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## ORIGINAL

### THE EFFECT OF SUBAXILLARY ENDOSCOPIC SURGERY WITHOUT AIR INFLATION ON THE DEGREE OF PAIN AND THE INCIDENCE OF COMPLICATIONS IN ATHLETIC PATIENTS WITH UNILATERAL THYROID CANCER

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#### ABSTRACT

**Objective:** To investigate the effect of subaxillary inflatable endoscopic surgery on the degree of pain and the incidence of complications in athletic patients with unilateral thyroid cancer. **Methods:** Sixty athletic patients with unilateral thyroid carcinoma (TC) accepted treatment in the hospital from January 2020 to December 2021 were chosen to be the object of the study. Adapting the means of random number table, they were split into 30 cases both in the control group and in the observation group. The control group were treated with traditional open surgery, and the observation group took the remedy with non-inflatable endoscopic surgery through axillary approach. The operation time, intraoperative bleeding, postoperative drainage volume, incision length and inpatient days; Satisfaction with the cosmetic effect of incision; Visual analogue scale (VAS); The occurrence of complications were contrasted within two groups. **Results:** Compare to the control group, the operation time, as well as postoperative drainage volume in the observation group increased fairly, and the amount of intraoperative bleeding, incision length and hospital stay considerably declined ( $P < 0.05$ ); In contrast to the control group (56.67%), the satisfaction of the observation one with the cosmetic effect of incision (90.00%) was significantly higher ( $P < 0.05$ ); In contrast to the control group, the VAS score of the observation group cut down considerably at 24h and 48h after operation ( $P < 0.05$ ); In contrast with the control group (43.33%), the incidence of complications in the observation group (16.67%) decreased considerably ( $P < 0.05$ ). **Conclusion:** In the treatment of athletic patients with unilateral TC, the

transaxillary approach of airless endoscopic surgery can not only effectively improve a number of surgical indicators, improve athletic patients' satisfaction with the cosmetic effect of the incision, but also reduce the degree of pain, reduce the occurrence of complications, with a higher clinical reference value.

**Keywords:** No inflation; Via axillary approach; Endoscopic surgery; Thyroid carcinoma; Degree of pain; Medical Applications; Incidence of complications

Thyroid carcinoma (TC) is a common surgical disease in the clinic, mainly presenting as a painless neck nodular or mass. Continuous growth of nodules or masses may compress blood vessels and nerves, etc., resulting in dysphagia, hoarseness, dyspnea and other symptoms. TC mainly occurs in the lateral thyroid lobule, which is mostly a single tumor, and is more common in women. And with the change of life and eating habits, the incidence of the disease increases year by year, seriously threatening the physical health and quality of life of athletic patients (Zarogoulidis et al., 2021). Surgical operation is the most effective and fundamental way of clinical treatment of TC, and its radical and safety have been clinically recognized. But people are not only satisfied with the cure, but the pursuit of cosmetic effect. Open surgery can cause large incision scar. With the persistent evolution and maturity of endoscopic technology, it has been gradually applied in tumor resection (C. Liu et al., 2020). At the same time, the approach method is also constantly updated, and endoscopic surgery through axillary approach is characterized by small incision and hidden surgical scar (Q.-F. Liu, Zhao, Cui, Yang, & Liao, 2021). Traditional operations require the construction of a carbon dioxide (CO<sub>2</sub>) pneumoperitoneum to maintain the operating space, but at the same time, it can have adverse effects on the body's circulation and respiratory systems. However, non-inflatable endoscopic surgery through axillary approach can establish the operating space without injecting CO<sub>2</sub>, thus effectively avoiding a variety of adverse effects (Stang et al., 2018). However, there are not many studies on the application of non-inflatable endoscopic surgery through axillary approach in unilateral TC, which is worthwhile to be explored in the future. Hence, the majority of the study to dig into the impact on inflatable endoscopic surgery through axillary approach on the pain degree and complication rate of athletic patients with unilateral TC, in order to furnish more ideas for clinical treatment of TC (Rocha, Manica, Noronha, Ramos, & Klassen, 2019).

## 1. DATA AND METHODS

### 1.1 General Information

There were 60 athletic patients in all with unilateral TC transferred to our hospital from January 2020 to December 2021 who were picked as the study entities. They were split into control group (n = 30) and observation group (n = 30) with the adoption of the accidental number table method. The control group accepted the treatment of traditional open surgery, and

the observation group accepted the treatment of non-inflatable endoscopic surgery through axillary approach. This study has acquired permission from the hospital ethics Committee. There were no obvious differences in gender, age, tumor diameter, tumor location, number of lesions and pathological types between two groups ( $P>0.05$ ), indicating comparability, see Table 1.

