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ULTRASONIC DISSECTION VERSUS CONVENTIONAL LIGATION COAGULATION IN THYROIDECTOMY

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Abstract

Ligation and diathermy coagulation was the standard method of hemostasis in thyroid surgery for more than a century. New hemostatic techniques were developed in the 1990th. Ultrasonic dissector used for the first time in thyroidectomy in 1999 by Tokami. Many studies compared the conventional method of thyroidectomy with new ultrasonic dissector technique. These studies found many advantages of the new method including reduction of operative time, shorter incision, decrease blood loss, decrease post operative drainage, shorten hospital stay and decrease complications. This study compared the two methods of hemostasis regarding incision length, operative time and complications.

Between March 2012 and March 2015, 143 patients underwent open thyroidectomy involved in a prospective study at Al-Faiha General Hospital. The patients were divided into 2 groups: Group 1, conventional thyroidectomy technique(clamp, tie and diathermy coagulation) included 104 patients. Group 2, ultrasonic dissection technique (sutureless thyroidectomy) included 39 patients. The patient characteristic and postoperative complications were reported. The incision length and the operative time was measured. All patients underwent surgery by the routine pre tracheal strap muscle cutting transeversly (not splitting). In group 2, the ultrasonic dissector was used in strap muscle cutting, sealing &section of the blood vessels and in the final resection of the gland.

The surgical incision length and operative time were compared in both groups. In lobectomy, there was no significant reduction in the length of incision with use of ultrasonic dissector(z value<1.96)(p >0.05), while in subtotal, total or near total thyroidectomy there was significant reduction in the length of incision (p value<0.05) with use of ultrasonic dissector. There was significant reduction of operative time (p value<0.05) in lobectomy and total or near total thyroidectomy with use of ultrasonic dissector as compared to conventional thyroidectomy technique. There was no significant difference in the complications in both techniques apart from increased incidence of temporary recurrent laryngeal nerve paralysis in ultrasonic dissector technique (9.2% in USDT v s 3.7% in CT of thyroidectomy).

This study found significant reduction of the surgical incision size similar to that obtained by Fabrizo who stated that thyroidectomy can be done with shorter incision. This improve patient satisfaction and cosmetic outcome. The operative time was significantly reduced in lobectomy, total or near total thyroidectomy by the use of ultrasonic dissector technique(USDT) as compared to the conventional technique (CT){lobectomy 44 minutes vs 55 minutes, total thyroidectomy 57 minutes vs 80 minutes}. Similar results were obtained by many other studies such as Micoli et al & Siperstein et al. this may save utilization of operation theatre and decrease waiting list. The USDT is safe as far as the complication rate was similar to that of CT apart from increase the incidence of temporary recurrent laryngeal nerve paralysis. Many studies confirmed the safety of USDT such as that of Tokami, Micolli, Siperstein etc .

In conclusion, thyroidectomy can be performed safely by the USDT with advantage of smaller incision & shorter operative time as compared to conventional technique.

Introduction

Thyroid surgery was hazardous before the mid–nineteenth century. After that, advances in anesthesia, antisepsis and hemostasis enabled surgeons to do thyroid surgery with very low mortality[1,2]. Theodor Billroth (1829-1894) followed by Theodor Kocher(1841-1917) performed thousands of operation with very successful results.

Accurate hemostasis is essential in any

surgical procedure, especially in thyroidectomy[3]. The thyroid gland is a highly vascular organ, the operative field is small and bleeding can cause respiratory obstruction and death. This necessitates meticulous hemostasis to achieve a successful outcome in thyroid surgery. The main method for achieving hemostasis was tying, clipping of blood vessels and coagulation, These methods are effective but time-consuming[4]. Currently we are very concerned about the long surgical waiting lists and should adopt hemostatic methods to reduce operative time with acceptable complication rate[5].

