Goiter surgery recommendations in sub-Saharan Africa in humanitarian cooperation

José Gil Martinez MD, PhD | Miguel González MD, PhD | Quiteria Hernández MD, PhD | María Angeles Rodríguez MD, PhD | Nuria Torregrosa MD, PhD | Elena Gil MD, PhD | Pedro Antonio Cascales MD, PhD | Miguel Angel Delgado MD, PhD | Joan Sancho MD, PhD | Victor Lopez-Lopez MD, PhD | Jose Manuel Rodriguez MD, PhD

1Department of General Surgery, University Clinical Hospital Virgen de la Arrixaca, Murcia, Spain
2Department of General Surgery, University Hospital Reina Sofia, Murcia, Spain
3Department of Maxillofacial Surgery, University Clinical Hospital Virgen de la Arrixaca, Murcia, Spain
4Endocrine Surgery Unit, Department of General Surgery, General University Hospital Santa Lucía, Cartagena, Spain
5Endocrine Surgery Unit, Department of General Surgery, Getafe University Hospital, Getafe, Spain
6Endocrine Surgery Unit, Department of General Surgery, Consorci Parc de Salut Mar de Barcelona, Barcelona, Spain
7Endocrine Surgery Unit, Department of General Surgery, University Clinical Hospital Virgen de la Arrixaca, Murcia, Spain

Correspondence
José Gil Martínez, MD, PhD, Ctra. Madrid-Cartagena, s/n, El Palmar, 30120 Murcia, Spain.
Email: pepegilmartinez@gmail.com

Abstract
Background: The standard treatment for endemic goiter is usually total thyroidectomy. In low- and middle-income countries, the management of thyroid disease, which is commonplace in fully developed countries, is not always possible. The purpose of this study is to establish a treatment algorithm to calculate the extent of thyroidectomy based on the risk factors of each patient.

Methods: This is a retrospective observational study conducted during the period between 2017 and 2019. A total of 287 patients with thyroid pathology were treated in Maragua Hospital (Kenya). The results of surgical treatment were analyzed after the implementation of an individualized treatment protocol.

Results: One hundred and sixty patients with different types of goiter underwent surgery: solitary nodule (54.4%), multi-nodular goiter (30.6%), diffuse goiter (10.6%), and intrathoracic goiter (3.8%). The techniques used were hemithyroidectomy (78.8%), Dunhill thyroidectomy (9.4%), bilateral subtotal thyroidectomy (6.9%), and total thyroidectomy (3.1%). There was no mortality. The surgical morbidity rate was 16% (only one major complication (3b)). Two cases of dysphonia were resolved in the first week. There were three cases of symptomatic hypocalcaemia, two of which resolved in the first week and the other of which was definitive. The follow-up at 6 months was 67%. The cancer rate found in the resection specimens was 5%.

Discussion: The implementation of individualized surgical protocols for thyroid surgery in sub-Saharan Africa can improve outcomes. The cooperation projects can increase access to complex surgical treatment for patients with limited resources in low- and middle-income countries.
INTRODUCTION

Goiter affects almost 6% of the population and is the most common endocrine disease, especially in endemic iodine-deficiency areas. In the developing world (sub-Saharan Africa, South Asia, the Caribbean, and Central America), the current treatment for thyroid disease, which is accepted in fully developed countries, is generally not available. Access to laboratory medicine, radiological diagnosis or therapeutic nuclear medicine is limited, iodine deficiency persists, and many countries lack expert surgeons and endocrinologists.

Thyroid surgery continues to be an important option for the treatment of multinodular goiter as it is a safe procedure with very low mortality and is one of the most necessary operations to perform, especially in endemic areas. Surgical management of these cases aims to treat goiter with a low morbidity and low recurrence rate, although, in disadvantaged countries such as some countries in Africa the ideal management of goiter is controversial. It should be considered that: (a) diagnosis is late, leading to a greater presence of giant goiters; (b) the possibility of hospital treatment for the majority of the population is minimal; (c) delays in treatment are common, which results in a higher incidence of advanced thyroid cancer; (d) the experience of medical-surgical teams is sometimes limited; and (e) replacement therapy with thyroxin is not usually possible, which determines the therapeutic indication and the technique to be performed.

The controversy over the extent of surgery in this benign disease, balancing recurrence/complications, acquires a new dimension in these resource-limited settings. It is necessary to assess whether the standard therapeutic management of goiter in highly developed countries is also applicable to least developed countries. The total thyroidectomy paradigm for goiter may have to be modified depending on the type of goiter, the availability of a specialist surgeon, and the availability of follow-up and/or replacement thyroxin. We are aware of the need for research in global surgery, which is why this study aims to develop a method for choosing the surgical technique based on these variables.

