoires après thyroïdectomie est de 18,9% dans notre service ; elle chute à 2,2% pour les complications permanentes. Les facteurs de risque retrouvés sont le goitre avec prolongement thoracique et un score TIRADS >= 4. Ces éléments devraient être pris en compte avant toute chirurgie thyroïdienne.

ABSTRACT

Aim. Thyroidectomy is a common surgical procedure performed in general surgery and Otorhinolaryngology (ORL). In our setting, most patients operated for thyroidectomy present very late with large tumours. Does that imply more post-operative complications? Which risk factors are associated with them? **Methods.** We carried out a case control study (June 2013 - July 2015), at the ORL department of the Yaoundé University Teaching Hospital (CHUY). All patients, operated for thyroidectomy by our team and who gave their consent were included. Socio-demographic, clinical and surgical data were collected and analysed. Patients who presented complications (cases) were compared to the others (controls) for risk factors. The Odds ratio and the 95% confidence intervals were calculated. **Results.** 90 thyroidectomies were recruited. 17 (18.9%) developed transient post-operative complications. 7 had cervical hematoma (7.8%) with 2 compressive ones who were re-operated. 8 had recurrent laryngeal nerve (RLN) palsy (8.8%), 3 were operated for tracheostomy, the tube was furthermore removed but 2 (2.2%) had permanent RLN palsy. 2 Patients suffered from tetanic crisis and were treated with intravenous then oral calcium. Independent risk factors after the logistic regression were the presence of an endo-thoracic component of the goitre and the TI-RADS grade equals or greater than 4 at the ultrasonography. **Conclusion.** The incidence of post thyroidectomy transient complications is 18.9% in our department but dropped to 2.2% for permanent complications. The risk factors are intra- thoracic goitres and TI-RADS grade equals or greater than 4. These factors have to be addressed in order to reduce complications.

INTRODUCTION

Thyroidectomy can be defined, as a surgical intervention consisting of partial or total removal of the thyroid gland. It is a common procedure performed in general surgery and Otorhinolaryngology (ORL). There are various indications of thyroidectomy; from endocrine diseases such as Grave's disease that cannot be controlled by medical treatment **[1]**, to thyroid nodules which can be benign or malignant tumours. Thyroid gland surgery requires from the surgeon a good knowledge of the neck anatomy but also some special skills in surgical techniques, in order to avoid or reduce significantly the post-operative complications **[2]**.

From studies carried on ORL surgical procedures in Cameroon and Gabon **[3,4]**, thyroidectomy with 11.3% (Cameroon) and 12.7% (Gabon) of all surgeries is the third most common surgical procedure performed, following tonsillectomies and/or adenoidectomies and removal of others tumours of the head and neck region. But most patients consulting for thyroid gland lumps do come late to the hospital. They usually present with very large tumours making the surgical procedure to become more complex and difficult. Does that mean that the incidence of complications is high in our context? In order to answer to this question, we decided to carry out a research on post-operative complications after thyroidectomies in our department. The aim of this study was to assess the incidence of post-operative complications following thyroid gland surgery, and to identify possible risk factors associated with these complications.