The majority of thyroid patients are females and the society is greatly concerned about cosmetic outcome of thyroidectomy so the surgical incision should be as small as possible[6]. This goals might be achieved by the newly developed vessel sealing systems at 1990s which were initially used for laparoscopic surgery. The first use of ultrasonically activated shears in thyroidectomy was published in 1999 by Tokami et al[7]. These shears allow coagulation and cutting of blood vessels at the same time by mechanical vibration at frequency of 55.5khz[8,9]. This causes rupture of hydrogen bonds of proteins and denaturation to form coagulum which seals the vessel[8]. This mechanical action, takes place at low temperature of 800 Celsius as compared to diathermy and also cause less collateral damage by heat dissipation[10], this is the main advantage of ultrasonic dissector as compared with a standard electrosurgical device allowing a wide application in thyroid surgery. A new device, with a tip smaller than 5 mm, might enable a more precise dissection near vital structures such as parathyroid glands and recurrent laryngeal nerve[9]. Many studies compared conventional (ligation and coagulation) method of thyroidectomy and ultrasonic dissector thyroidectomy.

The main advantages of the later method includes: Shorter operative time[10-18], reduction in the amount of blood loss[12,15,19], decrease in length of surgical incision[3,17], decrease in the amount of postoperative drainage[15,16,19] and reduction in complications[14,18].

The aim of the present study is to evaluate the safety and efficacy of ultrasonic dissector thyroidectomy technique as compared to the conventional technique in regard to operative time and length of surgical incision .

Patients and Methods

This prospective study was done between March 2012 and March 2015, at the surgical department of Alfaiha General Hospital, 153 patients with thyroid diseases underwent open thyroidectomy for different indications by the same surgical team. This study included 143 patients (106 females and 37 males), those with primary operation and re-do operation(reoperation) and completion thyroidectomy. Ten patients were excluded from the study because they had associated procedures such neck dissection or they did not completed 1 year follow-up. The patients were divided into 2 groups. Group 1, conventional thyroidectomy technique (clamp, tie and diathermy coagulation) included 104 patients. Group 2, ultrasonic dissection technique (sutureless thyroidectomy) included 39 patients.

The patients characteristic including age, gender, thyroid function state, primary & reoperation, extent of thyroid resection, incision length, operative time, histopathology (benign & malignant) and postoperative complications were reported. The incision length was measured in centimeter at the end of operation according to the extent of thyroidectomy(lobectomy, subtotal, total or near total). The operative time was measured in minutes from the start of the

skin incision until the end of skin closure according to the extent of thyroidectomy.

All patients underwent surgery by the routine pre tracheal strap muscle cutting transeversly (strap muscles transection rather than splitting) to provide a good access to the thyroid gland and avoid the need to dissect subplatysmal flaps (flapless thyroidectomy). In group 1 (conventional technique), hemostasis achieved by ligation of middle thyroid vein, terminal branches of superior pedicle, branches of inferior thyroid artery and small bleeding vessels near the recurrent laryngeal nerve & parathyroid glands, while diathermy coagulation used to control small bleeding vessels at other sites at operative field. In group 2, the ultrasonic dissector was used in strap muscle cutting, sealing & section of all blood vesseles and in the final resection of the gland. Lotus ultrasonic dissector and wireless ultrasonic dissector (sonicision). Suction drain was used selectively in 9 selected patients (only patients with large goiter and those who underwent extensive dissection). The patients were subjected for 1 year follow up and complications reported. Post operative hypothyroidism not reported as a complication in this study because the recent trend of many surgeons to do total or near total thyroidectomy in most thyroid cancers, hyperthyroidism and even non-toxic multinodular goiter to avoid recurrence of thyroid disease. Hypothyroidism is the expected end result of such operation.

The demographic characteristics were expressed in frequencies and percentages. Quantitative variables such as incision length and operative time were expressed as mean± standard deviation. Independent Z-test was used to compare two population mean and z value of >1.96 (p value<0.05) considered significant. The complications were expressed as percentages and analyzed by Z-test to compare two populations proportions and p value of <0.05 was considered significant.

