

CLINICAL STUDY

The PlasmaKinetic tissue management system in thyroid surgery

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Abstract: *Background:* Thyroid surgery involves meticulous devascularization of the gland. Although conventional technique being a highly efficient technique for vessel bleeding control, it takes long time. The aim of this study was evaluate the efficacy of PlasmaKinetic to the conventional technique.

Methods: We reviewed the medical records of 86 patients who underwent primary thyroid surgery by the same surgeon at our clinic between June 2006 and January 2008. Total thyroidectomy was performed at all of the patients in the study group.

Results: When the incidence of postoperative cord palsy was 2.32 %, transient hypoparathyroidism was 4.6 %. There was no significant difference in consideration of age, gender, thyroid gland weight, and complication rates between the PlasmaKinetic group and conventional group ($p > 0.05$). Operation time, mean drainage from the suction drain and duration of hospital stay of the patients in PlasmaKinetic group were significantly lower than those in conventional group ($p < 0.05$).

Conclusion: PlasmaKinetic technique decreases the operation time to a level of less than 50 minutes with no increase at complication rate (Tab. 3, Fig. 3, Ref. 14). Full Text (Free, PDF) www.bmj.sk.

Key words: euthyroid, hyperthyroid, thyroid, thyroidectomy, PlasmaKinetic, vessel ligation.

Thyroid surgery involves meticulous devascularization of the gland, which has one of the richest blood supplies among the organs, with numerous blood vessels and plexuses entering the parenchyma. Therefore, hemostasis is of paramount importance to control and divide the various vessels before excision of the gland. Standard vessel ligation, involving use of ties and suture ligatures, has been a conventional technique at most centers. Although being a highly efficient technique for vessel bleeding control, it takes long time. Time-saving operations are becoming an increasingly important issue, especially for the turnover of patients in high-volume operating theatres and for decreasing the anesthesia duration. The perfect surgical technique should aim to manage both the time and the potential complications of thyroid surgery.

The PlasmaKinetic tissue management system (Gyrus Medical, Maple Grove, MN) uses pulsed bipolar energy for coagulation. This system is designed to deliver intermittent pulses of energy through the instruments to the tissue, as opposed to conventional continuous bipolar energy. Presthus et al reported that vessel sealing with the pulsed bipolar system is more effective than clips, suture, or staples¹ in gynecologic surgery. But, there is no report about its effectiveness in thyroid surgery.

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The aim of this retrospective study was not only to represent a useful instrument and a quick technique for thyroid surgery, but also evaluate the efficacy of it in comparison to the conventional technique.

Patients and methods

We reviewed the medical records of 86 patients who underwent primary thyroid surgery by the same surgeon at our clinic between June 2006 and January 2008. Total thyroidectomy was performed in all of the patients in the study group.

According to the preoperative clinical, radiologic and laboratory evaluations, 44 patients were hyperthyroidic with the diagnoses of toxic multinodular goiter ($n=29$), and Graves' disease ($n=15$). Out of these 44 hyperthyroidic patients, 45.45 % ($n=20$) were in the PlasmaKinetic group. The indications for surgical treatment of these hyperthyroidic patients consisted of recurrent diseases accompanied by exophthalmia ($n=9$), patient's inconvenience with pharmacologic treatment ($n=27$), hepatotoxicity due to antithyroids ($n=3$) and large goiters ($n=5$), while the main indications for surgery of all euthyroidic patients were large goiters that caused compressive effects ($n=42$).