METHODS

A prospective case-control study was carried out at the Otolaryngology department of the CHUY, from June 2013 to July 2015. All the patients operated for thyroidectomy by our two seniors ORL surgeons and who gave their consent after proper explanations were included in the study. As soon as the indication for thyroidectomy was established, patients were sent to one of these surgeons in order to confirm the indication and the type of goitres (multinodular bilateral goitre, uni-nodular goitre). Their goitre were classified according to the 2004 WHO classification of goitre (Grade I: not visible but palpable; Grade II: visible and palpable and Grade III: compromising neighbouring organs) and the number of thyroid lobe(s) involved. Their general condition was evaluated for hypertension, diabetes mellitus and HIV infection; any previous thyroid surgery procedure done and the indication. The presence of compressive symptoms such as difficulties to breathe and to swallow was assessed; blood tests were done including full blood count, calcium level, kidney function, fasting blood sugar, coagulation tests and hormonal work up (ultra-sensible thyroid stimulating hormone). An ultrasound of the thyroid gland indicating the TI-RADS (Thyroid Imaging Reporting And Data System) classification of the thyroid nodules (< TI-RADS 4 or >= TI-RADS 4) was performed by a radiologist specialised on thyroid gland sonography. The presence of an endo-thoracic component was checked using clinical exam, chess X rays and confirmed during the surgery. The type of surgical procedure performed (total thyroidectomy; near total thyroidectomy or lobectomy; with or without a neck dissection) was noted and the duration of surgery from incision of the skin to its closure. 24 hours, one week, one month and six months after the procedure, blood calcium levels were checked to determine patients with hypocalcaemia due to hypoparathyroidism. A laryngoscopy was performed on day 1 and 7 after the procedure using a flexible laryngoscope to detect any paralysis of the vocal cord(s). In case of post-operative complications, the type(s) of complication(s) was (were) determined: hematoma, dyspnoea and/or dysphonia; tetanic crisis (confirmed by low calcium level below 7.5 mg/dl) and sepsis. The management of the complication was assessed (medical treatment with calcium therapy; surgical treatment such as tracheotomy or drainage of hematoma). All the patients were followed up at least during 6 months, those with complications were re-evaluated (clinical and laboratories exams) every fortnight to finally distinguish permanent complications from the others. The type of permanent complication was displayed. All the specimens were sent to the same pathologist and the results were compared among the patients.

All the patients were operated under general anaesthesia with endotracheal intubation and muscle relaxation. For total thyroidectomies both recurrent nerves were identified and at least two parathyroid glands were preserved. For near total thyroidectomies, the upper part of one intact thyroid lobe was preserved after having verify (through pathology examination) that the tumour was not malignant; the two recurrent nerves and at least two parathyroid glands were identified and preserved. For lobectomies, the affected lobe and the isthmus were removed, the ipsilateral recurrent nerve and at least one parathyroid gland were identified and preserved. The surgical wounds were closed with stiches and a rubber drain was left for 48 hours. After being extubated, patients were kept in a recovery room for 6 hours; when all vital parameters (oxygen saturation, respiratory rate, blood pressure and cardiac frequency) were considered normal, they were transferred to their rooms in the surgical ward. The first dressing of the wound was done on day 2 after the surgery and the drain removed. Patients were discharged on day 3 unless there was a particular problem or complication. Skin stiches were removed on day 7.

Data were collected with a coded questionnaire. Socio-demographic data, past medical history, pre-operative data, TI-RADS classification, surgical data, post-operative complication data, pathology results and treatment outcome were included in the questionnaire. Data were collected and analysed using Epi-Info computer software. All the patients with post-operative complications were considered as "cases" and compared to the patients without complication the "controls". Variables analysed as potential risk factors for complications were: the presence of hypertension, a previous thyroid gland surgery, a multinodular bilateral goitre, an endo-thoracic component of the goitre, the

presence of compressive symptoms, the TI-RADS classification >=4, the WHO grade III, a total thyroidectomy performed, the duration of the surgical procedure and the presence of a malignant tumour. Those potential risk factors were compared among cases and controls, and odds ratio and 95% confidence intervals were estimated with a p value < 0.05 considered statistically significant.

The patients were clearly informed about the research and were asked to give a written consent before being included in the study. Approval to conduct the study was obtained from the ethical committee of the Yaoundé Teaching University Centre (CHUY) before the beginning of the study.

RESULTS

Study population

From June 2013 to July 2015, 106 patients were admitted in the ORL department for thyroid gland surgery, representing 21% of all our operating cases during that period. Among them, 12 patients were operated by ORL residents and 4 refused to sign the informed consent for the study. Finally, only 90 patients were included in our study (figure 1).