Results

Table I shows the preoperative patients characteristics including age, gender, thyroid function state and operation type weather primary operation or reoperation. Group 1(CT) included 104 patients and group 2 (USDT) included 39 patients. The mean age in both groups are relatively similar (36.9 years in CT vs 38.5 years in USDT). The sex distribution of patients in group 1, 75 female (72%) and 29 male (28%) while in group 2, 31 female(79.5%) and 8 male (20.5%). The thyroid function state, in group 1, 71 patients(68.3%) euthyroid, 31 patients

(29.8%) hyperthyroid and 2 patients (1.9%) hypothyroid, while in group 2, 29 patients (74.36%) euthyroid, 8 patients (20.50%) hyperthyroid, and 2 patients (5.14%) hypothyroid. Regarding the type of operation, in group 1, 100 patient (96.16%) underwent primary operation and 4 patient (3.84%) underwent reoperation, while in group 2, 34 patient (87.18%) underwent primary operation and 5 patient (12.82%) underwent reoperation.

Table II shows the extent of thyroid resection and the histopatholgical result in both groups. In group 1 (CT), the extent of resection: 24 patients (23.2%) lobectomy, 38 patients (36.5%) subtotal thyroidectomy and 42 patients (40.3%) total or near total thyroidectomy while in group 2 (USDT), the extent of resection: 12 patients (30.75%) lobectomy, 4 patients (10.25%) subtotal thyroidectomy and 23 patients (59.00%) total or near total thyroidectomy .

Regarding histopatholgy of resected specimen, most patients with benign diseases in both groups. In group 1, 99 patients (95.2%) with benign diseases, and 5 patients (4.8%) with malignant diseases. In group 2, 37 patients (94.87%) with benign diseases and 2 patients (5.13%) with malignant diseases. Table III shows the surgical incision length and operative time in both groups. The mean surgical incision length in patients underwent lobectomy by CT is 5.4 cm , while the mean incision length for lobectomy by USDT is 4.9 cm, but this difference not significant (p value >0.05). The mean surgical incision length in patients underwent subtotal thyroidectomy (CT; 6.6cm vs USDT 5cm) and total or near total thyroidectomy (CT;7 cm vs USDT 5.1 cm) was significantly reduced by the use of ultrasonic dissector (p value<0.05).

The mean operative time of lobectomy by CT was 55 minutes, while that by USDT was 44 minutes. The mean operative time of subtotal thyroidectomy by CT was 73 minutes, while that by USDT was 60 minutes. The mean operative time of total or near total thyroidectomy by CT was 80 minutes , while that by USDT was 57 minutes. There was significant reduction in the operative time for lobectomy and total or near total thyroidectomy by the use of USDT as compared to that by CT (p value <0.05), but there was no significant reduction in the operative time of subtotal thyroidectomy by the use of USDT as compared to CT (p value >0.05).

Table I: Preoperative characteristics

variable	Conventional technique No. of patients (104)	Ultrasonic Dissector Technique No. of patients(39)
Age(years)		
Mean(±SD)	36.9 (10)	38.5(10)
Range	11-75	15-66
Gender		
Female	75 (72%)	31(79.5%)
Male	29 (28%)	8(20.5%)
Thyroid Function:		
Euthyroid	71(68.3%)	29(74.36%)
Hyperthyroid	31(29.8%)	8(20.50%)
Hypothyroid	2(1.9%)	2(5.14%)
Type of operation:		
Primary	100(96.16%)	34(87.18%)
Reoperation	4(3.84%)	5(12.82%)

Table II: Intraoperative & Histopathology Characteristics

Variable	Conventional technique No. of patients (104)	Ultrasonic Dissector Technique No. of patients(39)
Thyroid Resection		
Lobectomy	24(23.2%)	12(30.75%)
Subtotal	38(36.5%)	4(10.25%)
Total or Near total	42(40.3%)	23(59.0%)
Histopathology :		
Benign	99(95.2%)	37(94.87%)
Malignant	5(4.8%)	2(5.13%)

Table III: Incision Length & Operative Time

Variable	CT 104 patients	USDT 39 patients	Z test
Length of incision cm±SD			
Lobectomy	5.4(0.8)	4.9(0.9)	Not significant
Subtotal	6.6(1.0)	5.0(0.2)	Significant
Total or near total	7.0(0.8)	5.1(0.3)	Significant
OperativeTime min.±SD			
Lobectomy	55(9)	44(9)	Significant
Subtotal	73(10)	60(18)	Not significant
Total or near total	80(13)	57(20)	Significant

