

# Effect of Endoscopic Thyroidectomy via Anterior Chest Wall Approach on Treatment of Benign Thyroid Tumors

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## Abstract

*Objective:* To evaluate the inflammatory response and acid-base equilibrium index, as well as other clinical facts of the endoscopic thyroidectomy via the anterior chest wall approach.

*Methods:* 39 patients who received thyroidectomy in our surgical center during September 2007 and January 2008 were included in this study. Twenty of the patients underwent an endoscopic surgery, and the rest 19 received a conventional surgery. These patients' data were compared within and between treatment groups with respect to clinical facts and inflammatory evaluations. Arterial blood gas data and electrolyte data were analyzed within the endoscopic group.

*Results:* Endoscopic thyroidectomy group showed shorter operative time compared to that of conventional thyroidectomy group, although the difference didn't reach statistical significance. No significant difference regarding postoperative hospital stay was observed between two groups. Postoperative day 1 shows much higher values of IL-6 and TNF than that measured preoperative or postoperative day 3 in both groups. CRP appeared to be significantly increased postoperatively in both groups, although no difference between the two groups was found. Although blood cortisol significantly increased in both groups postoperatively, the data of endoscopic group postoperative day 1 was lower than the same day of conventional group. Arterial blood gas analysis showed that both PCO<sub>2</sub> and TCO<sub>2</sub> were statistically different between preoperation and 30 min after insufflation. No insufflation complication was observed.

*Conclusion:* Compared with conventional thyroid surgery, endoscopic thyroidectomy via anterior chest wall approach presented with no significant difference in respect of both clinical facts and laboratory outcomes.

**Keywords:** Surgery; endoscopy; thyroidectomy; anterior chest wall approach; inflammatory response; arterial blood gas analysis; electrolyte.

## INTRODUCTION

Ever since the endoscopic thyroidectomy was originated and developed, this operation has been favoured world widely with its excellent clinical and cosmetic outcomes. However, this operation requires insufflation of CO<sub>2</sub>, which may impair acid-base equilibrium. Moreover, the dissection of skin flap is more extensive than conventional thyroidectomy. All these concerns have been obsessing the surgeons whether it will cause more damage to the human body than the conventional one.

Our study tries to analyze and compare the differences between the endoscopic thyroidectomy and the conventional thyroidectomy in respect of inflammatory response, arterial blood gas (ABG) evaluation, as well as durations of operational time and postoperative hospital stay.

## PATIENTS AND METHODS

Thirty-nine (39) patients with benign thyroid diseases, hospitalized in our surgical centre during September 2007 and January 2008 were included in this study, preoperatively diagnosed by ultrasonography, including solitary nodule (16 cases), multiple cysts (5) and multiple nodules (18). No concomitant disease was found. These patients were non-randomly treated in either endoscopic method or conventional procedure on account of the tumor diameter (< 5 cm), age (not necessary excluding criteria but recommended in relatively young patients) and their own requests. Patients received either unilateral or bilateral subtotal lobectomy according to their state of lesions. Postoperative paraffin section indicates benign tumor in all patients, including 21 cases of nodular goiter, 18 adenoma including 2 with cystoid degeneration. No postoperative complications were observed, and no analgetics were applied after surgery.

We used 4-6 mmHg CO<sub>2</sub> to sustain the operative space.

Parametric data were evaluated by T-test and ANOVA analysis.

## RESULTS

### Clinical Facts

Among these 39 patients, 20 received an endoscopic thyroidectomy via the anterior chest wall approach and 19 were treated by a conventional thyroidectomy. The average age was  $37.1 \pm 9.12$  years old (range from 17 to 55) in the endoscopic group (EG), and  $43.2 \pm 11.6$  years old (20-63) in the conventional group (CG) (Table 1).

**TABLE 1: Patient characteristics**

	EG	CG
<b>Gender</b>		
Male	3	5
Female	17	14
<b>Age (years)</b>		
Mean (SD)	37.1(9.12)	43.2 (11.6)
Range	17-55	20-63
<b>Diagnosis</b>		
Nodular goiter	10	11
Adenoma	10	8

EG: Endoscopic Thyroidectomy Group, CG: Conventional Thyroidectomy Group.

### Durations of Operation and Postoperative Hospital Stay

The mean operative time (OT) of the endoscopic group was  $98.5 \pm 28.97$  min, while that of the conventional group was  $111.84 \pm 34.98$  min. The mean postoperative hospital stay (PHS) of the endoscopic group was  $3.50 \pm 0.61$  days, and that of the conventional group was  $3.63 \pm 0.68$ . No statistical significant differences on these durations were observed between two groups (Table 2).