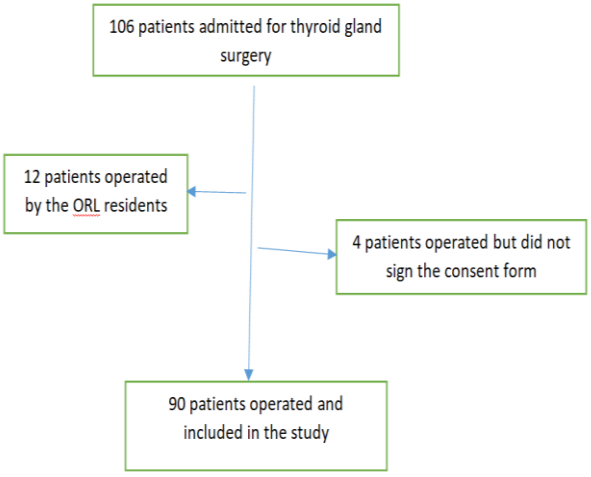

Figure 1: Distribution of the population operated for thyroidectomy in CHUY (June 2013-July 2015)

Characteristics of the study sample

90 patients were operated by our two senior surgeons, 10 (11.1%) were male and 80 (88.9%) were female, sex ratio: 1:8.

The mean age of the population was 43.6 (SD: +/- 12.8) years.

29 (32.2%) patients were originated from the west, 24 (26.7%) from the centre region, 8 (8.9%) from littoral region, 5 (5.6%) from the north and 24 (26.7%) from other regions of the country.

Most of the patients (33.3%) were working in private sectors, 28.9% were jobless, 26.7% were civil servants, and 11.1% were students.

Incidence of post-operative complications

After the surgical procedure, 17 patients out of the 90 developed post-operative transient complications; giving an incidence of 18.9% (95%CI = 11.4 – 28.5).

Type of post-operative complications

Among the complications, We had 7 (7.8%) cases of cervical hematoma, 3 (3.3%) cases of dysphonia and 7 (7.8%) cases of dyspnoea. Among the 7 cases of hematoma 2 were suffocating cervical hematoma, and we had 8 (8.8%) cases of recurrent nerve palsy confirmed by laryngoscopy, 2 (2.2%) cases of tetanic crisis due to hypoparathyroidism with hypocalcaemia.

Treatment and evolution of patients with post-operative complications

The two patients with tetanic crisis were put on intra venous calcium and then oral calcium. They improved clinically and three months after the surgery their blood calcium levels came back to normal.

Among the 7 cases of cervical hematoma, two were drained in the theatre under general anaesthesia (the two with severe dyspnoea); the other 5 (moderate hematoma) were treated in the outpatient department, by suction of the hematoma and compressive dressings.

Among the 8 cases of recurrent nerves palsy, 2 improved rapidly, the 3 patients with dysphonia were sent to a speech therapist, and within a month recovered their voices. 3 patients were operated for tracheostomy. One patient had a posterior cordotomy done because she had bilateral paralysis of the vocal cords. One recovered completely after the removal of the tube and the other had a permanent paralysis of the left vocal cord. So we had 2 patients with permanent recurrent nerves paralysis. Concerning these two patients, the first was a 42 years old lady with hypertension, a previous thyroid gland surgery 10 years back, an intra-thoracic component of her goitre and a TIRADS grade 5 at the neck sonography. The persistence of bilateral vocal cords paralysis indicated a posterior cordotomy. The second patient was a 28 years old lady with a multinodular bilateral goitre, a TIRADS 5 grade at the neck ultrasounds, she presented a severe dyspnoea after the surgery with immobility of vocal cords. One week after the tracheostomy we removed the tracheostomy tube and noticed that the left vocal cord was not moving at all.

Finally, 5 patients (5.5%) were re-operated because of post-operative complications and the incidence of permanent complications was 2.2% (95%CI = 0.3 – 4.2) only due to RLN paralysis.

Baseline characteristics of patients

The two populations, those with post-operative complications (cases) and without complications (controls) were almost similar as baseline characteristics are concerned (table 1).

Table 1: Baseline characteristics of cases and controls populations

Variables	Post-operative complications Cases, N = 17 (%)	No post-operative complications Controls, N = 73 (%)	P value
Mean Age (SD) in years	**44.3** +/- 13.0	**43.5** +/- 12.8	0.93
Gender			
Male	2 (11.8)	8 (11.0)	0.9
Female	15 (88.2)	65 (89.0)	0.9
Region of origin			
West	2 (11.8)	27 (37.0)	0.9
Centre	8 (47.1)	16 (21.9)	**0.02**
Littoral	1 (5.9)	7 (9.6)	0.61
North	1 (5.9)	4 (5.5)	0.36
Others	5 (29.4)	19 (26.0)	0.15
Occupation			
Civil servant	5 (29.4)	19 (26.0)	0.9
Private sector	5 (29.4)	25 (34.2)	0.69
Jobless	4 (23.5)	22 (30.1)	0.36
Student	3 (17.6)	7 (9.6)	0.15

Possible risk factors

The possible risk factors for post-operative complications were: the general condition of patients, a previous thyroid gland surgery, the type of goitre, an endo-thoracic component, the presence of compressive symptoms, the results of hormonal tests, the TIRADS grade of the tumour after neck sonography, the WHO grade of the goitre, the type of surgery performed, the results of the pathology of the specimen and the duration of surgery.

