

**TITLE**

**POST THYROIDECTOMY RECURRENT  
LARYNGEAL NERVE PARALYSIS AS  
SEEN AT KENYATTA NATIONAL  
HOSPITAL, NAIROBI-KENYA.**

**A PROSPECTIVE STUDY.**

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**A THESIS SUBMITTED IN PART FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF MASTER OF MEDICINE IN  
EAR, NOSE AND THROAT - HEAD AND NECK SURGERY, AT THE  
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## DECLARATION

is my original work and has not been presented for a degree in any other  
ersity.

ed  Date 17<sup>th</sup> June 2007

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## **DEDICATION**

This work is dedicated to my wife Mrs. Catherine Wahome, for her patience and support throughout the study. I also dedicate it to my parents Mr. and Mrs. Wahome, who are now deceased, and my sister Mrs. Mercy W. Mahianyu for their efforts in educating me.

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## ABBREVIATIONS

DL	=	Direct laryngoscopy
ENT-HNS	=	Ear, nose and throat - head and neck surgery
KNH	=	Kenyatta National Hospital
IL	=	Indirect Laryngoscopy
RLN(s)	=	Recurrent Laryngeal Nerve(s)
EMG	=	Electromyography
SPSS	=	Statistical Package for Social Sciences

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## ABSTRACT

### **Background**

Iatrogenic injury of recurrent laryngeal nerve (RLN) is one of the most serious concerns in thyroid surgery. I carried out a prospective study aimed at determining the prevalence of RLN paralysis, its presentation and the associated risk factors among patients undergoing thyroidectomy at Kenyatta National hospital (KNH), Nairobi, Kenya.

### **Methods**

All patients had indirect laryngoscopy (IL) done one day before operation to assess the integrity of the RLNs through vocal cords function. Patients with RLN paralysis prior to surgery were excluded from the study. Symptoms occurring one day after surgery were noted down. This was repeated at around six weeks post-operation and patients presenting with symptoms suggestive of RLN paralysis had a second IL done. Correlation between the occurrence of paralysis and the age, sex, histopathological process, type of operation done, surgeon's experience and intra-operative RLN identification was done.

### **Results**

Seventy-one (88.8%) had benign thyroid disease while 9 (11.2%) had cancer of thyroid. Seven patients (8.8%) were found to have developed RLN paralysis with the majority (57.1%) having suffered left adductor paralysis. Re-operation for recurrent malignancy had the highest rate of paralysis (40%) while primary operations in general (5.6%) and primary operations for benign disease (5.9%) had the lowest rates. Three patients (42.9%) presented with hoarseness alone, 3 (42.9%) with hoarseness and aspiration while 1 (14.2%) had dyspnoea.

### **Conclusions**

Thyroidectomy is an important etiological factor to developing RLN paralysis at KNH. Re-operations on the thyroid and failure to identify the RLN intra-operatively are significant risk factors to developing RLN paralysis. The majority of patients who develop RLN paralysis following thyroidectomy at KNH present with hoarseness.

## **INTRODUCTION**

Thyroidectomy is one of the commonly used modalities in treatment of thyroid diseases (8). Like any other operation, it has several associated surgical complications. Alkama (1987) noted laryngeal oedema, laryngomalacia, and vocal cord paralysis to be the commonest complications in our set-up (11). Thyroid surgery contributes 20-30% in aetiology, of recurrent laryngeal nerve paralysis (10). Permanent laryngeal paralysis is a surgical tragedy comparable to a surgically induced facial paralysis (20).

Recurrent laryngeal nerve paralysis represents one of the serious complications, causing, when bilateral serious functional sequelae such as phonatory, respiratory and psychological problems that limit working capacities and social relationships of the patient (2). The resulting hoarseness may be a serious functional impairment especially for those who rely on their voice professionally (4). The paralysis may pose a serious medico-legal concern especially if proper assessment of vocal cord function, coupled with an informed consent is not obtained before thyroid surgery (7).

Early diagnosis and management of vocal cord paralysis is important and could be life-saving in some patients.

At KNH, thyroidectomy is one of the commonly undertaken operations (about 200 per year). It is on the above basis that I undertook this study to determine the prevalence of recurrent laryngeal nerve paralysis, its presentation and associated risk factors among patients undergoing thyroidectomy at KNH.

### **SURGICAL ANATOMY OF THE THYROID GLAND, RECURRENT LARYNGEAL NERVES AND THE LARYNX.**

The thyroid gland is a highly vascular structure situated on the antero-inferior aspect of the neck, above the supra-sternal notch. In normal subjects, it has two lateral lobes joined together in the midline by the isthmus. The lateral lobes extend from the sides of the thyroid cartilage to the 6<sup>th</sup> tracheal ring while

the isthmus overlies the 2<sup>nd</sup> to the 4<sup>th</sup> tracheal rings anteriorly. There is sometimes a pyramidal lobe which projects upwards from the isthmus, usually on the left hand side. The gland is enclosed in pretracheal fascia. It is covered by the strap muscles and overlapped by the sternocleidomastoid muscles anteriorly. It is related posteriorly to the larynx and trachea, with the hypopharynx and esophagus behind them. The carotid sheath, with its contents lies lateral to the gland bilateriorly. On either side of the gland and in close proximity to its blood supply, lie two important nerves, the external branch of superior laryngeal nerve and recurrent laryngeal nerve (16).

The superior and recurrent laryngeal nerves are branches of vagus nerve. The external branch of superior laryngeal nerve lies deep to the upper pole of the thyroid gland and passes to the cricothyroid muscle, which it supplies. Here it lies in close proximity to the superior thyroid artery, which enters the gland through this pole. In 15% of the cases the nerve runs with these vessels and leaves them close to the gland. This nerve is usually injured during ligation and division of these vessels (1, 16).

The RLN has sensory, motor and parasympathetic fibres. It divides into an internal branch (which supplies sensation to the vocal cords and subglottic region) and an external branch, which provides motor function to all intrinsic laryngeal muscles except the cricothyroid. Before entering the larynx, the external branch sends branches to the inferior constrictor and cricopharyngeus muscles (1, 13).

The RLNs arise from the vagus in the superior part of the neck. The right nerve crosses the under surface of the right subclavian artery and ascends in the neck, aiming at the right tracheo-esophageal groove. The left nerve hooks around the arch of the aorta and ascends more vertically and deeper in the left tracheo-esophageal groove. The nerves enter the larynx at the cricothyroid articulation through the fibres of the inferior constrictor muscles.

During ascent of the RLNs from the thorax to the larynx, numerous anatomical variations can be encountered. When approaching the inferior pole of the thyroid gland, the RLN may pass posterior to the inferior thyroid artery (61.5%), anterior to the artery (32.5%) or between its branches (6.5%) (1). Many studies report that the nerves usually divide into two or more branches when approaching the inferior construction muscle before entering the larynx.

The RLN runs in the tracheo-esophageal groove in 65-77% of cases, lateral to the trachea in 22-33% and rarely anterolateral to the trachea, where it is highly susceptible to injury during thyroid surgery (1).

In about 0.6% of cases, an aberrant right subclavian artery arises from the aorta after the left subclavian artery has given off. In these cases, the right inferior laryngeal nerve fails to recur around the artery and passes directly from the vagus towards the larynx. In this instance, it is referred to as "*non-recurrent*" inferior laryngeal nerve and is highly susceptible to injury during thyroid surgery. Non-recurrence of the left inferior laryngeal nerve is a very rare occurrence but is seen in patient with a right-sided aorta (1, 13).

RLN may be attached to the back of the pre-tracheal fascia but never penetrates the fascia. The larynx lies in front of the hypopharynx opposite the 3<sup>rd</sup> to the 6<sup>th</sup> cervical vertebrae. It has 3 unpaired cartilages (thyroid, cricoid and epiglottis) and 3 paired cartilages (Arytenoid, corniculate and cuneiform). The arytenoid cartilage has a pyramidal shape with a base that articulates with the cricoid cartilages, a muscular process directed laterally to give attachment to muscles, a vocal process directed anteriorly to attach the vocal ligament and an apex directed upwards to support the corniculate cartilage. It has two important joints; cricoarytenoid and cricothyroid. Several membranes and intrinsic muscles hold the cartilages together to form a firm laryngeal framework, with only slight movement taking place at the joints. Extrinsic muscles attach the larynx to the surrounding structures.

A mucous membrane lines the inside of the larynx. It is loosely attached to the laryngeal framework except over the vocal cords, the corniculate and cuneiform cartilages. It is lined by a respiratory epithelium (ciliated pseudo-stratified columnar) except over the vocal cords and the upper part of the vestibule where it is stratified squamous. It has numerous mucous glands except over the vocal cords.

The cavity of the larynx is divided into 3 parts by the true and false cords into vestibule, ventricle and subglottic space. It can also be divided into 3 sites in relation to the vocal cords i.e. supraglottic, glottic and subglottic.

The vocal cords are two pearly - white sharp bands, extending from the middle of the thyroid cartilage angle to the vocal process of the arytenoids. Each cord consists of a vocal ligament, which is the true upper edge of the crico-vocal membrane, covered by mucous membrane with scanty subepithelial connective tissue.