**TABLE 2: Durations of operation and postoperative hospital stay (Mean  $\pm$  SD)**

	EG	CG	<i>p</i> -value
OT (min)	$98.5 \pm 28.97$	$111.8 \pm 34.98$	0.177
PHS (day)	$3.5 \pm 0.61$	$3.6 \pm 0.68$	0.433

OT: Operative Time, PHS: Postoperative Hospital Stay.

### Acid-base Equilibrium Index

Arterial blood gas analysis was carried out for every patient who received the endoscopic thyroidectomy preoperation (right after intubation), 30 minutes post insufflation, and right after the surgery (Table 3).

### Inflammatory Index

The venous blood was taken from every patient the day before operation, postoperative day 1 and day 3. These blood samples were analyzed for IL-6, TNF, CRP and cortisol (cortisol samples were strictly taken at a regular time, we choose 6 AM, in case of any possible influence caused by nyctohemeral rhythm) (Table 4 to 7).

**TABLE 4: IL-6 (ug/dl)**

	Preoperative	Postoperative day 1 [1]	Postoperative day 3 [1]
EG (Mean $\pm$ SD)	$4.2 \pm 0.48$	$7.2 \pm 0.50^*$	$4.6 \pm 0.30$
CG (Mean $\pm$ SD)	$4.4 \pm 0.72$	$7.2 \pm 0.26^*$	$4.5 \pm 0.28$
<i>p</i> -value [2]	0.320	0.830	0.300

1. Values from postoperative day 1 and day 3 were compared with that from preoperative measurement. \* *p*-value < 0.05.
2. *p*-values are from comparisons between CG and EG at each measurement point.

**TABLE 3: Acid-base equilibrium index for patients in EG (Mean  $\pm$  SD)**

	Preoperative	30 min after Insufflation	Postoperative	<i>p</i> -value
PH	$7.36 \pm 0.13$	$7.37 \pm 0.07$	$7.36 \pm 0.34$	0.439
PCO <sub>2</sub> (mmHg)	$45.67 \pm 7.92$	$48.75 \pm 7.58$	$45.41 \pm 8.32$	0.016
PO <sub>2</sub> (mmHg)	$556.60 \pm 102.32$	$532.22 \pm 105.72$	$554.80 \pm 104.84$	0.247
BE	$2.87 \pm 0.97$	$2.29 \pm 0.24$	$2.36 \pm 0.34$	0.096
SaO <sub>2</sub> (%)	$100 \pm 0$	$99.86 \pm 0.53$	$100 \pm 0$	0.336
TCO <sub>2</sub> (mmol/L)	$28.02 \pm 2.02$	$29.21 \pm 2.39$	$27.64 \pm 2.92$	0.012
HCO <sub>3</sub> <sup>-</sup> CO <sub>2</sub> <sup>-</sup> (mmol/L)	$27.00 \pm 2.44$	$26.67 \pm 2.76$	$27.76 \pm 2.11$	0.059
Na <sup>+</sup> (mmol/L)	$138.02 \pm 4.45$	$138.14 \pm 3.99$	$137.29 \pm 8.53$	0.076
K <sup>+</sup> (mmol/L)	$3.85 \pm 0.49$	$3.85 \pm 0.51$	$3.843 \pm 0.53$	0.962
ICa <sup>2+</sup> (mmol/L)	$1.144 \pm 0.05$	$1.138 \pm 0.09$	$1.148 \pm 0.04$	0.661

TCO<sub>2</sub> and PCO<sub>2</sub> increased statistical significantly during insufflation. No insufflating complications as pneumohypoderma or acid-base equilibrium disorder were observed.

**TABLE 5: TNF (ug/dl)**

	Preoperative	Postoperative day 1 [1]	Postoperative day 3 [1]
EG (Mean ± SD)	9.9 ± 1.49	11.31 ± 1.90*	10.48 ± 1.18
CG (Mean ± SD)	9.97 ± 2.04	11.71 ± 1.62*	10.44 ± 1.36
p-value [2]	0.110	0.320	0.580

[1] Values from postoperative day 1 and day 3 were compared with that from preoperative measurement. \*p-value < 0.05.

[2] p-values are from comparisons between CG and EG at each measurement point.

**TABLE 6: CRP (ug/dl)**

	Preoperative	Postoperative day 1 [1]	Postoperative day 3 [1]
EG (Mean ± SD)	0.36 ± 0.03	1.11 ± 0.14*	0.48 ± 0.05*
CG (Mean ± SD)	0.45 ± 0.03	1.03 ± 0.11*	0.72 ± 0.8*
p-value [2]	0.950	0.420	0.054

[1] Values from postoperative day 1 and day 3 were compared with that from preoperative measurement. \*p-value < 0.05.

[2] p-values are from comparisons between CG and EG at each measurement point.