After the bivariate analysis, only 6 of these factors happened to be significant as risk factors: the presence of hypertension, an endo-thoracic component of goitre, the presence of compressive symptoms, a TI-RADS grade equals or above 4, total thyroidectomy surgery, a longer operating time (table 2).

Table 2: Variables associated with post-operative complications after bivariate analysis

Variables	Complications (Cases) N=17 (%)	No complications (Controls) N=73 (%)	Unadjusted OR (95% CI)	P value
General condition				
Hypertension	6 (35.3)	5 (6.8)	8.2 (2.1 – 31.8)	**<0.01**
Diabetes mellitus	1 (5.9)	0	-	-
Good	10 (58.8)	68 (93.2)	1	-
Previous thyroidectomy				
Yes	2 (11.8)	1 (1.4)	9.6 (0.8 – 112.8)	0.07
No	15 (88.2)	72 (98.6)	1	-
Type of goitre				
Multinodular bilateral	17 (100)	52 (71.2)	-	-
Uninodular	0	21 (28.8)	-	-
Endo-thoracic component				
Yes	12 (70.6)	7 (9.6)	22.6 (6.2 – 83.2)	**<0.01**
No	5 (29.4)	66 (90.4)	1	-
Compressive symptoms				
Yes	11 (64.7)	10 (13.7)	11.6 (3.5 -38.3)	**<0.01**
No	6 (35.3)	63 (86.3)		
Hormonal results				
Euthyroidism	16 (94.1)	73 (100)	-	-
Hyperthyroidism	1 (5.9)	0	-	-
TI-RADS grade				
Below 4	4(23.5)	53 (72.6)	1	-
Equals or above 4	13 (76.5)	20 (27.4)	8.6 (2.5 -29.5)	**<0.01**
WHO grade				
Grade II	1 (5.9)	15 (20.5)	1	-
Grade III	16 (94.1)	58 (79.5)	4.1 (0.5 -33.7)	0.18
Type of surgery done				
Total thyroidectomy	15 (88.2)	24 (32.9)	9.4 (2.0 -45.1)	**<0.01**
Near total thyroidectomy	2 (11.8)	30 (41.1)	1	-
Lobectomy	0	19 (29)	-	-
Pathology results				
Benign	13 (76.5)	68 (93.2)	1	-
Malignant	3 (17.6)	5 (6.8)	3.1 (0.7 -14.8)	0.15
Grave's disease	1 (5.9)	0	-	-
Duration of surgery **(Means and SD in minutes)**	**211.8** +/- 84.5	**143.4** +/-51.6	-	**<0.01**

Pathology results

The pathology results revealed 81 (90%) benign tumours, 8 (8.9%) malignant tumours and one case of Grave's disease confirmed by clinical and hormonal evaluation. Among the malignant tumours, one case of anaplastic carcinoma was observed and 7 cases of papillary carcinoma.

Multivariate analysis to identify independent risk factors

After having identify the possible risk factors of post-operative complications, a step by step logistic regression was performed to bring out independent risk factors of post-operative complications after thyroid gland surgery. Two factors remained significant: the presence of an endo-thoracic component of the goitre and the TIRADS grade equals or above 4 (table 3).