All hyperthyroidic patients received anti-thyroid preoperatively to achieve an euthyroidic state. All patients with Graves' disease were treated with propranolol with an initial dosage of 40–60 mg/day and propylthiouracil of 300–400 mg/day or methimazole of 10–30 mg/day, which were reduced gradually to maintain euthyroidism, as serum thyroid hormone concentra-

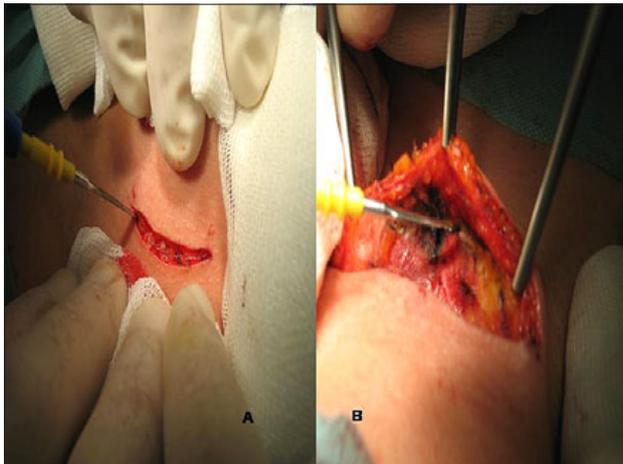


Fig. 1. A – dividing the skin and subcutaneous tissue by cutting device of monopolar electrocautery, B – preparing the lower flap by the coagulation device of monopolar electrocautery.

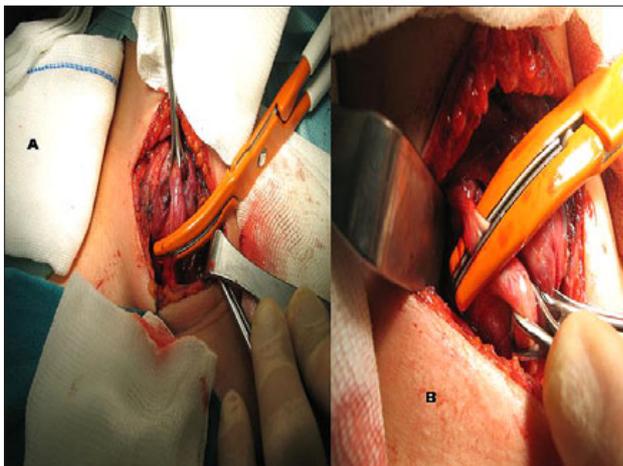


Fig. 2. A – ligation of the left lower pole by PlasmaKinetic in a hyperthyroidic patient, B – ligation of the right upper pole by PlasmaKinetic in a hyperthyroidic patient.

tions declined. The patients received this treatment for a minimum of 1 month before the operation and the patients who had recurrent hyperthyroidism were followed up for at least 1 year after cessation of the anti-thyroid treatment. Relapses were confirmed by clinical presentation and laboratory data.

The patients who had been receiving either any medications known to have any side effects on coagulation, or any anti-coagulative drugs were excluded. Also, the patients who had been diagnosed with any coagulopathic disorders before were excluded. Because of the low number of patients, the ones who have been diagnosed as thyroid cancer by the histopathologic analysis of the specimen, were excluded.

During the one-year period, from June 2006 till the end of June 2007, 46 primary thyroid operations were performed by the same surgeon, where operative hemostasis was achieved using the conventional technique.

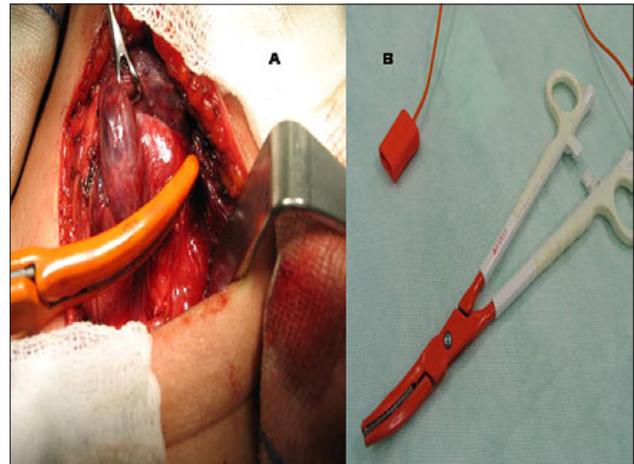


Fig. 3. A – ligation of the middle thyroid vein by PlasmaKinetic in a hyperthyroidic patient, B – PlasmaKinetic forceps.