The glottis (rima glottidis) is the elongated space between the vocal cords anteriorly (60%) and the vocal process and base of arytenoids posteriorly (40%). Its anteroposterior length is about 24 mm in adult males and 16mm in females. The size and shape of the glottis varies with the movements of the vocal cords (22).

The intrinsic muscles may act on the vocal cords or laryngeal inlet. Acting on the vocal cords, the posterior cricoarytenoid abducts them while the lateral cricoarytenoid, transverse arytenoids, cricothyroid and thyroarytenoid adducts them. Cricothyroid tenses while thyroarytenoid and vocalis muscle relaxes the cords. On the laryngeal inlet, thyroepiglotticus opens it while aryepiglotticus and oblique arytenoids close it.

#### **The larynx performs the following important functions:**

Through sphincteric closure of the laryngeal opening, false and the true cords, it protects the lower airways from aspirated foreign bodies and secretions.

Through vibration of the vocal cords by exhaled air, the larynx produces sound which is converted into speech by the modulatory action of lips, tongue, palate, pharynx and teeth.

Acts to regulate airflow into and out of the lungs. During inspiration the vocal cords abduct while during expiration they are adducted.

Closure of the glottis helps to fix the chest wall. With this, intra-abdominal pressure can be increased in such activities as lifting heavy objects, pulling, climbing, coughing, vomiting, defecation, micturation and child bearing.

## **PATHOPHYSIOLOGY OF RECURRENT LARYNGEAL NERVE**

### **PARALYSIS**

RLN can be cut, crushed, stretched or cauterised during surgery (14). Underland (1977) (25) classified peripheral nerve injuries into 5 classes according to the degree of injury:

*Neuropraxia.* Pressure on the nerve trunk causing conduction block. No disruption of the axonal continuity occurs and the connective tissue elements remain intact. Removal of pressure restores full conduction.

*Axonotmesis.* The axon degenerates distally from the site of the injury to the motor endplate and proximally to the first node of Ranvier (wallerian degeneration). Connective tissue elements remain viable so that, regenerating axons may return precisely to their original destinations. Removal of original insult permits complete recovery.

*Endoneurotmesis.* Injury disrupts the axon and the endoneurium so that the regenerating axon may enter the wrong endoneural tube or may fail to enter an endoneural tube at all leading to incomplete recovery with synkinesis.

*Perineurotmesis.* In addition to III above, the perineurium is also disrupted, and the potential for incomplete recovery and aberrant regeneration is greater. Intra-neural scarring may prevent most axons from reaching the muscle.

*Epineurotmesis*. This is complete transection of the nerve, including its epineurial sheath. There is almost no hope for useful regeneration unless the ends are approximated.

Following a nerve injury, a mixture of above lesions occur i.e. some fibres may have a conduction block whereas others are disrupted, with varying degrees of connective tissue injury.

Generally speaking, the resultant vocal cord paralysis can either be unilateral or bilateral; adductor or abductor, the terminologies referring to the movement the vocal cord cannot make when paralysed (13).

Several theories have been advanced to explain the position of the paralysed vocal cords. **Felix Sermon (1881)** observed that the paralysed cords usually rested in the median position, since; according to him abductor function of the recurrent laryngeal nerve was more vulnerable to injury than adductor function. He attributed this to the phylogenetic development of the larynx, the adduction function being more primitive was more resistant to pressure injury. It is now clear that the neuromuscular pathology of laryngeal paralysis is a more complex (10, 13, 14, 17).

**King and Gregg (1948)** ascertained that the posterior (internal) branch of RLN supplied motor innervation to the posterior cricoarytenoid and arytenoid muscles and the anterior branch to other intrinsic muscles. Hence selective injury to any one of the branches would result in paralysis of a particular muscle group i.e. abductor in case of injury to posterior branch. This theory has been proven wrong since the internal branch of RLN is chiefly adductor (10, 17).

**Wagner (1890)** and **Grossman (1897)** explained the median and paramedian positions of the vocal cords following RLN paralysis as a result of continued function of the cricothyroid muscle, supplied by the external branch of the superior laryngeal nerve. This muscle tenses the cords and adducts the

arytenoids. This theory has been proved experimentally correct and is generally accepted (13, 17).

**Crumley (2000)** suggests that the final resting position of the vocal cords depends on the results of random nerve regeneration, the poorly functioning re-innervation modified by the severity of the injury, formation of scar tissue and effects of nerve growth stimulating and inhibiting factors. He points out that motor axons grow towards the distal nerve stump and muscles in a random, almost chaotic fashion. In addition other adjacent nerves such as fibres of the vagus, internal branch of superior laryngeal nerve, cervical sympathetic and parasympathetic nerves might grow towards and innervate the intrinsic laryngeal muscles. He refers to the resultant abnormal innervation as "*synkinesis*". He prefers the expression "*vocal fold motion impairment*" to vocal cord paralysis, claiming that many RLN injuries are partial and do not transect the nerve. As a result of the *synkinesis*, there is always some motor unit action potential activity in the laryngeal muscles (14, 18). He classified vocal cord paralysis into four classes according to presentation:

*Type I*=Immobile and poorly mobile vocal fold with a satisfactory voice and airway.

*Type II*=Spasmodic vocal fold that jerks, twitches or jumps, with unsatisfactory voice and/or airway.

*Type III* =Hyper-adducted vocal fold with intermediate-to-normal voice. Airway impairment may be present.

*Type IV* =Hyper-abducted vocal fold with poor, breathy voice, no airway difficulty but with possible aspiration.

He termed *type I* as favourable and types *II*, *III* and *IV* as unfavourable. *Type IV* is said to be rare <sup>(14)</sup>.



## **RISK FACTORS OF DEVELOPING RLN PARALYSIS FOLLOWING THYROIDECTOMY.**

Several factors have been found to be associated with higher rates of RLN paralysis. Some of these factors are:

- 1) Poor expertise of the surgeon (2, 9). Very low surgical morbidity rates for thyroidectomy are reported in specialised centres (9).
- 2) Type of thyroidectomy. Total and completion thyroidectomies show the highest rates of paralysis (2, 6,9).
- 3) Type of disease. Operation for cancer of thyroid, grave's disease and recurrent goitre are associated with a higher risk for RLN paralysis (6, 8, 9).
- 4) Failure to routinely identify the RLN during thyroidectomy increases the risk of the nerve being injured (4).
- 5) Anatomical anomalies of the RLN increase the chances of injury during thyroidectomy (2, 3).

## **PRESENTATION IN RECURRENT LARYNGEAL NERVE PARALYSIS**

The presentation depends on the degree of injury and whether both or one RLN is injured.

### **(a) Poor Vocal cord function:**

- (i) Unilateral paralysis with the vocal cord in the median or paramedian position - symptoms maybe minimal. Hoarseness may prevail with impairment of high-pitched sounds such as in signing. Hoarseness and stridor may only occur in extreme exertion. Compensation by the opposite cord may occur with improvement of the symptoms (10, 13).
- (ii) Bilateral paralysis with cords in the median and paramedian position may present with a good voice but the degree of dyspnoea and stridor is variable. Some patients present with marked

dyspnoea and stridor at rest while some become symptomatic only on exertion. Any inflammatory condition affecting the larynx makes the symptoms worse (10, 13, 19).

- (iii) Paralysis with the cords in the intermediate or abducted position - patients present with a weak, breathy voice and short phonation time due to leakage of air through the incompetent glottis. Aspiration can be a prominent presenting symptom sometimes leading to aspiration pneumonia (10, 13, 17, 19).

Patients with cricoarytenoid joint immobility and/or interarytenoid scar (either due to direct injury or prolonged intubation) can mimic features of bilateral vocal cord paralysis. Thorough evaluation, which might include testing of arytenoid mobility at DL and EMG, is important in differentiating these conditions from true vocal cord paralysis (24).

- (b) **Poor laryngeal sphincter function** presents with symptoms of aspiration (cough and choking sensation). Sometimes the aspiration can be significant as to cause aspiration pneumonia. Lack of sensation in the lower laryngeal compartment affects the cough reflex and therefore worsens the aspiration, which can happen without being detected (13, 17).
- (c) **Inability to obtain a positive subglottic pressure** limits the patient's capability to undertake such activities as coughing, micturating, defecation, vomiting, climbing and lifting heavy objects (10, 17, 19).
- (d) **Poor innervation of the cricopharyngeus and inferior constrictor muscles** and the inability to develop a positive subglottic pressure disorganizes the swallowing reflex and patients present with dysphagia (10, 13, 17).