Table 3: Variables associated with post-operative complication after logistic regression

Variables	Post-operative Complications N= 17 (%)	No complication N= 73 (%)	Adjusted Odds ratio (95% Confidence Intervals)	P value
Endo-thoracic component				
Yes				
No	12 (70.6)	7 (9.6)	19.9 (4.3 -93.5)	**<0.01**
	5 (29.4)	66 (90.4)	1	-
TI-RADS grade				
Below 4	4 (23.5)	53 (72.6)	1	-
Equals or above 4	13 (76.5)	20 (27.4)	7.1 (1.5 -33.4)	**<0.01**

Outcome

After a follow up of at least 6 months, the outcome was excellent for 86 (95.6%) patients, 2 (2.2%) patients were on remission from their papillary carcinoma, 2 (2.2%) were deceased. One from her anaplastic carcinoma, one month after the surgery and the second patient from a disease not related with her surgery.

DISCUSSION

This study on post-operative complications of thyroidectomies and their possible risk factors is among the firsts carried out in our setting. Despite the limited number of patients recruited, it can help us to improve the outcomes of patients undergoing thyroid gland surgery in our department.

Study population

With close to 21% of all our surgical procedures, thyroidectomy is the third most common surgery performed in our department. Thyroidectomies occupied also the third position on a study done in Yaoundé on ORL surgical practices from 1998 to 2003 **[3]**. Even though at that time its frequency was 11.3% in five hospitals. The surgical activity has increased and is becoming more specialised in reference hospitals, for instance the CHUY has become a specialised centre for neck surgery. That is probably why we have many cases of thyroid gland surgery.

Characteristics of study sample

Our study population was made of 88.9% of women and 11.1% of men. Thyroid gland diseases are more common in women, so it is not a surprise to have such a gap between men and women as thyroid surgery is concerned. Other papers found the same figures: 89% of women in Brazil **[5]**, 82% of women in Dakar-Senegal **[6]**, 88.6% in Mali **[7]** in 2015.

The mean age was 43.6 (+/-12.8) years which is closed to the mean ages found in Mali **[7],** in Morocco **[8]** and in Brazil **[9].** The forties happens to be the common age for thyroid gland surgery worldwide.

The regions of origin of the population was consistent with the findings of the third demographic census of the Cameroonian population organised by the BUCREP (Central Bureau of the Census and population studies) **[10].** Most patients were from the private sector because they can afford to pay for their surgery, the others probably received financial supports from their families and relatives.

Incidence of complications

The aim of this study was to assess post-operative complications after thyroid gland surgery. We found an incidence of 18.9% (95%CI= 11.4 – 28.5) of transient post-operative complications and 2.2% (95%CI = 0.3 – 4.2) for permanent complications. We expected a much higher incidence considering the fact that most of our patients came very late to consult with very large goitres. But our figures were similar to those observed in the literature **[5, 9, and 11].** This can be explained by the fact that our surgeons are already used to operate patients with enormous goitres so they have gained experience and feel very comfortable no matter the size of the goitre.

Type of complications

Recurrent laryngeal nerve (RLN) palsy was the most common complication observed in our study with 8.8% as transient complication and turned to be with 2.2% the only permanent complication observed. During the surgical procedure, most of the RLN were dissected and preserved but we still had RLN palsy. It is a common complication of thyroid gland surgery and can reach up to 3.1% as definitive complication in the literature **[5]**. Our study pointed out the fact that well trained and

experienced surgeons may operate complicated cases of goitres with low morbidity due to RLN.

Cervical hematomas were observed with a 7.8% rate as the second most common transient complication. Removal of very large masses from the neck usually leave a big empty space on the neck which may be filled by blood and serous fluids despite the presence of a drain, leading to a cervical hematoma. Two cases of these hematomas were re-operated, the first was due to severe hypertension on a patient known hypertensive and the second had problems with her clotting factors because of a liver failure on hepatitis C. That is why they bled directly after surgery. In others studies, **[6, 9, 12]**, the incidence of cervical hematoma is always below 5%; this difference can be explained by the limited number of patients we had during our study but also by the fact that we had many patients with very large goitres leaving a big empty space in the neck after surgery.

Hypocalcaemia on hypoparathyroidism was the third complication observed in our study, with only 2 transient cases (2.2%). Those patients had signs of severe hypocalcaemia and were managed with IV then oral calcium. Transient hypocalcaemia ranges from 1.6 to 20% in the literature **[13, 14]** so our figures fit with it. We did not record cases of permanent hypoparathyroidism maybe because of the willing of our surgeons to identify and preserve by all means the parathyroid glands of the patients and/or by the limited number of patients in our research.