From the beginning of July 2007, we changed our operative technique for intraoperative hemostasis and the bipolar PlasmaKinetic energy was introduced as the primary means of hemostasis in thyroid surgery.

Patients were assessed for early postoperative complications: recurrent laryngeal nerve (RLN) paralysis, hypoparathyroidism, hemorrhage, operating time, wound healing and duration of postoperative hospital stay.

Indirect laryngoscopic examination was applied to carry out an evaluation of the vocal cords motility before and after surgery in all patients. The ones who had preoperative vocal cord palsy were excluded. Postoperative cord palsy was defined as the presence of an immobile vocal cord or decreased movements of the vocal cords during phonation. Permanent vocal cord palsy was defined as the presence of persistent dysfunction and clinical dysphonia lasting for longer than a 6-month postoperative period.

Hypocalcaemia was defined as a serum calcium level lower than 2 mmol/L postoperatively. The presence of clinical symptoms or signs including facial paresthesia, positive Chvostek's or Trousseau's signs, and muscular spasm of hypocalcaemia were reported. Hypoparathyroidism and RLN palsy were defined as permanent when there had been no evidence of recovery within 6 months after surgery. Symptomatic hypocalcaemia was treated with parenteral calcium and oral administration of 1.25-dihydroxy vitamin D3 (calcitriol) supplementation of 0.1–0.15 g/day. The patients with asymptomatic hypocalcaemia were discharged with oral calcium supplementation. Patients discharged with oral supplementation at doses modified in relation to serum calcium concentration were followed up weekly until their serum calcium levels reached the expected normal values.

Surgical technique

Total thyroidectomy, which was defined as total bilateral extracapsular thyroidectomy, was performed as follows. The skin was prepared routinely. The incision should be made about two

fingers above the sternal notch as usual collar incision. The skin and subcutaneous tissue was divided by using cutting device of monopolar electrocautery (Fig. 1a). Then the flaps were prepared by the coagulation device of monopolar electrocautery (Fig. 1b). A midline vertical incision between sternohyoid muscles was made by the cutting device of monopolar electrocautery. After proper cleavage plane was developed by obtuse dissection, the sternohyoid and sternothyroid muscles were pulled outward from the thyroid gland by means of a retractor. All veins and arteries of the superior (Fig. 2a) and inferior (Fig. 2b) thyroidal poles, middle thyroid veins (Fig. 3a), all small vessels around the Berry's ligament were sealed by the PlasmaKinetic forceps (Fig. 3b). After bleeding control, suction drains were placed in all patients. Sutures were used only for closure.

All thyroid gland specimens were weighted postoperatively. After surgical intervention, histopathological examinations were performed for all patients. Informed consent forms were obtained from all patients before surgery.

Statistics

The data were analyzed using SPSS 11.5 for Windows. Statistical analysis was performed by Student's t test for continuous variables and chi-square test or Fisher's exact test for categorized variables. The results were expressed as mean±SD, and $p < 0.05$ was accepted to be statistically significant.

Results

Total thyroidectomy was performed in all operations. There was no operative mortality. None of the patients had postoperative wound infection. When the incidence of postoperative cord palsy was 2.32 % (2/86) (both in hyperthyroidic conventional group), transient hypoparathyroidism was 4.6 % (4/86) (one in hyperthyroidic conventional group, two in hyperthyroidic PlasmaKinetic group, one in hypothyroidic conventional group). Neither cord palsy nor hypoparathyroidism, which were described as postoperative complications in our patients, became permanent.