## **INVESTIGATIONS IN RECURRENT LARYNGEAL NERVE PARALYSIS.**

1. **Indirect laryngoscopy** - Is quick and simple and therefore a reasonable initial investigation to perform both before and after surgery on the symptomatic patient (7). In most patients, it will be possible to arrive at a decision with indirect laryngoscopy and further instrumental techniques can only supply superfluous information in most cases (21). This can be done either through use of a) laryngeal mirrors or b) flexible fiberoptic nasolaryngoscope. A laryngeal mirror allows three-dimensional viewing and good colour resolution but offers poor visualisation in some cases especially in those with abnormal anatomy, those with excessive gag-reflex and in children. In these patients flexible nasolaryngoscopy can be performed with good results. Both types of examinations require the use of topical anaesthetics to reduce discomfort and gag-reflex. Examination using laryngeal mirror is easier, faster and has better resolution than use of flexible nasolaryngoscope. With IL, lesions in the larynx, resting position and mobility of the vocal cords can be assessed.
2. **Direct laryngoscopy** - This examination uses rigid laryngoscopes and requires the patient to be put under general anaesthesia. Assessment is more reliable during the final stage of spontaneous - ventilation general anaesthesia (14). The examiner needs to be careful to avoid faulty placement of the distal end of the laryngoscope which can fix one side of the larynx and lead to an erroneous evaluation. More details on lesions can be obtained than in IL since the patient is under anaesthesia.
3. **Stroboscopy** - the action of the laryngo-stroboscope rests on the fact that the vibrations on the vocal cords are periodic so that they return, at regular intervals, to the same position. A delayed image of the vibrations of the cords is produced by slightly reducing the frequency of the flashes of light compared with vibrations of the cords. They are then illuminated in a

successfully later and later phase of movement by the pulses of light producing an apparent slow forward movement of the vibrating cords. The examination is carried out in the same manner as conventional laryngoscopy, with the normal light source replaced by a flashing xenon tube. The stroboscopic light source can also be linked to a Hopkins rod or fiberscope. Both can be used for video display or recording of the image. The light from the stroboscope is transmitted to the larynx by a quartz fibre bundle. Mainly the upper surface of the vocal cords is seen, whereas the lower surface remains out of sight. However the medial surfaces, which are directed towards each other, are easily seen, at least during the open phase of the vocal cords. This is an advantage over the conventional laryngoscopy where during phonation the fast vibrations only permit a blurred view of the medial edges and therefore small irregularities can escape the examiner's view. In stroboscopic laryngoscopy one sees the vibrating part of the vocal cords sharply defined, and everything which protrudes from their medial edges is distinctly observed. With the help of a well adjusted stroboscope, the extremely fast vibration movement appears as a gentle waving motion.

#### **4. Electromyography (EMG)**

This involves recording of action potentials from the intrinsic laryngeal muscles. The muscles can be approached either through the mouth and pharynx with wire electrodes being placed on the vocalis muscle or needle electrode through the skin of the neck (percutaneous) being placed in the various layers of the laryngeal musculature. EMG is evolving as an assessment modality and the indications and applications are not yet universally agreed (14). The procedure should be reserved for research purposes (21).

## **TYPES OF THYROID SURGERIES**

1. *LUMPECTOMY* - removal of a thyroid nodule alone with minimal surrounding thyroid tissue.
2. *PARTIAL THYROIDECTOMY* - Removal of a thyroid nodule with a larger margin of surrounding thyroid tissue.
3. *TOTAL LOBECTOMY (HEMITHYROIDECTOMY)* - Complete removal of one thyroid lobe and the isthmus.
4. *SUBTOTAL THYROIDECTOMY* - bilateral removal of more than one half of the thyroid gland on each side plus the isthmus.
5. *NEAR TOTAL THYROIDECTOMY* - total lobectomy and isthmusectomy with removal of more than 90% of the contralateral lobe.
6. *TOTAL THYROIDECTOMY* - Removal of both thyroid lobes plus the isthmus.
7. *COMPLETION THYROIDECTOMY* - A subsequent operation to convert a lesser operation into a near-total or total thyroidectomy.

## **MANAGEMENT OF RECURRENT LARYNGEAL NERVE PARALYSIS**

Many surgical methods have evolved including injection of teflon paste to the vocal cords, dermograft fat infections, implantation of autologous cartilage and fascia etc. Details of these methods are outside the scope of this study.

## **STUDY JUSTIFICATION**

Recurrent laryngeal nerve paralysis is a known complication of thyroid surgery with studies quoting figures of between 0.4 to 30%. This paralysis can cause serious functional sequelae such as phonatory, respiratory and psychological problems that limit working capacities and social relationships of the patient.

Thyroidectomy being one of the commonly undertaken operations at KNH, there is need to know the prevalence of this complication, its clinical presentation and the associated risk factors. No prospective study has been undertaken at KNH to achieve this. By having this knowledge, the health worker will be in a better position to counsel patients on the possible effects of thyroidectomy on the function of the larynx, make early diagnosis of RLN paralysis from presentation and examination and know the possible risk factors associated with a higher risk of this paralysis in thyroid surgery.

## **LITERATURE REVIEW SPECIFIC TO THE STUDY**

Paralysis of the larynx may be caused by peripheral or central damage to the RLN fibres. However, the later is rare (13). Thyroidectomy is one of the operations associated with RLN paralysis. The reported incidence of permanent paralysis varies widely from 0.4% (8) to 7.7% (4). However, the incidence could be as high as 13% and 30% of patients during thyroidectomy for thyroid cancer and in secondary thyroidectomy, respectively (6).

**Stell and Maran (2000)** (10) found that malignant disease accounted for 25% of the RLN paralysis, surgical trauma 20%, non-surgical trauma 15%, idiopathic causes 15%, neurological causes 15%, inflammatory causes 5% and miscellaneous causes 5%.

**Ramadan et al (1998)** (23) carried out a study on 98 patients with RLN paralysis at West Virginia University Hospital and found that 30% had physical trauma, 32% had neoplasms, 30% had surgical trauma, 8% had central causes, 3% had infections while 16% were idiopathic.

**Chung YL et al. (2000)** (6) did a prospective evaluation of vocal cord function before and after thyroid surgery on 500 patients at a University hospital in Hong Kong. In their study, indirect laryngoscopy or flexible laryngoscopy was performed 48 hours before surgery and repeated within 2 weeks after surgery. They defined postoperative cord paralysis as the presence of an immobile vocal cord or decreased movement of the vocal cord during phonation. They observed that 6.6% of the patients developed postoperative unilateral vocal cord paralysis. They documented no bilateral vocal cord paralysis. Of the risk factors they analysed, surgery for malignant neoplasm and recurrent substernal goitre was associated with an increased risk of permanent vocal cord paralysis, while primary operations for benign goitre were associated with the lowest risk.

**Chiang F.Y. et al. (2004)** (4) did their study on 521 thyroidectomy patients at a University Hospital in Taiwan and found that 7.7% of the patients developed RLN paralysis despite routine identification of RLN during surgery. All patients underwent preoperative and postoperative laryngoscopic examination of the vocal cords. Patients with RLN paralysis resulting from infiltration by disease etc, and those in whom RLN(s) had been sacrificed during surgery were excluded from the statistics. Recovery from temporally RLN paralysis had a mean of 30.7 days and persistent vocal cord dysfunction beyond 6 months was considered permanent. The rates of temporally to permanent paralysis were 4.0/ 0.2%, 2.0/0.7%, 12.0/1.1% and 10.8/8.1% for groups classified according to benign thyroid disease, thyroid cancer, grave's disease and re-operation, respectively. They therefore concluded that operations for Thyroid cancer, Grave's disease and recurrent goitre demonstrated significantly higher RLN paralysis rates. They recommended total lobectomy with routine RLN identification as a basic procedure in thyroid surgery.

**Giovanni et al. (1999)** did a retrospective review of 192 patients who had undergone thyroidectomy with routine identification of RLN at a university hospital in Messina, Italy. They concluded that iatrogenic injury to RLN or its branches might be better avoided by searching, identification and exposing the nerve itself, and following its course with care. They also concluded that injury to the nerve can occur as a result of poor expertise of the surgeon.

**Joao G. et al. (2005)** (8) did a retrospective review of 1020 patients who had undergone thyroidectomy at a cancer hospital in Brazil and found out that 0.4% of the patients had developed permanent RLN paralysis.

**Mbogh G.M. (2001)** (12) did a retrospective review of 454 patients who had undergone thyroidectomy at KNH between January 1989 and December 2000. He found that 28 (6.2%) of the patients had developed vocal cord paralysis following surgery. From his study, total thyroidectomy, re-operations and surgery for cancer of the thyroid were associated with a higher risk of



developing RLN paralysis. Of the patients who developed paralysis, majority presented with dysphonia (69%) followed by stridor on exertion (14%). Dysphagia, stridor at rest, voice fatigue and inability to sing high tones, and throat irritation and discomfort had a similar lower rate of 7%.

## **STUDY OBJECTIVES**

### **Main objective:**

The study aimed at determining the prevalence of RLN paralysis following thyroidectomy, its clinical presentation and associated risk factors as seen at KNH.

### **Specific objectives:**

1. Determine the prevalence of RLN paralysis following thyroidectomy at KNH.
2. Determine the clinical presentation of patients with RLN paralysis following thyroidectomy at KNH.
3. Determine the risk factors associated with development of RLN paralysis in patients undergoing thyroidectomy at KNH.

## **MATERIALS AND METHODS**

### **Study design**

A prospective hospital based case series study.

### **Study setting**

The study was conducted at thyroid and ENT-HN surgery clinics, all general surgery wards 5A, 5B, 5D and 4B, all surgical amenity wards and ENT-HN surgery ward 5C of KNH.