Risk factors

After the bivariate analysis, 6 factors were identified as possible risk factors:

- Hypertension: 35.3% of our patients were hypertensive; Post-operative hypertension has been identified as an independent risk factor of cervical haemorrhage following thyroid gland surgery **[15, 16]**. This can be explained by the increasing of blood pressure after the effect of general anaesthesia especially on hypertensive patients, which can lead to bleeding on the bed of the previous goitre.
- Compressive symptoms: Found to be associated with post-operative complications because they are linked to the presence of a huge tumour at the level of the neck. The size of the tumour is strongly associated with complications **[15]** like injury of RLN or parathyroid gland but also with post-operative bleeding.
- Type of surgery done: An association can be found between total thyroidectomy and complications like RLN paralysis **[17].** We therefore expect to have less complications when a lobectomy or a near total thyroidectomy is performed. But recent studies **[18]** have proven that when there are well codified, there is no difference in terms of post-operative complications between total thyroidectomy, near total thyroidectomy and lobectomy.
- Duration of surgery: It has been noticed that a long duration of surgery is associated with more post-operative complications as thyroid gland surgery is concerned. But some papers **[11]** demonstrated that prolonged duration of surgery is not a risk factor for post-operative complications.
- Endo-thoracic component of the goitre: seems to be associated with post-operative complications because of the difficulties to remove the intra thoracic component of the goitre
- TI-RADS grading above or equals 4: which is associated with a high index of suspicion of the presence of a malignant tumour **[19]**. This can imply an aggressive attitude from the surgeon who would like to perform a more complete surgery leading sometimes to complications.

The multivariate analysis only identified two independent risk factors of post-operative complications. The presence of an endo-thoracic component of the goitre and the presence of a TI-RADS score above or equals to 4.

Endo-thoracic goitres are found to be associated with complications in many studies **[20].** Those complications mostly involve the RLN palsy **[20]**. It is an independent risk factor of complications because of the difficulties to perform a thyroidectomy when an endo-thoracic component is present. The TI-RADS score equals or above 4 can be considered as an independent risk factor here because as explained up our surgeons were particularly concerned by the necessity to do a complete surgery of a nodule suspected to be a malignant tumour, that attitude may have led to complications.

CONCLUSION

The incidence of complications following thyroid gland surgery is 18.9% (95%CI = 11.4 – 28.5) in our department. Those complications are RLN palsy, cervical hematoma and hypoparathyroidism. The permanent complications were 2 cases of RLN palsy (2.2%). Those figures observed in a low to middle setting like ours are not different from figures of the literature. The independent risk factors were the presence of an intra-thoracic component of the goitre and a TI-RADS score equals or above 4. Our surgeons should be concerned about the presence of these particular risk factors in other to reduce the incidence of post-operative complications in our settings.

What is already known on this topic?

- Thyroid gland surgery may be associated with post-operative complications. The most common complications found are mostly: Hypoparathyroidism and recurrent laryngeal nerve palsy
- The most common risk factors for thyroidectomy post-operative complications are endo-thoracic goitres, very larges goitres size and Grave's disease.

What this study adds to the literature?

- The incidence of post-operative complications after thyroid gland surgery in a developing country like Cameroon is almost similar to the incidence found in developed countries; despite the fact that people come late to the hospital presenting very large goitres and the surgical instruments and equipment are not always available.

- Permanent hypoparathyroidism was not found in our research.
- Ultra-sonographic classification of thyroid nodules (TI-RADS grade) may have an impact of post-operative complications.
- This paper may help general surgeons and ENT surgeons when preparing thyroid gland surgeries to prevent complication by stressing on risk factors like endothoracic component and TI-RADS >=4.

CONFLICTS OF INTEREST:

The authors declare that they have no competing interest.

AUTHORS' CONTRIBUTIONS

BOLA SIAFA Antoine: Conception, collection of data, statistical analysis and Writings
DJOMOU Francois: Conception and Writings
ANDJOCK NKOUO Yves Christian: Statistical Analysis and Writings
SANDO Zacharie: Reviewing and Writings, Data collection on Pathology results
ASMAOU BOUBA Dalil: Reviewing and Writings
NJOCK Richard: Conception and supervision.

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