We present this article according to the TREND Statement Checklist.

PATIENTS AND METHODS

Study design

Two hundred and eighty-seven black patients with thyroid disease were prospectively studied with retrospective data collection, throughout 2017, 2018, and 2019 in a rural hospital setting (Maragua Hospital, Muranga County) in central Kenya, in the framework of an International Cooperation Programs (IC), conducted by the Spanish NGO “Cirugía solidaria,” in collaboration with the Vihda (a non-profit general interest organization registered in Spain and Kenya and whose main purpose is to improve the living conditions of the most disadvantaged in Kenya) and Diagrama (a non-profit organization that attends the needs of vulnerable people or people in social difficulty, always from the defense and promotion of Human Rights) foundations, also Spanish, as well as with the government of the Muranga region. The patients were recruited by the local counterpart Vihda. The municipality has a population of one million and Maragua, with 35,000 inhabitants, is the most underdeveloped district in this central province of Kenya is below the poverty threshold, with little possibility of obtaining replacement therapy or a regulated follow-up. The surgical team was made up of qualified personnel who worked in close collaboration with the Maragua Hospital staff for 15 days/year in surgical and hospitalization tasks.

The evaluation of the patients included a clinical study with general and cervical examinations, thyroid function tests, and an ultrasound study performed by a radiologist (TI-RADS). Fine needle aspiration was not performed. Each goiter was typed using the palpatory method adapted by the WHO/PAHO. Research Resource Identifiers (RRIDs) have not been used.

Finally, all patients with a goiter of any degree (except for the very small asymptomatic ones) who had associated clinical manifestations (dyspnea, cough, hoarseness, tremor, tachycardia, or excessive sweating) were included for treatment. Patients with uncontrolled hyperthyroidism or ASA IV were excluded. Antibiotic prophylaxis was performed in all patients. All the patients were informed and signed their informed consent. Excluded patients were referred for control of their disease by local doctors and summoned for the following surgical campaign.

The aim of this study was to achieve a goiter treatment protocol in unfavorable environments that allows a personalized choice of the most appropriate technique for each patient. In all cases, an attempt was made to identify the surgical approach according to the patient’s specific risk factors. The extent of thyroidectomy was determined based on (Figure 1) the following.

1. Goiter characteristics.
2. Expert surgeon.
3. Tracking possibility.
4. Thyroxine availability (social status).
5. Operative findings.

All operations were performed by experts in thyroid surgery; some were assisted by local surgeons. The patients accepted the chosen surgical option. No intraoperative biopsy was performed in any case. General anesthesia was used in all patients and energy devices
with scissors were used for dissection and sealing of the peri-thyroid vessels. In all cases, location of the parathyroid and recurrent nerves was attempted. Drains and topical haemostats were used in most cases.

All resection specimens were sent for histopathological analysis by local pathologists. All patients with bilateral surgery had clinical and calcaemia control. Postoperative hypocalcaemia in patients with unilateral thyroidectomy was measured clinically by examining...
circumoral paraesthesia, carpopedal spasm, muscle fasciculation, and Trosseau and Chvosteks signs. If there was a high index of clinical suspicion, a determination of calcaemia was done. Voice quality was evaluated and indirect laryngoscopy was performed in all patients.

Postoperative follow-up included clinical examination, thyroid function tests, and serum calcium in selected cases. The patients were discharged after 24–48 h, with a discharge report that included recommendations, treatment to be followed, and date of review. The follow-up was carried out in the 1st week and 1 year later (in the following campaign). In the intervening period, the follow-up was carried out by local personnel.

### 2.2 | Effectiveness analysis

A descriptive study of thyroidectomy procedures was conducted, which analyzed the following.

- Indicators of scientific and technical quality (the adoption of preoperative studies, assessment by anesthesia, the application of informed consent, the use of anesthesia, antibiotic prophylaxis and surgical techniques, and the use of drainage).
- Effectiveness indicators (mortality, morbidity, post-discharge follow-up, and recurrence). To calculate disability and mortality that were avoided with our intervention, we used a “calculation of DALYs averted” as an indicator (Supporting Information Material S1). To calculate potential DALYs for thyroid surgery we used the formula of the original work carried out by Bickler et al.\(^\text{10}\)
- Efficiency indicators (certificate of discharge, average postoperative stay).

### 2.3 | Statistical analysis

The results were analyzed using the statistical software program IBM SPSS Statistics version 15.1. The median-IQR was used for continuous quantitative variables, and the frequency and percentage for qualitative variables.