### **Study population**

The current study was confined to eighty patients (77 females, 3 males whose age was between 6 and 75 years, median age 46 years) who underwent thyroidectomy between August and December 2006, with documented normal RLNs function before operation.

### **Sample size**

The sample size was determined using Kish and Leslie's formula. The minimum number of patients to be included in the study was calculated to be 77 using a P (prevalence) value of 0.077 (7.7%) (4).

### **Inclusion and exclusion criteria**

#### a) Inclusion criteria:

1. All patients who underwent thyroid surgery during the study period.
2. Patients who consented for the study.

#### b) Exclusion criteria:

1. Patients who declined to consent for the study.
2. Patients whose thyroid disease histology was not known at the time of data analysis.

3. Patients whose vocal cords function could not be assessed preoperatively.
4. Patients who had neurological disease known to affect RLN function e.g. stroke.
5. Patients who had RLN paralysis pre-operatively.
6. Patients who underwent thyroid surgery as part of other major neck operations e.g. laryngectomy.
7. Patients whose RLN(s) was intentionally sacrificed during thyroid surgery.
8. Patients who had other known head and neck malignancies/tumours known to interfere with RLN function.

**Materials:**

1. Laryngeal mirrors
2. Portable headlight
3. Local anaesthetic (xylocaine 1%) in form of a spray
4. Clean gauze, gloves and face masks
5. Savlon
6. Spirit (Surgical)
7. Receivers
8. Direct laryngoscopy set
9. Theatre facilities
10. Stroboscope
11. Flexible laryngoscope
12. Adrenaline
13. Regal swabs
14. Tilley's forceps

## **Personnel**

1. All examinations and data entry was done by the researcher personally.
2. Data analysis was done with the help of a statistician

## **Procedure:**

All patients scheduled to undergo thyroid surgery were evaluated for eligibility and upon meeting the inclusion criteria were recruited into the study.

a) The pre-operative assessment included:

1. Patient age and sex
2. A detailed history with particular attention given to history of voice changes (dysphonia), difficulty in breathing (dyspnoea), difficulty in swallowing (dysphagia) and any choking and coughing associated with swallowing (aspiration). Previous neck operations including thyroid surgery and presence of any known neurological diseases such as stroke were documented.
3. A comprehensive physical examination and in particular quality of voice, presence or absence of stidor, other neck masses other than thyroid, presence of neck scars – surgical and otherwise. A neurological examination to rule out or confirm neurological disease was also carried out.
4. All patients who met the inclusion criteria after above assessment had indirect laryngoscopy done the day before surgery to determine the state and function of the vocal cords. Patients whose IL was non-conclusive and those found to have vocal cord paralysis were excluded from the study. Any lesions/tumors noted at IL were documented. The resting position and function of the vocal cords for the patients without vocal cords paralysis were documented in the patients assessment form (see appendix I). A clear diagram of the IL findings in the larynx was drawn to enable comparison with the postoperative IL findings.

**b) Post-operative assessment:**

1. All patients were reviewed one day after surgery and any dysphonia, dysphagia, aspiration, dyspnoea and stridor documented. No IL was be done at this stage.
2. Patients' operation notes were checked for details pertaining identification of RLN<sub>(s)</sub> during surgery. Those whose RLN<sub>(s)</sub> was intentionally sacrificed were excluded from study. The type of thyroid surgery done was also documented. Surgeon's experience was categorized (**table I**).

**Table I: Surgeons' categories.**

<b>SURGEON'S CATEGORY</b>	<b>DESCRIPTION</b>
I	Registrar
II	Consultant for 1- 5 years.
III	Consultant for 6- 10 years.
IV	Consultant for > 10 years.

3. A third assessment was carried out about six weeks after surgery and above symptoms and signs reviewed. Patients with dysphonia, dysphagia, aspiration, dyspnoea or stridor had a 2<sup>nd</sup> IL done and the findings recorded. Those with dysphonia and/or mild-moderate dyspnoea and presenting difficulty at this 2<sup>nd</sup> IL had stroboscopy done while those with severe dyspnoea and /or stridor had DL done under general anaesthesia.

## Technique of indirect laryngoscopy

### **a) Using laryngeal mirror.**

First, the procedure was explained to the patient in detail. The patient was then be put in a sitting position with the back straight and the hips planted firmly against the chair opposite and at the same head-level with examiner. With the patient's mouth wide open, the oropharynx was anaesthetized using a local anaesthetic (xylocaine 1%) in form of a spray to reduce discomfort and gag reflex during the examination. Patients were given a receiver to spit into if need arose. As the anaesthetic agent took effect, the examiner put on grooves and adjusted the headlight to a suitable position.

The patient was asked to lean forwards slightly from the waist and place chin upwards to allow the examiner's light to illuminate the oropharynx. With help of a gauze sponge wrapped around the anterior part of the protruded tongue and held between the thumb and index finger, the tongue was pulled out. The examiner's middle finger retracted the upper lip superiorly.

The examiner then advanced a laryngeal mirror (having been previously dipped in savlon to prevent fogging) into the oropharynx and elevated the uvula and soft palate under direct vision aided by a headlight. Any lesion in the larynx, and in particular the vocal cords was noted. The resting position, any oedema or wasting of the vocal cords was also documented. Lastly the mobility of the cord was assessed at panting, quiet breathing and phonation with a high-pitched EEEE.....

### **b) Using flexible nasolaryngoscope.**

With the patient in a similar sitting position as in a) above, the nasal cavity was anaesthetised with xylocaine 1% spray and decongested using regal gauze strips dipped in adrenaline. As the decongestant and anaesthetic took effect, the scope was prepared with the focus ring being used to get the brightest possible image. The regal gauze strips were then removed and the scope

advanced through the middle meatus, the nasopharynx and into the oropharynx. Assessment was then done like in a) above.

**c) Using a stroboscope.**

A 90<sup>0</sup> telescope connected to a monitor was used and assessment done like in a) above.

**d) Direct laryngoscopy.**

After obtaining informed consent to undertake the procedure, patients were put under general anaesthesia through nasotracheal tube while lying supine on operating table. After draping, a laryngoscope was advanced into the larynx through the mouth. The larynx was examined for any lesions. The laryngoscope was then removed and reversal of anaesthesia started. During reversal, as the patient started spontaneous breathing, the laryngoscope was re-introduced and the resting position and mobility of the vocal cords assessed.

**Quality control**

The questionnaire/ patient's assessment form was pre-tested before commencement of the study and appropriate modifications made to minimize errors.

To ensure uniformity, all interviews and examinations were done by the researcher.

**Data collection and analysis**

All information collected was entered into a patient's assessment form (appendix I). The data was checked for completeness, consistency and accuracy. It was transferred into a coded sheet and analysed using SPSS version 11.0 with the help of a statistician. Statistical analysis was performed using Pearson chi-square or Fisher's exact test (categorical variables) and the *t*-test (continuous variables).  $P < 0.05$  was regarded as statistically significant. The data was later



presented in text, graphs, tables and charts and conclusion and recommendations drawn from the results.

### **Study limitations**

1. Loss of patients during follow-up.
2. Lack of facilities to do EMG which would have helped in differentiating cricoarytenoid joint immobility and/or interarytenoid scar from true vocal cord paralysis.
3. Failure to identify asymptomatic RLN injuries.

### **Ethical Consideration**

Permission to carry out the study was obtained from the ethical and research committee of KNH. Information collected in the course of this study will be handled confidentially.

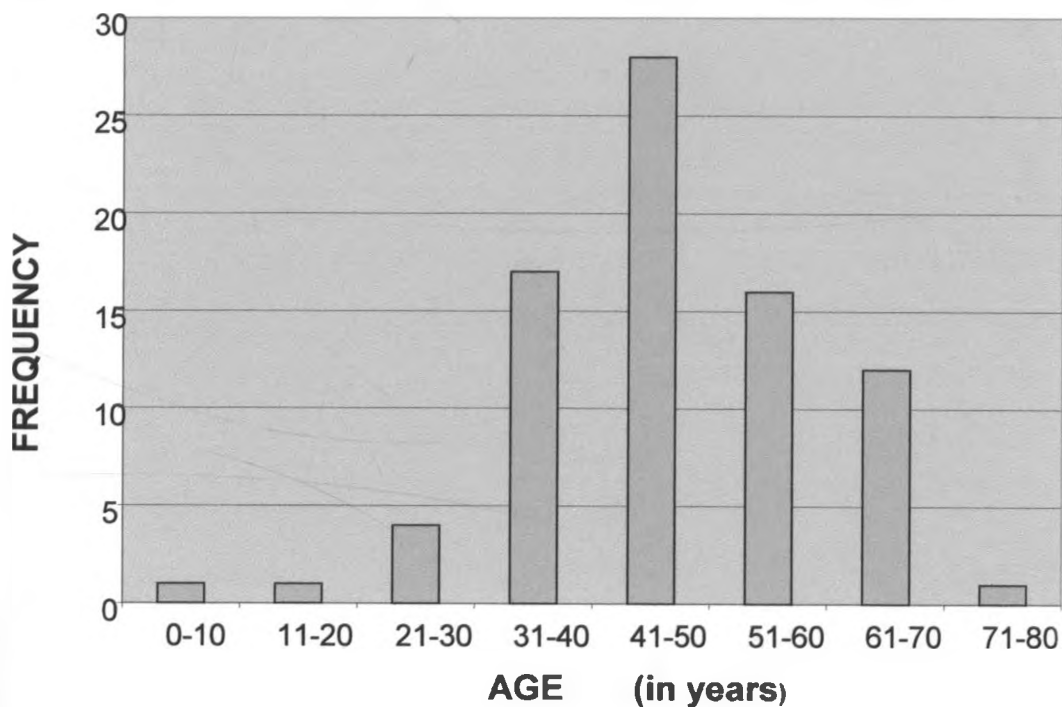
## **RESULTS**

A total of 93 thyroidectomies were done during the study period. Three patients declined to consent for the study, one had RLN paralysis before operation and five did not have histology results by the time of data analysis. Four patients were lost to follow-up. All the above 13 patients were excluded from the study leaving 80 patients in the study. Seventy-seven (96%) were females and 3 (4%) were males. The age range was 6 to 75 years, with a median age of 46 years. Seven patients (8.8%) developed RLN paralysis.

