

Role of Neck Triangles in safe Thyroid surgeries

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Introduction:

The first thyroid surgery was performed by Kocher in 1912. From what was a risky and critical surgery, now it has become a really safe surgery without the adverse risk of complications in expert hands. This has become possible because of better understanding of anatomical structures and their relations to thyroid gland, advancement in safe anesthesia techniques, and near universal availability of excellent diathermy which has enabled the surgeon to perform this surgery under relatively blood less field. The current day morbidity following thyroid surgery is considered to be less than 1%.

Most dreaded complication of thyroid surgery is injury to recurrent laryngeal nerve. Bilateral injury to recurrent laryngeal nerve would condemn the patient to life long tracheostomy. The credit of description of recurrent laryngeal nerve should go to Galen. He stressed the importance of protecting the nerve at any cost. Most surgeons who operated on thyroid gland including the greats like Billroth, Kocher and Joll avoided dissecting anywhere near the nerve. Lahey routinely exposed the recurrent laryngeal nerve while dissecting the thyroid gland. According to him it is difficult to injury a structure which is clearly visible. He took extra precaution to expose the nerve while dissecting the thyroid gland. Studies reveal that recurrent laryngeal nerve is most susceptible to damage in the last 2 cms of its course (close to the thyroid gland). Injury to this nerve during thyroid surgery should be considered as a disaster.

It was Susruta who first described that injury to the neck in the region of the angle of the jaw caused hoarseness (6th century BC). He first thought that hoarseness was due to injury to blood vessels in the neck. It was Rufus of Ephesus who first discovered that injury to the nerve and not to vessels was responsible for this hoarseness of voice. Galen's extensive work in the 2nd century was a significant contribution to the anatomical knowledge of recurrent laryngeal nerve. He gave a detailed description of the nerve including its anatomical course and its physiology. He used the term recurrent (reversivi) to describe this nerve. Experimentally he demonstrated that pigs stopped squealing when this nerve was cut. The landmark studies of Galen cautioned surgeons about the importance of preserving recurrent laryngeal nerve during thyroid surgeries.

The next important milestone in understanding anatomy of recurrent laryngeal nerve is the near accurate illustration and description of this nerve by Leonardo da Vinci and Vesalius. During the early 19th century the wide use of antiseptics the infection rate following surgery was drastically reduced. Since it was not routine for laryngeal examination to be done in all patients with hoarseness of voice following thyroid surgery the exact incidence of injury to this nerve is under-reported.

In the early period of 20th century, the Russian surgeon Alexander Bobrov proposed routine visual identification of recurrent laryngeal nerve during thyroid surgeries. This was in contrast to the warning of George Crile who described the region of recurrent laryngeal nerve as a No Man's Land. He cautioned against meddling with posterior capsule of thyroid during the surgery as recurrent laryngeal nerve is usually close to the posterior capsule of thyroid gland. He even went to the extent of declaring that "a nerve if seen is injured". This myth was effectively broken by Frank Lehey's study which was performed in 1938. He used a phenomenal number of 3000 thyroid surgeries in which recurrent laryngeal nerve was identified and was able to conclusively prove that routine identification of the nerve does not risk injury to the nerve, on the contrary it reduced the incidence of nerve damage.

External laryngeal branch of superior laryngeal nerve is another nerve that is susceptible to injury during thyroid surgery. This nerve plays a vital role as tensor of the vocal cord and injury to this nerve leads to voice fatigue and loss of voice pitch. Injury to this nerve was previously largely neglected or sometimes not even noticed by many patients who are not singers. Interest to this nerve was drawn during 1935 when the world famous opera singer (soprano) Amelia Galli-Curci underwent a disastrous thyroid surgery during which this nerve was damaged and her singing career was abruptly ended.

At this juncture it should be pointed out that the course of recurrent laryngeal nerve and superior laryngeal nerve are highly variable. It is hence difficult to identify these structures during routine surgery. It was towards this end various triangles have been described with the fond hope that they will help the surgeon in identifying these nerves.

Triangles of Neck:

Various triangles in the neck has been described to identify vital structures during thyroid surgery. The crucial neurovascular structures that could be damaged can be protected if the surgeon has good anatomical knowledge of these crucial structures. These triangles provide valuable landmarks to indicate the approximate location of these structures.

Behrs Triangle:

This triangle is also known as Riddle's triangle. This was first described by OH Behrs. This triangle is used to identify the recurrent laryngeal nerve close to the tracheo oesophageal groove. The recurrent laryngeal nerve forms one side of this triangle. The other sides of this triangle happen to be common carotid and inferior thyroid arteries.