There was no significant difference with regard to age, gender, thyroid gland weight, and complication rates between the PlasmaKinetic group and conventional group ($p > 0.05$). Also, there was no statistical difference between the two groups in consideration of wound healing ($p > 0.05$). Operation time, mean drainage from the suction drain and duration of hospital stay of the patients in PlasmaKinetic group were significantly lower than in the conventional group ($p < 0.05$) (Tab. 1). There was no significant difference between the two groups in terms of the mean complication rates and wound healing.

Among all 86 patients, 44 were hyperthyroidic and 42 were euthyroidic. Out of 44 hyperthyroidic patients, 20 were operated by PlasmaKinetic. There was no significant difference in consideration of age, gender, thyroid gland weight, duration of hospital stay and complication rates between the hyperthyroidic PlasmaKinetic group and hyperthyroidic conventional group ($p > 0.05$). Operation time, and mean drainage from the suction

Tab. 1. The comparison and statistical evaluation between the patients of the PlasmaKinetic and conventional surgical technique group.

Total	PlasmaKinetic group	Conventional surgical technique group	P value
Number of patients	40	46	
Mean age±SD	36.1±11.1	39.8±8.7	0.24
Sex (women/men)	30/10	35/11	>0.05
Mean drainage from the suction drain (cc)	48.2±23.2	102.3±33.9	<0.05*
Resected tissue weight (gram)	66.2±13.5	65.3±12.6	0.84
Mean operation time (minutes)	53.9±13.2	101±26.1	<0.05*
Mean Hospital stay (days)	1.7±0.8	2.7±0.9	0.001*
Complication rates	2/40	4/46	>0.05

*Statistically significant

**Comparisons were done by Student's T-test except comparison of complication rates by chi-square test.

Tab. 2. The comparison and statistical evaluation between the hyperthyroidic patients of the PlasmaKinetic and conventional surgical technique group.

Hyperthyroid group	PlasmaKinetic group	Conventional surgical technique group	P value
Number of patients	20	24	
Mean age±SD	35.2±10.4	39.5±9.2	0.324
Sex (women/men)	14/6	17/7	>0.05
Mean drainage from the suction drain (cc)	56±29.5	104.1±33.9	0.002*
Resected tissue weight (gram)	56.9±9.8	61.5±11.9	0.325
Mean operation time (minutes)	49.9±13.9	96.6±30.5	<0.05*
Mean Hospital stay (days)	2.1±0.8	2.5±0.6	0.171
Complication rates	2/20	3/24	>0.05

*Statistically significant

**Comparisons were done by Student's T-test except comparison of complication rates by chi-square test.

drain in hyperthyroidic PlasmaKinetic group were significantly lower than those in conventional group ($p < 0.05$) (Tab. 2).

Out of 42 euthyroidic patients, 20 were operated by PlasmaKinetic. There was no significant difference in consideration of age, gender, thyroid gland weight, and complication rates between the euthyroidic PlasmaKinetic group and euthyroidic conventional group ($p > 0.05$). Operation time, mean drainage from the suction drain and duration of hospital stay of the patients in euthyroidic PlasmaKinetic group were significantly lower than those in conventional group ($p < 0.05$) (Tab. 3).

Tab. 3. The comparison and statistical evaluation between the euthyroidic patients of the PlasmaKinetic and conventional surgical technique group.

<i>Euthyroid group</i>	PlasmaKinetic group	Conventional surgical technique group	<i>P</i> value
Number of patients	20	22	
Mean age±SD	37.1±12.4	40.1±8.5	0.521
Sex (women/men)	16/4	18/4	>0.05
Mean drainage from the suction drain (cc)	40.5±11.6	100.4±35.5	<0.05*
Resected tissue weight (gram)	75.5±9.7	69.5±12.6	0.24
Mean operation time (minutes)	58±11.8	105.9±20.8	<0.05*
Mean Hospital stay (days)	1.3±0.4	3±1.1	0.001*
Complication rates	0/20	1/22	>0.05