**Table 1: Age distribution among thyroidectomy patients.**

AGE IN YEARS	FREQUENCY	PERCENTAGE
0-10	1	1.25
11-20	1	1.25
21-30	4	5
31-40	17	21.25
41-50	28	35
51-60	16	20
61-70	12	15
71-80	1	1.25
<b>TOTAL</b>	<b>80</b>	<b>100</b>

**Figure 1: Age distribution among thyroidectomy patients**



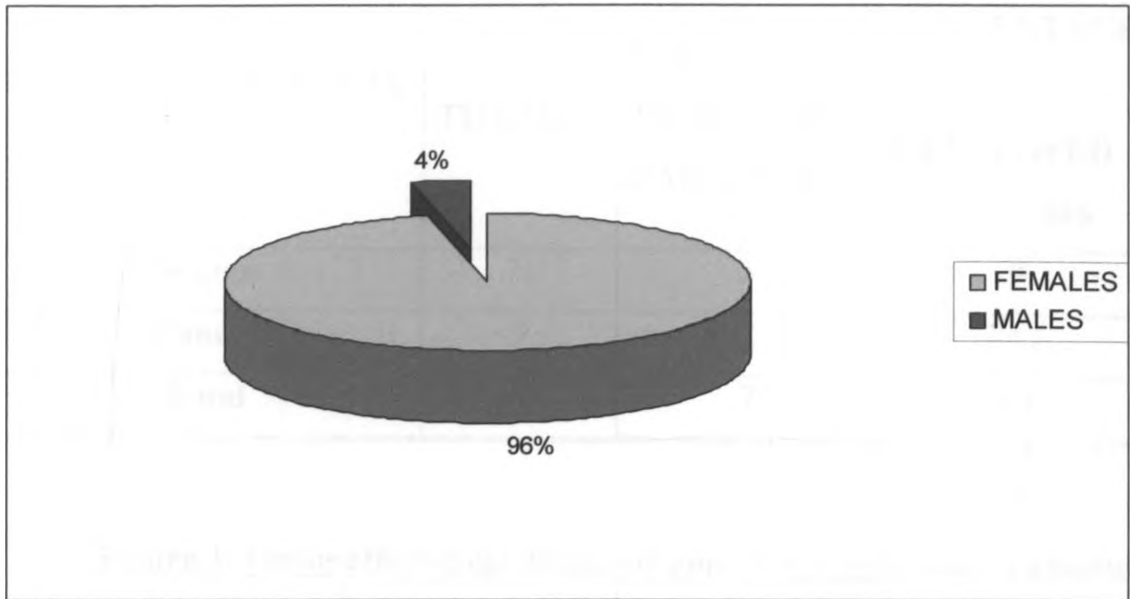
Majority (35%) of the patients who were operated were in their 5<sup>th</sup> decade of life (table 1 and figure 1).

**Table 2: Age distribution among patients who developed RLN paralysis.**

<b>AGE IN YEARS</b>	<b>FREQUENCY</b>	<b>PERCENTAGE (%)</b>
0-10	0	0
11-20	0	0
21-30	0	0
31-40	1	14.2
41-50	2	28.6
51-60	2	28.6
61-70	2	28.6
71-80	0	0
<b>TOTAL</b>	<b>7</b>	<b>100</b>

There was no significant correlation between age and development of RLN paralysis (table 2) (P=0.26).

**Figure 2: Sex distribution among thyroidectomy patients.**

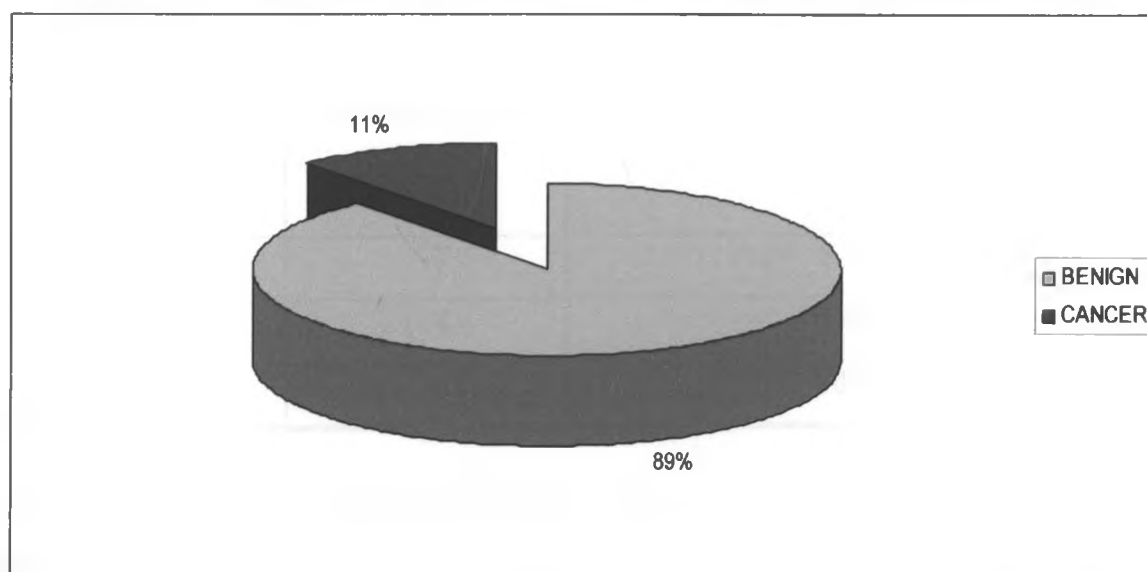


Majority (96%) of the patients operated were females (**figure 2**). All the patients who developed paralysis were females. There was no statistically significant association between sex of the patient and development of RLN paralysis ( $P=0.76$ ).

**Table 3: Histopathological process and rate of RLN paralysis.**

HISTOPATHOLOGICAL PROCESS	TOTAL	NO. DEVELOPED PARALYSIS	PERCENTAGE (%) DEVELOPED PARALYSIS
Benign	71	5	7
Cancer	9	2	22.2
Total	80	7	8.8

**Figure 3: Histopathological diagnosis among thyroidectomy patients.**



Benign thyroid disease accounted for 88.8% (n=71) of the patients operated while cancer of the thyroid was noted in 11.2% (n=9) (figure 3 and table 3). This study failed to show any statistically significance association between the histopathological process and development of RLN paralysis (P=0.18).

**Table 4: Types of thyroidectomies performed.**

<b>TYPE OF OPERATION</b>	<b>FREQUENCY</b>	<b>PERCENTAGE (%)</b>
Left hemi-thyroidectomy	15	18.8
Sub-total thyroidectomy	14	17.5
Near-total thyroidectomy	13	16.3
Partial thyroidectomy	11	13.8
Completion thyroidectomy	9	11.3
Right hemi-thyroidectomy	7	8.8
Total thyroidectomy	7	8.8
Lumpectomy	4	5.0
<b>TOTAL</b>	<b>80</b>	<b>100</b>

From the above table (table 4), majority of the operations done were left hemi-thyroidectomies (18.8%). Only 4 lumpectomies were done during this period accounting for 5% of the operations. Completion thyroidectomies accounted for 11.3% of the operations.

**Table 5: Rate of RLN paralysis for the various thyroidectomies performed.**

<b>TYPE OF OPERATION</b>	<b>FREQUENCY</b>	<b>N0. DEVELOPED PARALYSIS</b>	<b>PERCENTAGE (%) DEVELOPED PARALYSIS</b>
Left hemi-thyroidectomy	15	3	20
Sub-total thyroidectomy	14	0	0
Near-total thyroidectomy	13	1	7.7
Partial thyroidectomy	11	0	0
Completion thyroidectomy	9	3	33.3
Right hemi-thyroidectomy	7	0	0
Total thyroidectomy	7	0	0
Lumpectomy	4	0	0
<b>TOTAL</b>	<b>80</b>	<b>7</b>	<b>8.8</b>

**Table 5** shows that 33.3% of the completion, 20% of the left hemi-, and 7.7% of the near-total thyroidectomies done developed RLN paralysis. None of the total, sub-total, partial, right hemi-thyroidectomies nor the lumpectomies developed paralysis. No significant association between type of operation done in general and development of RLN paralysis was shown in this study ( $P=0.06$ ).