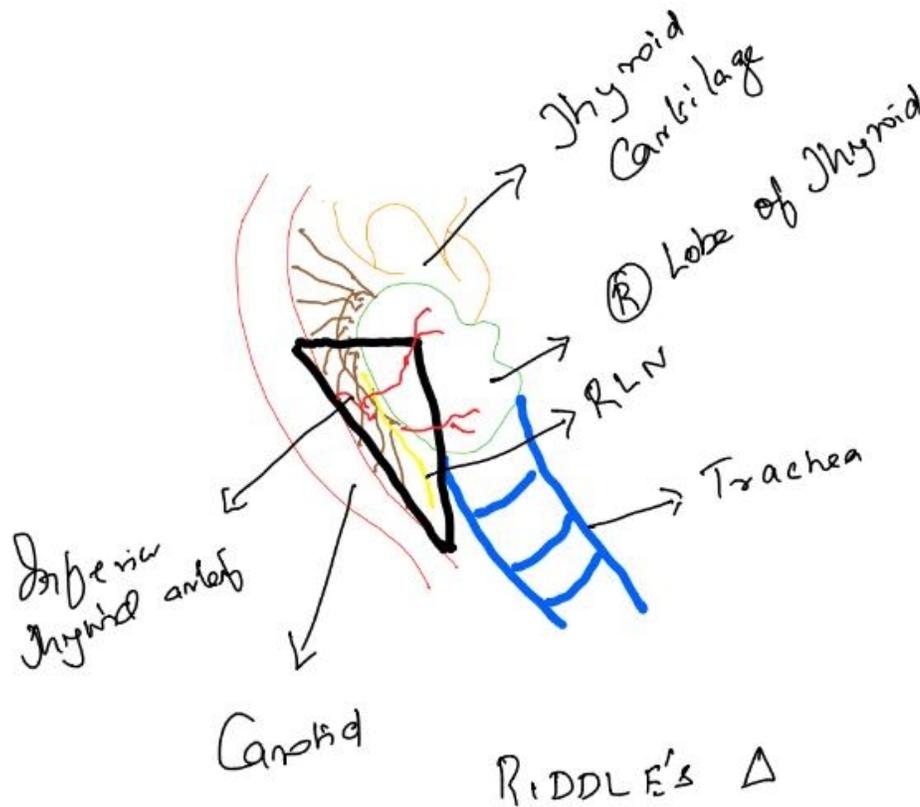


Diagram showing Riddle's Triangle

The base of this triangle is formed by the common carotid artery.

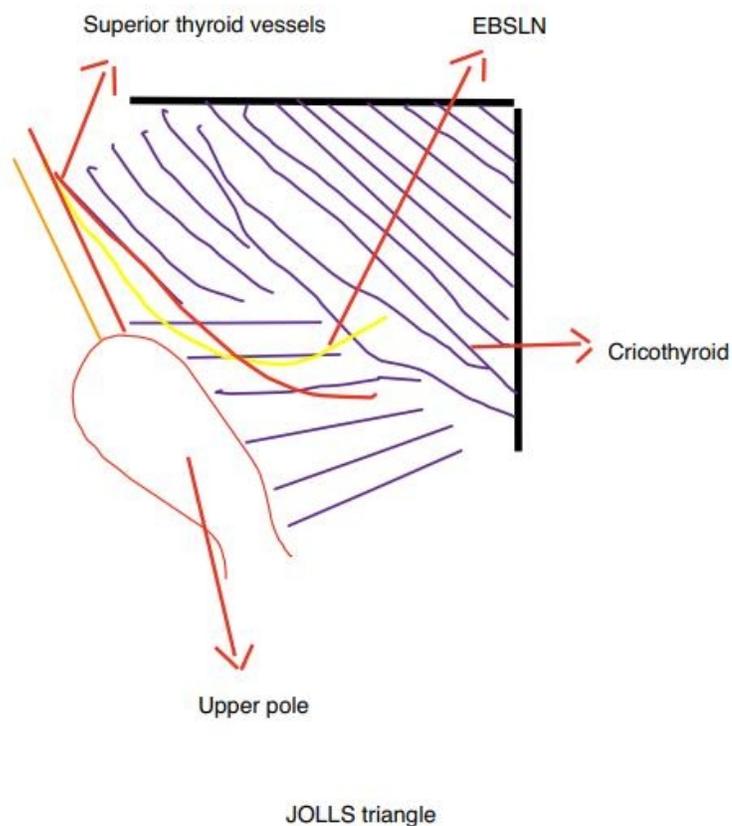
Inferior thyroid artery lies superiorly.

The recurrent laryngeal nerve forms the lower arm of the triangle.

Most accurate and safe way of identification of the nerve is to seek it low down in the tracheo-oesophageal groove. It is in this location the nerve forms the third side of Behr's triangle.