Our study received an exemption from requiring ethical approval, from the HCUVA committee.

### 3 | RESULTS

During the 3-year campaign in Kenya, 1140 patients underwent surgery, with a total of 1174 procedures. In total, 14% of the operated patients (160) had thyroid pathology.

Of the 287 patients with goiter who were assessed, 127 were excluded (age ≥ 50 years old\(^\text{11}\): 10; small size: 2; exacerbated symptoms of hyperthyroidism such as sweating, tremors or palpitations: 6; thyroid laboratory abnormalities: 3; severe comorbidities: 12; and absence of blood test: 94). Finally, 160 patients with a median age of 41 (IQR, 32–48) years received surgery.

The general data on sex, age, and anesthetic risk are shown in Table 1. The female/male ratio was 15:1.

The vast majority of patients presented with cervical tumor to a greater or lesser extent. The ultrasound study showed: TI-RADS 2–3: 88% and TI-RADS 4–5: 12%.

The grade, type, and dominant symptomatology can be seen in Table 2.

The type of surgical technique assigned to each patient was performed based on the criteria defined in Figure 1. One of the patients with diffuse goiter presented with tracheal inflation with histopathological confirmation of anaplastic cancer which required resection of the tracheal cartilage and tracheostomy for respiratory obstruction.
Data on operative time, weight, DALYs averted, follow-up, and presence of cancer in the specimen can be seen in Table 3.

The pathological study shows 49% multinodular goiter, 22.5% follicular adenoma, 15.5% colloid nodule, 8% thyroiditis, and 5% thyroid cancer (88.8% follicular type). All the patients with cancer in the resection specimen corresponded to TIRADS 4–5 at diagnosis. Microinvasive carcinoma without angioinvasion was found in three patients who underwent hemithyroidectomy and where thyroidectomy was not completed. TT or TQT was performed in the rest. No delayed TT was performed in any case, nor was treatment with iodine completed. Prophylactic central emptying was not performed.

### TABLE 3
Results according to surgical technique (surgical time, DALYs averted, weight, follow-up, and cancer in the specimen)

| Technique                          | Surgical time /min (median, IQR, min) | Weight (median, IQR, grs) | Follow-up at 1 year (%) | Cancer in the specimen (%) | DALYs averted (median, IQR, DALYs) |
|------------------------------------|---------------------------------------|---------------------------|-------------------------|---------------------------|----------------------------------|
| Isthmectomy (n = 2)               | 57 (55–57)                            | 45 (40–45)                | 91                      | 5                         | 3.25 (2.9–3.2)                   |
| Hemithyroidectomy (n = 127)       | 60 (55–90)                            | 90 (70–150)               | 6                       | 1                         | 4.13 (3.5–5.3)                   |
| Thyroidectomy-Dunhill (n = 15)     | 90 (75–90)                            | 150 (80–300)              | 6                       | 1                         | 4.13 (2.9–5.9)                   |
| Bilateral subtotal thyroidectomy (TQT) (n = 11) | 90 (90–120)                            | 150 (70–500)              | 6                       | 1                         | 4.13 (2.9–4.1)                   |
| Total thyroidectomy (n = 5)        | 120 (120–160)                         | 180 (130–675)             | 5                       | 1                         | 4.7 (1.8–5.9)                    |
| Total                               | 65 (60–90)                            | 130 (70–150)              |                         | 8 (5%)                    | 4.1 (3.5–5.3)                    |

### TABLE 4
Complications according to surgical technique

| Technique                          | Seroma (%) | Hematoma (%) | Injury RLN (%) | Hypocalcaemia (%) | Regrowth (%) | Total complications (%) |
|------------------------------------|------------|--------------|---------------|-------------------|--------------|-------------------------|
| Isthmectomy (n = 2)               | 6 (5%)     | 5 (4%)       | 1 (9%)        | 1 (7%)            | 3 (2%)       | 14 (11%)                |
| Hemithyroidectomy (n = 127)       | 2 (13%)    | 1 (9%)       |               | 1 (7%)            | 3 (2%)       | 1 (13%)                 |
| Thyroidectomy-Dunhill (n = 15)     | 2 (18%)    | 1 (19%)      |               | 1 (7%)            | 3 (2%)       | 4 (36%)                 |
| Bilateral subtotal thyroidectomy (TQT) (n = 11) | 1 (20%)    | 1 (20%)      |               | 1 (20%)           | 3 (18%)      | 4 (40%)                 |
| Total thyroidectomy (n = 5)        |            |              |               |                   |              | 11 (6.8%)               |
| Total                               |            |              |               |                   |              | 6 (3.75%)               |
| Total (%)                          |            |              |               |                   |              | 2 (1.25%)               |
| n (n = 160)                        |            |              |               |                   |              | 3 (1.8%)                |
| Total (%)                          |            |              |               |                   |              | 3 (1.8%)                |
| n (n = 160)                        |            |              |               |                   |              | 25 (16%)                |

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### 3.1 Scientific-technical quality indicators

All patients underwent preoperative evaluation by an anesthesiologist and informed consent and antibiotic prophylaxis. Drains were used in 90% of the interventions.