**Table 6: Re-operation and RLN paralysis**

	<b>FREQUENCY</b>	<b>NO. DEVELOPED PARALYSIS</b>	<b>PERCENTAGE (%) DEVELOPED PARALYSIS</b>
<b>Operated once</b>	71	4	5.6
<b>Operated twice</b>	9	3	33.3
<b>TOTAL</b>	80	7	-

However, considering RLN paralysis development in association with primary and secondary thyroid operations (**table 6**), a statistically significant difference was shown ( $P=0.02$ ).

**Table 7: Rate of RLN paralysis among patients re-operated for cancer and for benign diseases.**

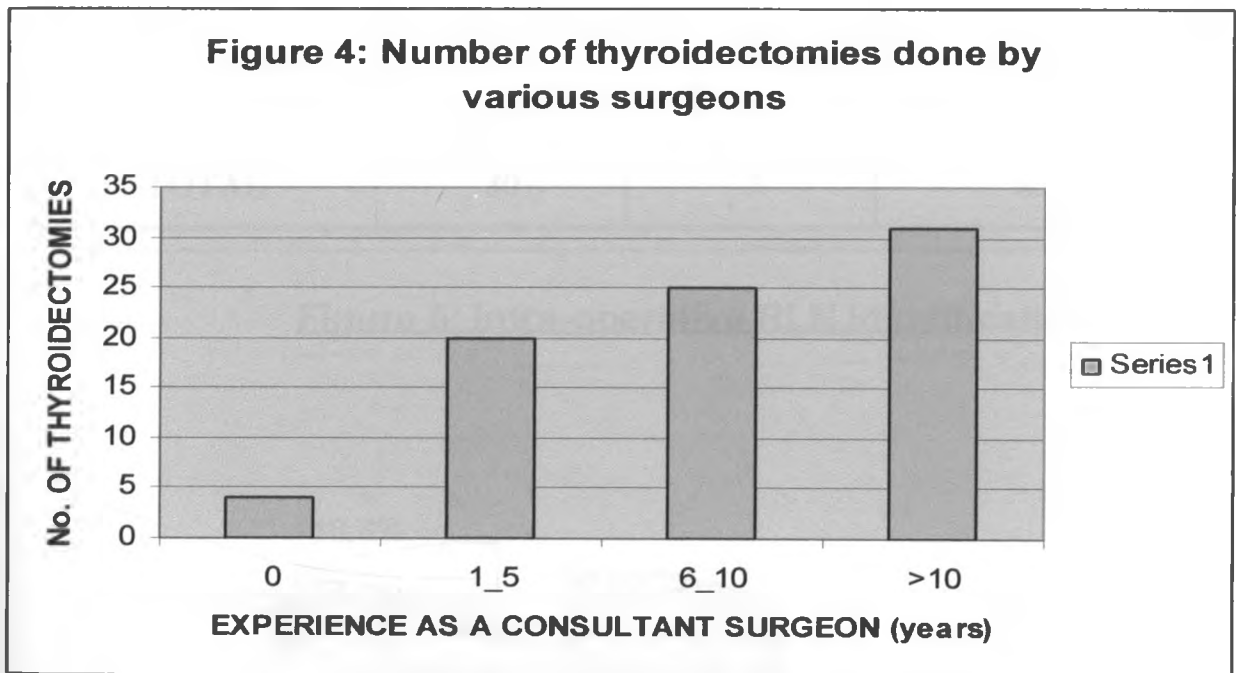
	FREQUENCY	NO. DEVELOPED PARALYSIS	PERCENTAGE DEVELOPED PARALYSIS
<b>Re-operated for benign disease</b>	4	1	25
<b>Re-operated for cancer</b>	5	2	40
<b>TOTAL</b>	9	3	33.3

The difference between primary and secondary operations in developing paralysis was shown to be more ( $P=0.01$ ), when the number of thyroid operations done on an individual was coupled with the underlying histopathological process (table 7). According to this table, 2 of the 5 patients (40%) operated for recurrent cancer of thyroid and 1 of the 4 (25%) operated for recurrent benign disease developed RLN paralysis. The lowest rate of paralysis (5.6%) was seen among patients who were operated on the thyroid for the first time irrespective of the underlying histopathological process (table 6).

**Table 8: Rate of RLN paralysis among the various categories of surgeons.**

SURGEON'S CATEGORY	NO. OF PATIENTS OPERATED	PERCENTAGE OF TOTAL OPERATED	NO. DEVELOPED PARALYSIS	PERCENTAGE OPERATED DEVELOPED PARALYSIS	PERCENTAGE OF TOTAL PARALYSED
Registrar	4	5	0	0	0
Consultant 1-5 years	20	25	2	10	28.6
Consultant 6-10 years	25	31.25	5	20	71.4
Consultant >10 years	31	38.75	0	0	0
<b>TOTAL</b>	<b>80</b>	<b>100</b>	<b>7</b>	<b>8.8</b>	<b>100</b>

**Figure 4: Number of thyroidectomies done by various surgeons**



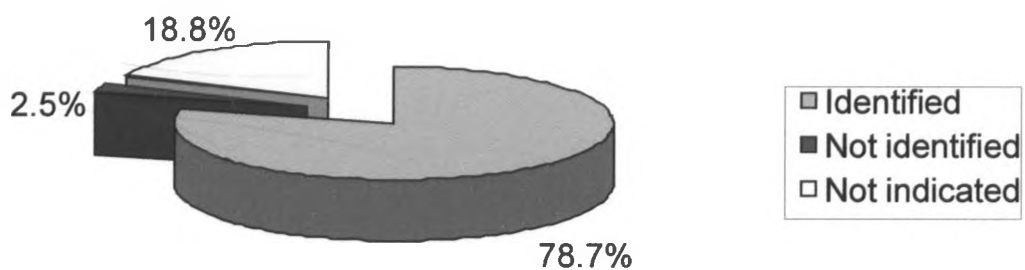
Majority of the operations (38.75%) were performed by surgeons who had been consultants for more than 10 years, followed by consultants for 6-10 years (31.25%) and consultants for 1-5 years (25%). Only 5% of the operations were done by registrars (table 8 and figure 4).

Despite the largest number being operated by the senior surgeons (> 10 years experience), none of their patients developed paralysis. Twenty-percent (20%) of the patients operated by those with experience of 6-10 years, and 10% by those with experience of 1-5 years as consultants developed paralysis, accounting for 71.4% and 28.6% of the total paralysis respectively. None of the patients operated by the registrars developed paralysis (**table 8**). This study failed to show any significant association between the surgeon's experience and development of paralysis (P=0.06).

**Table 9: Intra-operative RLN identification and rate of RLN paralysis.**

RLN STATUS	FREQUENCY	NO. DEVELOPED PARALYSIS	PERCENTAGE (%) DEVELOPED PARALYSIS
Identified	63	0	0
Not identified	2	2	100
Not indicated	15	5	33.3
<b>TOTAL</b>	<b>80</b>	<b>7</b>	<b>8.8</b>

**Figure 5: Intra-operative RLN identification.**



Operation notes indicated the RLN(s) to have been identified in 63 patients (78.7%) and not identified in 2 patients (2.5%). The state of the nerve(s) was not indicated in the operation notes of 15 patients (18.8%) (**table 9** and **figure 5**).

A 100% of the patients in whom the RLN(s) was not identified developed paralysis while none of those in whom the nerve(s) was identified developed paralysis. Both the patients in whom the nerves were not identified had re-operations for recurrent cancer of the thyroid. Five patients (33.3%) whose operation notes did not indicate the state of the nerve(s) developed paralysis (**table 9**). A strong association was shown between intra-operative identification of RLN and development of its paralysis ( $P < 0.01$ )

**Table 10: Intra-operative identification of RLN and rate of RLN paralysis among the various categories of surgeons.**

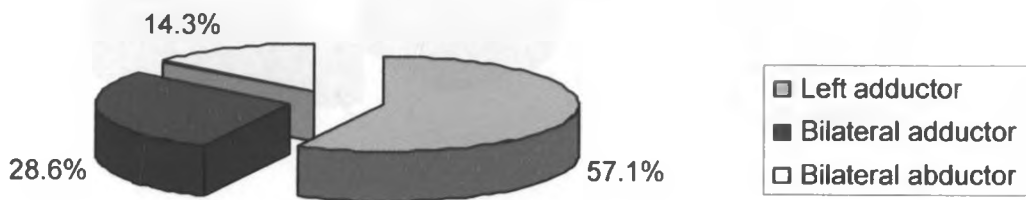
<b>SURGEON'S CATEGORY</b>	<b>NO. OF PATIENTS OPERATED</b>	<b>RLN IDENTIFIED</b>	<b>RLN NOT IDENTIFIED</b>	<b>STATE OF RLN NOT INDICATED</b>	<b>NO. OPERATED DEVELOPED PARALYSIS</b>
Registrar	4	3	0	1	0
Consultant 1-5 years	20	17	1	2	2
Consultant 6-10 years	25	19	1	5	5
Consultant > 10 years	31	24	0	7	0
<b>TOTAL</b>	<b>80</b>	<b>63</b>	<b>2</b>	<b>15</b>	<b>7</b>

According to **table 10**, registrars identified the RLN(s) in 3 (75%) of the 4 patients they operated. They failed to indicate the state of the nerve in 1 patient (25%). Consultants in the 1-5 years category identified the nerve(s) in 17 (85%) of the 20 patients they operated, did not identify the nerve in 1(5%) and failed to indicate its state in 2 (10%). Consultants in the 6-10 years category identified the nerve in 19 (76%) of the 25 patients operated, failed to identify the nerve in 1 (4%) and did not indicate the state of the nerve in 5 (20%). In the more than 10 years experience category, the nerve(s) was identified in 24 (77%) of the 31 patients they operated, while its state was not indicated in 7 (22.6%). Therefore, consultants in the 1-5 year experience category showed the highest rate of identifying the RLN followed by the more than 10 years experience category while the registrars showed the lowest followed by the 6-10 years experience category. The consultants in the 1-5 years category were also the best in indicating the state of the RLN while the registrars were the worst followed by the consultants in the more than 10 years experience category.