*Statistically significant

**Comparisons were done by Student's T-test except comparison of complication rates by chi-square test.

Discussion

Thyroidectomy remains to be one of the most frequently performed operations in the iodine-deficient regions as in our country. The purpose of the surgical treatment in thyroid diseases should be to eliminate the disease with acceptable low complication rates. Any new surgical technology or operative technique should yield similar or improved patient outcomes and similar or low rates of complications compared with conventional methods. Until now, some trials have been conducted on the use of PlasmaKinetic in urology (2–5) and gynecology (1, 6, 7). This is the first study about PlasmaKinetic usage in thyroid surgery. The main advantage of this technique is the decrease in the operation time. A shorter operation time by PlasmaKinetic was reported by various authors (1–7). In our series, PlasmaKinetic reduced the duration of operation by 46.7 % (51.6 % in hyperthyroidic and 45.3 % in euthyroidic patients). There was a mean reduction in operative time approximately 45 minutes in the PlasmaKinetic group. On the other hand, adequate hemostasis especially in hyperthyroidic patients can shorten the hospital stay duration due to the early removal of the aspirating drains as in our series. High-flow drainage above 150 cc/24 h, in one Graves' disease patient and in PlasmaKinetic group and two Graves' disease patients, two toxic multinodular goiter patients and three euthyroidic multinodular goiter patients in the conventional technique group, caused long hospital stay. These patients were discharged after the late removal of their suction drain. The complication rates were found to be similar in both groups in our study. However, postoperative RLN palsy seems to be more likely in conventional group.

Conventional electro-surgery includes unipolar and bipolar diathermy. Unipolar electro-surgery uses high voltage for cutting,

dissection, and fulguration; bipolar electro-surgery uses low voltage for coagulation only. Bipolar electro-surgery is the most popular energy-based modality for tissue management in laparoscopic procedures. The advantages of bipolar electro-surgery are: its focus on the tissues between jaws of the instrument, a lower rate of stray current with undesired tissue effects, and low capacitive coupling (8). However, in its current form, bipolar instruments can possibly cause lateral thermal damage, and the jaws tend to stick to the tissue, which is then difficult to remove after coagulation. These problems are the result of continuous energy delivery with the traditional bipolar generator, but are not due to the instrument itself (9). The PlasmaKinetic tissue management system (Gyrus Medical, Maple Grove, MN) uses pulsed bipolar energy for coagulation. This system is designed to deliver intermittent pulses of energy through the instruments to the tissue, as opposed to conventional continuous bipolar energy. The tissue between the jaws of the forceps is therefore allowed to cool between pulses, limiting the lateral thermal injury and tissue sticking. The pulsed bipolar system has two different modes (vapor pulse coagulation, and PlasmaKinetic tissue cutting) delivering predetermined levels of energy matched to specific surgical instruments. It has been reported that vessel sealing with the pulsed bipolar system is more effective than clips, suture, or staples (1).

There are some studies about the usage of Ligasure (10–13) and Harmonic scalpel (14) in thyroid surgery. The use of Ligasure device or Harmonic scalpel seems to be more expensive than the conventional technique (11, 14). However, operations by Ligasure or Harmonic scalpel required less operation time. Also, we found that PlasmaKinetic allows gaining more time. These ligation properties of the device allowed the average intraoperative time to be reduced by 28.4 % (13). In our series, PlasmaKinetic reduced the duration of operation by 46.7 % (51.6 % in hyperthyroidic and 45.3 % in euthyroidic patients). Saving time may allow an additional operation to be performed in the operating room along the day. In our country, PlasmaKinetic is cheaper than Ligasure or Harmonic scalpel. The cost-effectiveness analysis of these instruments may be helpful when choosing one of these techniques over the other.

The limitation of our study is the number of the patients. But, we wanted to share the early results of the study about the PlasmaKinetic technique which decreases the operation time to a level of less than 50 minutes with no increase at complication rate.

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