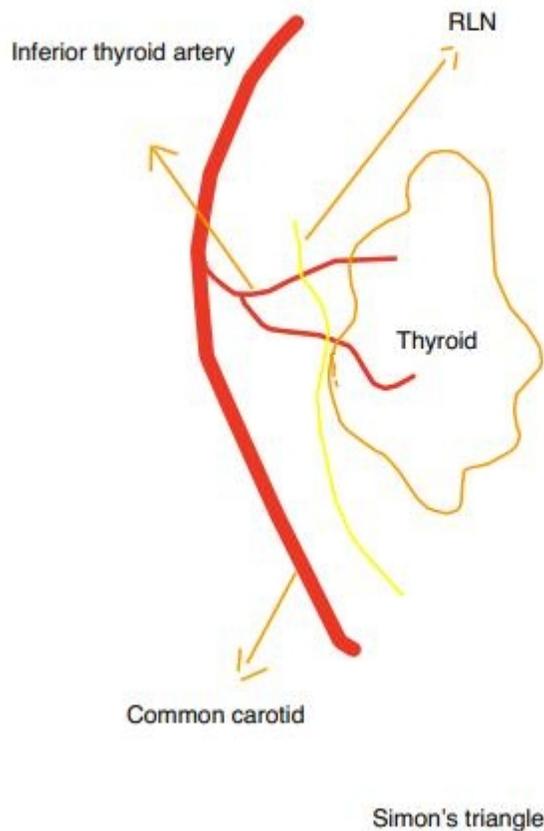
Joll's triangle:

This triangle is also known as sternothyrolaryngeal triangle. This triangle is used to identify the external branch of superior laryngeal nerve. This nerve is supposed to lie within Joll's triangle. The upper pole of thyroid gland and superior thyroid vessels from the lateral border while superiorly there is attachment of strap muscles. Floor is formed by cricothyroid muscle.



Simon's triangle:

This is another triangle that is used to identify the recurrent laryngeal nerve. The anterior border of this triangle is formed by the recurrent laryngeal nerve, posteriorly lies the common carotid artery and the base of the triangle is formed by the cricothyroid muscle.



Lore's triangle;

This was first described by Lore to identify the recurrent laryngeal nerve. This triangle helps in identification of recurrent laryngeal nerve inferiorly. The following are the boundaries of this triangle.

Medial – Medial border is formed by trachea and oesophagus

Lateral – Common carotid artery

Superior – Surface of inferior pole of thyroid gland

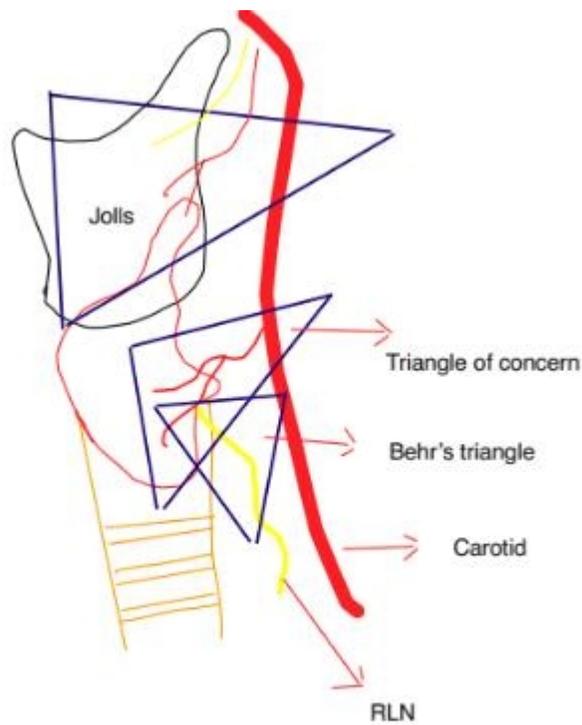
Triangle of concern:

This triangle warns the surgeon during thyroid surgery about the most vascular and dangerous area of the surgical procedure. Bleeding occurs usually during thyroidectomy from the following blood vessels.

Middle thyroid vein – Drains directly into the internal jugular vein (Middle pedicle of thyroid).

Inferior thyroid vein

Branches of inferior thyroid artery in the vicinity of recurrent laryngeal nerve



Triangles of thyroid

Cricothyroid space of Reeves:

This is supposed to be an avascular space between the upper pole of thyroid and the cricothyroid muscle. Dissection confined to this area helps the surgeon in avoiding injury to the surrounding important structures like the superior laryngeal nerve.

The concept of a large number of triangles that are used to identify the vital neurovascular structures during thyroid surgery is testthyroidectomy to the fact that these triangles can just be used as pointers to the probable position of these structures.