**Table 2.7: Cortisol (ug/dl)**

	Preoperative	Postoperative day 1 [1]	Postoperative day 3 [1]
EG (Mean ± SD)	7.36 ± 1.26	8.2 ± 0.86*	9.07 ± 0.85*
CG (Mean ± SD)	7.79 ± 0.91	10.6 ± 1.2*	10.14 ± 0.78*
p-value [2]	0.43	0.03	0.56

[1] Values from postoperative day 1 and day 3 were compared with that from preoperative measurement. \*p-value < 0.05.

[2] p-values are from comparisons between CG and EG at each measurement point.

## DISCUSSION

Since the establishment of our minimally invasive surgery centre in 2003, we've successfully carried out more than 170 endoscopic thyroid operations via the anterior chest wall approach. After the originating period, the physician learning curve gradually drives to stability. According to the analysis of about 100 patients who received endoscopic thyroidectomy during 2004 and 2006, the mean operative duration was 93.5 min. In our study, we reported similar endoscopic thyroidectomy operative duration (98.5 min), which was 13 minutes shorter than the mean operative time in the conventional thyroidectomy. The small size of this study limited the statistical power to show the significance of the difference. There was no difference of

postoperative hospital stay between patients received endoscopic thyroidectomy and conventional thyroidectomy. No postoperative complication was observed in this study. All these clinical data can prove that this kind of operation has inclined towards maturity. Reviewing the history of all 174 patients treated with endoscopic thyroid surgery in our center, 6 patients presented with hoarseness after surgery, 5 were transient, only one permanent recurrent laryngeal nerve damage who was then recovered by taking neurosuture, 4 of these 6 patients were confirmed by pathological examination as thyroid carcinoma, including the permanent damage one, the other 2 were nodular goiters.

The insufflation pressure of sustaining the operative space had already been verified through many laboratory and clinical researches.<sup>1,2</sup> Bellantone and Rubinos,<sup>1,3</sup> animal experiment proved that low pressure (<10 mmHg) of CO<sub>2</sub> insufflation in the anterior neck region had no obvious negative effect on circulation and blood-flow dynamics. Recently, the generally recommended insufflation pressure is 4-6 mmHg, it can absolutely provide an ideal operative space for the surgeons. Our research showed only TCO<sub>2</sub> and PCO<sub>2</sub> increased statistically during insufflation, but came back to baseline value right after desufflation. TCO<sub>2</sub> consists of two parts, one is HCO<sub>3</sub><sup>-</sup>, (occupies 95% of the consistence of TCO<sub>2</sub>) and the other is soluble CO<sub>2</sub>. The unchanged THCO<sub>3</sub><sup>-</sup> explains the increase of soluble CO<sub>2</sub>. And soluble CO<sub>2</sub> can sufficiently be compensatory by mechanical ventilation. The stable acid-base index, the rapid recovery of TCO<sub>2</sub> and PCO<sub>2</sub> and the absence of insufflation complication can best prove that 4-6 mmHg of insufflation will not cause any irreversible damage to human body.

Studies comparing endoscopic surgery and related conventional surgery have been carried out universally with consistent conclusions. Researches focused on inflammatory responses after laparoscopic surgery involve not only general but also focal responses. Due to the insufflation of CO<sub>2</sub>, the pH value is suppressed focally in the operative field,<sup>4-6</sup> but not in general system. The acid circumstances can than lead to focal immune suppression and reduce inflammatory response. IL-6, TNF and CRP, the general measurement for acute inflammatory response, indicate the degree of surgical damage.<sup>7,8</sup> Blood cortisol is widely accepted as the suppressor of inflammatory response, which can decrease IL-6, TNF and CRP generations.

Our study found that TNF and IL-6 increased significantly on postoperative day 1 and recovered to preoperative level on postoperative day 3 in both groups. There was no difference of IL-6 or TNF between the two groups at any measurement point. CRP is an acute-phase protein, which increased significantly after surgery. But there was no difference between two groups either. It was reported that the increasing concentration of CO<sub>2</sub> in the blood can inhibit the releasing of blood cortisol.<sup>9</sup> In our study, blood CO<sub>2</sub> transiently increased during endoscopic surgery, and meanwhile the blood cortisol in the endoscopic

group appeared to be lower than that in the conventional group on postoperative day 1. Because of the suppressive effect on TNF and IL-6 of cortisol, it can reversely prove that TNF and IL-6 level of endoscopic group is no higher than that of conventional group. All these outcomes above manifested that endoscopic thyroidectomy would neither enhance the inflammatory response nor damage human function, despite its extensive dissection of skin flap.

Compared with conventional thyroid surgery, endoscopic thyroidectomy via anterior chest wall approach presented with no significant difference in respect of inflammatory responses, acid-base index, and duration of operative time and postoperative hospital stay. These data support the safety and feasibility of this procedure in treatment of benign thyroid tumors. And in the light of its cosmetic advantage, more and more patients who are suffering from thyroid diseases will get benefit from this technology.

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