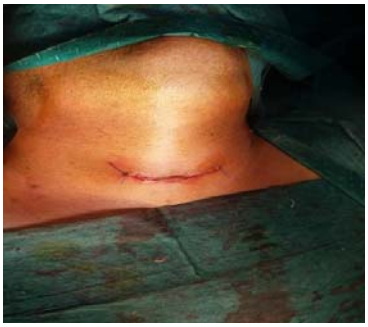
Table IV shows thyroidectomy complications were compared in both groups (conventional & ultrasonic dissector). The complications included: hematoma, seroma, wound infection, wound sinus, temporary recurrent laryngeal (RLN) paralysis, transient hypocalcaemia, superior laryngeal nerve (SLN) paralysis, voice changes without nerve paralysis, recurrent goiter, hypertrophic scar and superficial skin burn caused by electrosurgical instruments.

There was no permanent recurrent laryngeal nerve paralysis or permanent hypocalcaemia in both groups. The incidence of complications in both groups as follows ; haematoma in CT 0.95% vs 0% in USDT, seroma in CT 8.57% vs 2.5% in USDT, wound infection 0.95% in CT vs 5% in USDT, wound sinus in CT 2.85% vs 2.5% in USDT, temporary RLN paralysis in CT 3.7% vs 9.2 % in USDT, transient hypocalcemia in CT 10.47% vs 12.8% in USDT, SLN paralysis in CT 1.95% vs 2.5% in USDT, voice changes without nerve paralysis in CT 4.76% vs 0% in USDT, recurrent goiter in CT 0.95% VS 0% in USDT, hypertrophic scar in CT 2.85% vs 2.5% in USDT, superficial skin burn in CT 0% vs 2.5% in USDT, There was no significant difference in the complications in both techniques (p value >0.05) apart from increased incidence of temporary recurrent laryngeal paralysis in ultrasonic dissector technique (3.7% in CT vs 9.2% in USDT).

Table IV: Complications

Complications	Conventional 104 cases	Ultrasonic Dissector 39 cases	Z test
Haematoma	1(0.95%)	0	Not significant
Seroma	9(8.57%)	1(2.5%)	Not Significant
Wound infection	1(0.95%)	2(5%)	Not significant
Wound sinus	3(2.85%)	1(2.5%)	Not significant
Temporary RLN paralysis Nerve at risk	6(3.7%) 162	5(9.2%) 54	significant
Transient hypocalcaemia	11(10.47%)	5(12.8%)	Not significant
SLN Paralysis	2(1.95%)	1(2.5%)	Not significant
Voice changes without N. paralysis	5(4.76%)	0	Not significant
Recurrent goiter	1(0.95%)	0	Not significant
Hypertrophic scar	3(2.85%)	1(2.5%)	Not significant
Superficial skin burn	0	2(5%)	Not significant

Conventional thyroidectomy



Ultrasonic dissection thyroidectomy

Discussion

Many advantages of ultrasonic dissection technique (USDT) over conventional technique(CT) of thyroidectomy had been discussed in literature. This study compared the incision length, operative time and complications between the two techniques. The results that, the incision length was shorter with use of an ultrasonic dissector than the conventional technique in subtotal and total or near total thyroidectomy. The mean surgical incision length in our patients who underwent subtotal thyroidectomy by CT (38 patients) was 6.6 cm and by USDT(4 patients) was 5 cm. In patients who underwent total or near total thyroidectomy by CT (42 patients), the incision length was 7 cm and by USDT(23 patients) the incision length was 5.1. Similar result was obtained by Grasso E, Guastella T[20], who was studied 144 patients with total thyroidectomy, the incision length was 5.5 cm by CT and 4.2 cm by USDT. This result also was compatible with result obtained by Fabrizo who was found that more open thyroidectomies could be safely performed with shorter incisions[21]. This can be explained by the fact that ultrasonic dissector enable surgeon to work in a limited field. Many surgeons create longer incisions than needed because they overestimate the difficulty of thyroidectomy. Shorter incision improve patient satisfaction and cosmoses. This is important since most patients in thyroid surgery are women and young adults and the incision at visible anatomical location[22-24].