### 3.2 Indicators of effectiveness

There was no mortality in the entire series. Surgical morbidity was 16%, with only one major complication (3b): a case of bleeding without respiratory compromise, which required reoperation 12 h after the intervention. The rest of the hematomas or seromas were evacuated by puncture in the hospital ward.

The two cases of dysphonia resolved in the first 10 days. There were three cases of symptomatic hypocalcaemia, two of which resolved in the first week and the other of which was definitive. Complications are shown in Table 4.

### 3.3 Efficiency indicators

All patients were given a discharge report. The mean length of stay of the operated patients was 26 h (IQR, 25–34).

### 4 DISCUSSION

The prevalence of thyroid disease in low-income countries is not well known, essentially due to the lack of diagnostic resources. The majority of thyroid diseases in the developing world present as goiters, and deformation of the neck sometimes associated with compressive symptoms of neck structures. In addition, 75% of people with goiter live in underprivileged countries. In these countries, the lack of technical and laboratory resources causes errors and delays in...
diagnosis, which often results in giant goiter, compressive goiter or cancer (up to 7%–8%). \(^{15}\)

The incidence rates of cancer related to this type of goiter, together with esthetic alterations, cultural connotations, and the possibility of obstructive signs, may make surgery necessary in almost all cases. \(^{16}\)

Although total thyroidectomy could be the best option \(^{7}\) to avoid regrowth, its association with hypoparathyroidism or lesions of the recurrent nerve may question its global use and consider the use of limited resections. Thus, although the Cochrane review by Erbil \(^{17}\) found more regrowth in subtotal thyroidectomies, reoperation was hardly necessary, showing a higher rate of complications in total, even for specialized surgeons. \(^{18}\) For this reason, surgery for goiters should be safe and associated with as few complications as possible, or none, especially in those settings where the possibilities of follow-up are limited. Dralle emphasizes the risks and benefits of total versus subtotal thyroidectomy and highlights the need to individualize the surgical approach according to the patient’s specific risk factors for disease recurrence or surgical morbidity. \(^{19}\) Also, the long-term quality of life does not seem to be affected by the extent of thyroid resection. \(^{20}\)

Therefore, we always try to perform an individualized surgical treatment, considering that the decision of a more radical resection approach, while reducing the risk of recurrence, also increases surgical morbidity \(^{21}\) and also considering the conditions of the goiter itself, the availability of an expert surgeon or thyroxin, and the possibility of follow-up. It should not be forgotten that many patients may never return for follow-up after surgery or that replacement thyroxin may not be available. \(^{6,22}\)

For this reason, we believe that lobectomy in selected patients should be the option for symptomatic unilateral multinodular goiter. In our series, a higher proportion of unilateral surgery was performed considering that it will avoid the need for lifelong treatment with L-thyroxin, and in the case of recurrence, the patient will not suffer higher rates of complications due to reoperation of the opposite lobe, since this contralateral lobe has been left intact during the primary surgery. In addition, in selected patients with unilateral disease, unilateral thyroid lobectomy would be the procedure of choice \(^{23,24}\) even in cases of bilateral multinodular goiter with minimal multinodular formation in the contralateral lobe. In our series, there was no mortality. The mortality rate of close to 0%, which is presented in high-income countries, \(^{25}\) does not correspond to the mortality rate of thyroid surgery in low-income countries \(^{26}\), where we found results of around 3%. \(^{27,28}\)

Our complication rate of 13% (Table 4), mainly in more resective techniques (all of a minor nature except reoperation for hematoma), supports our hypothesis that the selection of the technique based on certain variables improves the results, especially in settings with limited resources, although the incorporation of various types of energy devices and the inclusion of experienced surgeons with more than 1000 thyroidectomies may have contributed. \(^{29}\)