**Table 11: Types of paralysis developed.**

<b>TYPE OF PARALYSIS</b>	<b>FREQUENCY</b>	<b>PERCENTAGE (%)</b>
<b>Left adductor</b>	4	57.1
<b>Bilateral adductor</b>	2	28.6
<b>Bilateral abductor</b>	1	14.3
<b>TOTAL</b>	7	100

**Figure 6: Types of paralysis developed.**

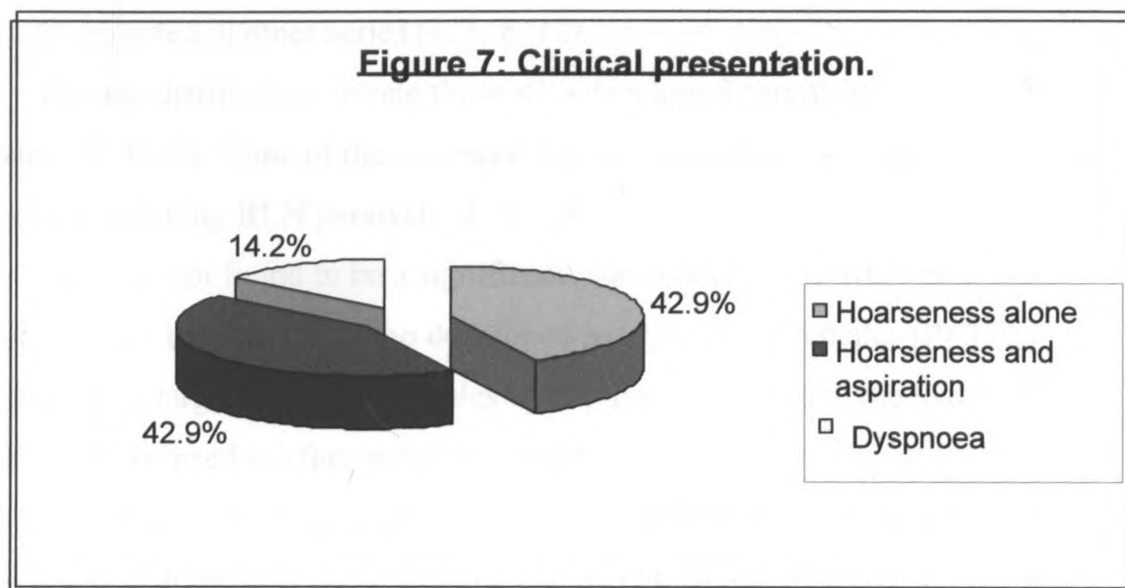


Left adductor paralysis was the commonest paralysis noted (57.1%) followed by bilateral adductor paralysis (28.6%). Bilateral abductor paralysis accounted for 14.3% of the total observed paralysis (**table 11** and **figure 6**).

**Table 12: Clinical presentation among patients with RLN paralysis.**

PRESENTATION	FREQUENCY	PERCENTAGE
Hoarseness alone	3	42.9
Hoarseness and aspiration	3	42.9
Dyspnoea	1	14.2
<b>TOTAL</b>	<b>7</b>	<b>100</b>

**Figure 7: Clinical presentation.**



Thirty-four (34) patients were observed to have hoarseness on the first post-operative day. Four of these patients had been noted to have hoarseness pre-operatively due to vocal cord nodules. Their hoarseness was found to persist beyond six weeks post-operatively despite normal vocal cords mobility. Of the 30 who developed hoarseness after operation, 24 (80%) had recovered by six weeks post-operatively while the remaining 6 were found to have vocal cords paralysis.

Among the patients who developed paralysis, 3 (42.9%) presented with hoarseness alone, 3 (42.9%) with hoarseness and aspiration while only 1 (14.2%) had dyspnoea (table 12 and figure 7).



## **DISCUSSION**

This prospective study was confined to 80 patients 77 females (96%) and 3 males (4%). The large number of females as compared with the males was as a result of the fact that thyroid disease is mainly a disease for females. This compares well with other reported series (4, 6, 12). The age distribution also compares favourably with other series. Our median age was 46 years as compared to Chung YL et al (6) (43 years) and Mbogoh GM (12) (45 years).

In this study the overall rate of paralysis was 8.8% as compared to rates of 0.4-7.7% reported in other series (4, 6, 8, 12).

The age distribution among those who developed paralysis was found to be the same ( $P>0.05$ ). None of the reviewed studies showed age as a significant risk factor to developing RLN paralysis (4, 5, 6, 8, 12).

Sex was not found to be a significant risk in developing RLN paralysis despite the fact that all those who developed paralysis were females ( $P>0.05$ ). This was due to the large number of females operated as compared to the males. Similar findings are reported in other series reviewed.

Cancer of the thyroid tends to infiltrate neighbouring structures. Attempt at oncological clearance put these structures at increased risk of injury. In this study, 22.2% of the patients operated for cancer developed paralysis as compared to 7% of those who had benign disease. Despite this big difference, this study did not show cancer of the thyroid as a statistically significant risk in developing RLN paralysis ( $P=0.18$ ). This can be attributed to the small number of patients operated for cancer as compared to those who had benign disease. Chiang FY et al (4) also failed to show operation for cancer as a statistically significant risk factor unlike other studies (5, 6, 8).

The more extensive a thyroid operation is, the higher the risk of developing hypothyroidism amongst other complications. Less extensive operations are advocated for especially when dealing with benign diseases (2, 16, 20). This was evident in this study where total thyroidectomy was only performed on 7 patients

(9.8%) of the 71 who had primary thyroidectomy done. Hemi-thyroidectomy was the commonest operation undertaken (22 out of 80, 27.5%) with majority (15) being left hemi-thyroidectomies. None of the primary total thyroidectomies done developed paralysis, the highest rate of paralysis being seen among those who had left hemi-thyroidectomy (20%) and completion thyroidectomy (33.3%). In general, type of thyroidectomy done was not shown as a significant risk factor in developing paralysis ( $P=0.06$ ). However, considering primary and completion thyroidectomy, re-operation was found to be a significant risk factor to developing paralysis ( $P=0.02$ ). The increased risk here is attributable to the alteration in normal anatomy caused by the primary operation. The risk was even higher ( $P=0.01$ ) when the re-operation was performed for malignant disease. This compares well with other studies elsewhere (4, 6,8) and locally (12).

In this study, failed identification of the RLN(s) intra-operatively was shown to be a significant risk factor to developing paralysis following thyroidectomy ( $P<0.01$ ). Indication of the intra-operative state of the nerve(s) can be of medical legal importance especially when paralysis results. Despite being associated with the second highest rate of total observed paralysis (28.6%), the consultants in the 1-5 years experience category wrote the most comprehensive notes regarding the intra-operative state of the RLN(s). The registrars wrote the worst notes but none of their patients developed paralysis. A mixed picture was therefore observed pertaining to experience of the surgeon, intra-operative identification of the nerves and development of paralysis. As a result of above, surgeons experience was not shown to be a statistically significant risk in developing RLN paralysis in this study ( $P=0.06$ ). Joao et al (8) also found similar results. Chow et al (9) found the association significant but did not give any figures, Giovanni et al (2) thought that this association did not deserve any particular attention while all the other studies reviewed did not address this issue (3-6, 12).

In this study, adductor paralysis was observed in 6 (86%) out of 7 patients who developed paralysis. Majority of the patients got left adductor paralysis

(57.1%), followed by bilateral adductor paralysis (28.6%) while bilateral abductor paralysis was the least noted (14.3%). This observation can partly be attributed to the larger number of left hemi-thyroidectomies as compared to other types of thyroidectomies performed. It is worth noting however that the higher rate of left as compared to right RLN paralysis was an unexpected observation. At the region of the thyroid gland the right nerve is more vulnerable to iatrogenic injury than the left owing to its more lateral position. In addition to this, the right nerve is sometimes not found in the tracheo-esophageal groove and has a higher rate of non-recurrence than the left nerve (1, 6, 13). Mbogo GM (12) in his retrospective study also found the rate of left paralysis to be higher than the right. The relevance of this observation cannot be statistically ascertained due to the small numbers involved.