In this study, comparison of operative time in CT and USD technique of thyroidectomy we found significant reduction in the operative time by USD use in lobectomy and total or near total thyroidectomy (55minute v s 44 minute in lobectomy) (80 minute vs 57 minute in total or near total thyroidectomy). In subtotal thyroidectomy there was no significant reduction in the operative time which might be due to small number of patients (4 patients only) in the USD group. Comparison of operative time in our study and other studies using ultrasonic dissector for thyroid surgery shown in table V.

Table V: Operative Time in Different Studies

Study	CT Operative time (minutes)	USD Operative time (minutes)	Z test
This study(2016):			
Lobectomy	24(55minute)	12(44 minute)	Not significant
Subtotal	38(73minute)	4(60 minute)	Significant
Total or near total	42(80minute)	23(57 minute)	Significant
Micoli et al:			
Total or near total(2002)	26(90 minute)	26(53 minute)	Significant
Total or near total(2006)	50(46 minute)	50(40 minute)	Significant
Siperstein et al(2003)			
Lobectomy	49(115 minute)	38(89 minute)	Significant
Total	36(161 minute)	47(132 minute)	Significant
Cordon et al (2005)			
Subtotal	18(112 minute)	23(93 minute)	Not significant
Total	12(136 minute)	7(104 minute)	Not significant

The reason to ascertain why the hemostasis is so accurate and rapid following the use of the ultrasonic dissecter device is multi-factorial. It has

excellent handling and fewer changes of instruments as compared to the conventional technique. Repeatedly changing instruments in conventional thyroidectomy can be cumbersome and frustrating that can be the cause for avulsion. Apart from the above, the use of a knot has technical implications (human error) and the device has great control over a section of thyroid tissue. In addition to that USDT can achieve thyroidectomy without the need for extensive dissection and thus reducing the operating time.

Table VI shows thyroidectomy complications in this study and other studies. In this study, there was no significant difference in the complication rate between CT&USD technique apart from an increase incidence of temporary RLN paralysis in the USD group (3.7% in CT vs 9.2% in USDT). R circocchi[11] also found increase in incidence of temporary RLN paralysis with the use of ultrasonic dissector(0.83% in CT vs 1.94% in USDT). This might be due to the thermal effect of ultrasonic device. However this paralysis resolve in most patients in less than 2 months and can be avoided in the future when we gain more experience.

Other studies showed no difference in the major complication rate with the use of both thyroidectomy techniques such as Jong[25] and R. Circocchi[11], while Jose[26] showed significant reduction in the incidence of hematoma & seroma with the use of USDT. These complications may be related to the many factors such as extent thyroid resection, size of goiter, histopathological diagnosis in addition to the type of hemostatic method.

Table VI: Major complications in different studies

Complication	Conventional Technique No./total(%)	Ultra Sonic Dissector Technique No./total(%)	Significance
Haematoma; Our study(2016) Jong(2012) Jose(2012)	 1/104(0.95%) 0 9/468(1.92%)	 0 1/104(0.9%) 1/419(0.24%)	 Not significant Not significant Significant
Seroma Our study(2016) Jong(2012) Jose(2012)	 9/104(8.57%) 3/108(2.7%) 15/468(3.21%)	 2/39(5%) 3/104(7.6%) 2/419(0.5%)	 Not significant Not significant significant
Wound infection Our study(2016) Jose(2012)	 1/104(0.95%) 2/468(0.43%)	 2/39(5%) 1/419(0.24%)	 Not significant Not significant
Temporary RLN paralysis Our study(2016) R. Cirocchi(2012)	 6/162(3.7%) 1/120(0.83%)	 5/54(9.2%) 3/201(1.94%)	 Significant Significant

Conclusion

Ultrasonic dissector surgery can be used safely in thyroid which can be performed through small incision (minithyroidectomy), that improve cosmosis & patient satisfaction. Other advantage is reduction of the operative time which can save utilization of the operation theatre & decrease the waiting operating list.

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