Overall, between 2% and 12% of total thyroidectomy patients develop permanent hypoparathyroidism, according to national registries and large multicenter studies. \(^{30}\) There is agreement that the risk of permanent hypocalcaemia is much lower after bilateral subtotal thyroidectomy and the Dunhill procedure. \(^{31,32}\) Our low rate of hypoparathyroidism (1.8%), mainly in resective techniques, can be justified, fundamentally in addition to the experience of the team, by the choice of surgical technique with few complete bilateral surgeries, \(^{33,34}\) although these calcium levels were not assessed in any case in our series given the small number of patients undergoing total thyroidectomy. It is true that parathyroid insufficiency is the most common complication after total thyroidectomy, but permanent impairment of parathyroid function is rare. Unfortunately, the media in this environment do not allow follow-up programs similar to those in highly developed countries. \(^{35,36}\)

On the other hand, our rate of transient recurrent paralysis of 1.6% is below the usual standards and one case recovered in the first week, although the paralysis was definitive in another. Likewise, experience and the lower number of nerves at risk (hemithyroidectomies) were favorable factors. It is true that the number of TTs could have been higher but the availability of thyroxin or follow-up has conditioned the indication.

In agreement with the study by Li et al. \(^{37}\) our complications are greater in the total thyroidectomy groups. In most cases, total thyroidectomy was not performed, and our low regrowth rates (1.8%) did not require surgery; also, given the environment, we did not consider the use of thyroid hormone to prevent recurrences. \(^{38}\)

The main limitation of our study was undoubtedly the difficulty in evaluating the results of the follow-up (67%). In previous campaigns in other countries, this was extremely difficult. All patients diagnosed with cancer have been followed up by local surgeons without finding signs of relapse so far (ultrasound and TGB if possible). The chance of a carcinoma found incidentally is 5%–15% of all surgeries for goiter. \(^{2,29}\) In addition, it is worth mentioning that complete thyroidectomy is rarely required, since 60%–80% of these cancers are papillary microcarcinomas where hemithyroidectomy is sufficient, \(^{40}\) so no second interventions are necessary, although in our case there was a greater proportion of follicles conditioned by iodine deficiency.

Our results may provide a new way of treating thyroid disease in underprivileged environments, being extrapolated to similar conditions.

This type of essential surgical care, also called primary surgery or global surgery, has recently begun to be considered a fundamental component of health systems in low-income countries. Its favorable benefits and the devastating impact of surgical conditions in terms of DALY are now more widely recognized. \(^{41}\) The burden of DALYs associated with surgical conditions is greater in sub-Saharan Africa than in any other region and is estimated at 38 DALYs lost per 1000 people. Most of this disease burden could be avoided if surgical treatment were more accessible. \(^{42}\) Our calculation of DALYs averted with this type of surgery is promising enough to continue working in this direction. We believe that it may be of interest to complete the study with an evaluation of the cost of each DALY and give an approximation of how much is being saved with this type of intervention.

It is not easy to meet the needs of unsatisfied thyroid surgery in sub-Saharan Africa or the developing world in general. The strategy should include short-term humanitarian assistance, as is currently offered, as well as well-considered long-term programs for the training and retention of local staff. Our NGO (Solidarity Surgery) works
using this model, with assistance projects trying to alleviate the large number of goiters which need to be intervened in sub-Saharan Africa, and with training and training programs for local personnel, similar to other initiatives like the one between the Diakonie Hospital in Mannheim (Germany) and the “Leo Hospital” (Burkina Faso) or in South Sudan. The results of “The Lancet Commission” on global surgery highlight the resulting improvements in the national economies of countries that carried out a modest investment in surgical services.

5 | CONCLUSION

Total thyroidectomy as a standard approach to goiter with bilateral involvement should be reconsidered in sub-Saharan Africa. The implementation of individualized surgical protocols for thyroid surgery can improve outcomes. The cooperation projects can increase access to complex surgical treatment for patients with limited resources in low- and middle-income countries.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

AUTHOR CONTRIBUTIONS

Jose Gil: Conception and design; manuscript writing; final approval of manuscript. Miguel González, Nuria Torregrosa, and Elena Gil: Collection and assembly of data; manuscript writing; final approval of manuscript. Quiteria Hernández: Provision of study materials or patients; manuscript writing; final approval of manuscript. María Angeles Rodríguez: Provision of study materials or patients; manuscript writing; final approval of manuscript. Pedro Antonio Cascales: Data analysis and interpretation; manuscript writing; final approval of manuscript. Miguel Angel Delgado Angel: Administrative support; manuscript writing; final approval of manuscript. Joan Sancho: Administrative support; manuscript writing; final approval of manuscript. Víctor Lopez-Lopez: Data analysis and interpretation; manuscript writing; final approval of manuscript. José Manuel Rodríguez: Data analysis and interpretation; manuscript writing; final approval of manuscript.

ORCID

José Gil Martínez https://orcid.org/0000-0002-5812-8899

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