Eighty-percent (80%) of the patients who had developed hoarseness following operation had recovered by six weeks post-operatively. This transient hoarseness is attributable partly to the effects of intubation on the vocal cords and partly to temporally RLN paralysis resulting from manipulation of the nerves during thyroidectomy. Other factors such as haematomas and tissue tightness could also contribute to the hoarseness.

Clinical presentation following RLN paralysis depends on the type of paralysis suffered. Adductor paralysis presents more with hoarseness while abductor paralysis causes upper airway obstruction presenting as dyspnoea, especially when both nerves are involved. Aspiration is mainly seen in patients with adductor paralysis especially when bilateral. In this study 6 (86%) out of the 7 patients who got paralysis presented with hoarseness, 1 with aspiration and 1 with dyspnoea accounting for 14.2% of the total presentation each. One patient presented with both hoarseness and aspiration. As expected, all the patients found to have either hoarseness alone or in combination with aspiration had adductor paralysis while the patient who presented with dyspnoea had abductor paralysis.

## CONCLUSIONS

1. Thyroidectomy is predominantly performed on females at KNH, majority of whom are middle-aged.
2. Majority of the thyroidectomies at KNH are performed by surgeons with over 10 years of experience.
3. Majority of the operations performed on the thyroid gland at KNH are hemithyroidectomies more so on the left lobe.
4. Thyroidectomy is an important aetiological factor of RLN paralysis at KNH.
5. The age and sex of the patient, the type of thyroidectomy performed and the experience of the surgeon performing the operation are not significant risk factors to developing RLN paralysis at KNH.
6. Patients operated for cancer of the thyroid show a higher rate of RLN paralysis than in benign thyroid disease.
7. In repeat operations of the thyroid, the risk of developing RLN paralysis is significantly higher than in primary operations of the thyroid. This risk is even higher when the operation is performed for recurrent malignant disease.
8. Majority of the patients developing hoarseness immediately following thyroidectomy will recover spontaneously by the sixth week post-operatively. This hoarseness is not always to be associated with RLN paralysis.
9. Failure to routinely identify RLN intra-operatively significantly increases the risk of developing RLN paralysis following thyroidectomy.
10. The commonest clinical presentation following RLN paralysis after thyroidectomy at KNH is hoarseness.
11. Indirect laryngoscopy is quick and simple and therefore is a reasonable initial investigation to perform both before and after thyroidectomy on the symptomatic patient.

## RECOMMENDATIONS

1. An informed consent, with special attention being given to the risk of injury and subsequent paralysis of the RLNs, should always be obtained before undertaking a thyroidectomy.
2. Pre-operative assessment of RLNs function through IL should be made routine especially in patients presenting with features of RLN dysfunction before thyroidectomy. The findings should be noted clearly in the patients file.
3. Intra-operative identification (and exposure) of the RLN(s) during thyroidectomy should be made routine where applicable. The intra-operative findings should always be noted clearly in the patients' operation notes.
4. Re-operations on the thyroid gland should be avoided at all cost by obtaining the best possible clearance of disease during the primary operation.
5. Patients presenting with hoarseness immediately after thyroidectomy should be followed up for at least six weeks before being concluded to have RLN paralysis. The paralysis should be confirmed by at least doing an IL to ascertain the function of the vocal cords.
6. Another prospective study should be conducted to establish the rate of permanent RLN paralysis following thyroidectomy at KNH. The proposed study should also look into the treatment modalities offered to patients with RLN paralysis at KNH.

## APPENDIX – PATIENT ASSESSMENT FORM

1. IP No..... STUDY No.....  
AGE..... SEX.....
2. HISTOPATHOLOGICAL DIAGNOSIS.....
3. PREVIOUS THYROID SURGERY? (*tick correct response*).
- (a) YES [ ]
- (b) NO [ ]
4. SYMPTOMS BEFORE CURRENT OPERATION (*tick correct response*)
- (a) Dysphonia [ ]
- (b) Difficult in breathing (Dyspnoea)
- (i) At rest [ ]
- (ii) On exertion [ ]
- (c) Dysphagia [ ]
- (d) Aspiration (cough and choking on swallowing) [ ]
- (e) Other (specify).....
5. PRE-OPERATIVE EXAMINATION (*tick correct response*)
- (a) Hoarseness [ ]
- (b) Dyspnoea
- (i) At rest [ ]
- (ii) On exertion [ ]
- (c) Stridor (i) Mild [ ]
- (ii) Moderate [ ]
- (iii) Severe [ ]
- (d) Dysphagia [ ]
- (e) Others (specify).....
- (f) INDIRECT LARYNGOSCOPY FINDINGS:
- (I) Lesions (specify)
- (i) Right cord.....
- (ii) Left cord.....
- (iii) Other areas (specify).....

(II) Atrophic Cord? (*tick correct response*)

- (i) Right            YES [    ]            NO [    ]
- (ii) Left            YES [    ]            NO [    ]

(III) Resting position of the cords (*tick correct response*)

- |                     | <u>Right</u> | <u>Left</u> |
|---------------------|--------------|-------------|
| (i) Median          | .....        | .....       |
| (ii) Paramedian     | .....        | .....       |
| (iii) Intermediate  | .....        | .....       |
| (iv) Fully abducted | .....        | .....       |

(IV) Vocal cord mobility (*tick correct response*)

- |                | <u>Right</u> | <u>Left</u> |
|----------------|--------------|-------------|
| (i) Normal     | .....        | .....       |
| (ii) Reduced   | .....        | .....       |
| (iii) Immobile | .....        | .....       |

**POST OPERATIVE ASSESMENT**

6. TYPE OF THYROID SURGERY DONE: (*tick correct response*)

- (a) Lumpectomy (I) Right [    ]
- (II) Left [    ]
- (b) Partial thyroidectomy I) Right [    ]
- II) Left [    ]
- (c) Hemithyroidectomy I) Right [    ]
- II) Left [    ]
- (d) Subtotal thyroidectomy [    ]
- (e) Near- total thyroidectomy [    ]
- (f) Total thyroidectomy [    ]
- (g) Completion thyroidectomy [    ]
- (h) Other (specify)..... [    ]

7. SURGEON'S CATEGORY: (*tick correct response*)

- I. Registrar [    ]
- II. Consultant for 1- 5 years. [    ]
- III. Consultant for 6- 10 years. [    ]
- IV. Consultant for > 10 years. [    ]

8. RECURRENT LARYNGEAL NERVE (*tick correct response*)

	<u>Right</u>	<u>Left</u>
(a) Identified	i) YES [    ]	YES [    ]
	ii) NO [    ]	NO [    ]
	iii) NOT INDICATED	[    ]
(b) Spared	i) YES [    ]	YES [    ]
	ii) NO [    ]	NO [    ]
	iii) NOT APPLICABLE	[    ]

9. ASSESSMENT ON 1<sup>ST</sup> POST OPERATIVE DAY (*tick correct response*)

(a) Hoarseness	[    ]
(b) Dyspnoea	(i) at rest [    ]
	(ii) On exertion [    ]
(c) Stridor	(i) Mild [    ]
	(ii) Moderate [    ]
	(iii) Severe [    ]
(d) Dyshagia	[    ]
(e) Other (specify).....	

10. SYMPTOMS 6 WEEKS AFTER OPERATION (*Tick correct response*)

(a) Dysphonia	[    ]
(b) Dyspnoea	(i) at rest [    ]
	(ii) On exertion [    ]
(c) Aspiration	[    ]
(d) Dysphagia	[    ]
(e) Others (specify) .....	

11. EXAMINATION 6 WEEKS AFTER OPERATION (*tick correct response*)

(a) Hoarseness	[    ]
(b) Dyspnoea	(i) at rest [    ]
	(ii) On exertion [    ]
(c) Stridor	(i) Mild [    ]
	(ii) Moderate [    ]
	(iii) Severe [    ]



(d) Dysphagia [ ]

(e) Others (specify) .....

(f) Indirect laryngoscopy done and successful? (tick correct response)

(iv) YES [ ]

(ii) NO [ ]

(g) If NO in (f) above, which investigation done? (tick correct response)

(i) None (not necessary) [ ]

(ii) Stroboscopy [ ]

(iii) Direct laryngoscopy [ ]

(h) Findings:

(I) Lesion(s) (specify)

(i) Right cord.....

(ii) Left cord.....

(iii) Other areas (specify).....

(II) Resting position of the cords (tick correct response)

	<u>Right</u>	<u>Left</u>
(i) Median	.....	.....
(ii) Paramedian	.....	.....
(iii) Intermediate	.....	.....
(iv) Fully abducted	.....	.....

(III) Vocal cord mobility (tick correct response)

	<u>Right</u>	<u>Left</u>
(i) Normal	.....	.....
(ii) Reduced	.....	.....
(iii) Immobile	.....	.....

12. VOCAL CORDS PARALYSIS PRESENT (tick correct response)

i) Yes [ ]

ii) No [ ]

13. TYPE OF PARALYSIS.....

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