**Tab. 1** Comparison of two groups of general statistics

General information		Control group (n=30)	Observation group (n=30)	$t/\chi^2$	$P$
Gender [N (%)]	Male	9 (30.00)	8 (26.67)	0.023	0.887
	Female	21 (70.00)	22 (73.33)		
Average age (years)		47.36±6.53	46.73±5.97	0.372	0.708
Mean tumor diameter (cm)		1.44±0.52	1.32±0.49	0.459	0.639
Tumor location [N (%)]	Left	12 (40.00)	13 (43.33)	0.473	0.492
	Right	18 (60.00)	17 (56.67)		
Number of lesions [n (%)]	single	23 (76.67)	22 (73.33)	0.454	0.501
	multiple	7 (23.33)	8 (26.67)		
Pathological type [N (%)]	Papillary carcinoma	21 (70.00)	22 (73.33)	0.181	0.672
	Follicular carcinoma	7 (23.33)	6 (20.00)		
	other	2 (6.67)	2 (6.67)		

## 1.2 Inclusion and exclusion criteria

**Inclusion criteria:** ① All athletic patients were recognized as unilateral TC by thyroid function, neck X-ray, ultrasound and other examinations; ② Patients with normal lung function; ③ The maximum diameter of the tumor was 5cm; ④ Informed consent was endorsed by athletic patients themselves or their families.

**Exclusion criteria:** ① Athletic Patients with contraindications or the disability to tolerate surgery during the research; ② Patients with a illness history of neck and axillary surgery and radiotherapy; ③ Patients with thyroid diseases such as thyroiditis and hyperthyroidism; ④ Complicated with other tumor diseases; ⑤ Athletic Patients with cervical lymph node metastasis and distant metastasis.

## 1.3 Surgical methods

The control group received traditional open surgery: athletic patients were supine on the operating table. An arc incision of approximately 6cm in length was made about 2cm above the superior sternal notch, and the incision was made layer by layer with an electric knife until the platysma muscle was reached. The thyroid hook was used to pull it apart and the linea alba was found to be incised to separate the anterior muscle group. The thyroid envelope was obtuse and the middle thyroid vein was separated. Ligation of

the clotting band line with ultrasonic knife was used. The upper thyroid gland was separated by ultrasonic knife along the annular nail space and then ligation with silk thread was used. The upper and lower parathyroid glands were identified and retained, and the movement of the recurrent laryngeal nerve was detected by recurrent laryngeal nerve detector. The inferior thyroid vessels are cut and ligation, exposing the trachea. Then the paratracheal lymph nodes were cleaned along the recurrent laryngeal nerve, and then the trachea, isthmus and paratracheal lymph nodes on the affected side were removed along the trachea. The wound was rinsed, the silicone drainage tube was placed next to the trachea, extracted from the incision and fixed, and finally the incision was sutured layer by layer.

The observation group underwent aeration free transaxillary endoscopic surgery: general anesthesia was performed even though the patient was supine on the operating table. The patient was instructed to abduct the upper limb and perform certain fixation. A 3~4cm arc incision was made among the midaxillary line and the anterior axillary line, and the incision was dissociated along the fascia and subcutaneous space to the outer margin of the pectoralis major. From the surface of the pectoralis major fascia gradually dissociates towards the neck until crossing the clavicle to the clavicular head triangle, sternocleidomastoid thoracic bone. A special suspension hook was used to pull and expose the endoscopy instrument. It begins to dissociate from the inner triangular fascia space until it crosses the cervical sheath vessels and incises the deep cervical middle fascia to the posterior of the banded muscle. The perithyroid gland and omohyoid muscle were dissociated. The outer membrane of thyroid was separated, and the middle thyroid vein was separated, and the coagulation and separation were performed by ultrasonic knife. The lower pole is further dissociated, the inferior thyroid artery and vein are severed, and the trachea is exposed. The suspensory ligament was cut by ultrasonic knife, the annular nail space was exposed, and the upper pole artery and vein were closed and separated. The gland was pulled forward, the outer capsule was cut laterally, the inferior parathyroid gland was identified, the inferior artery branch was closed, and the parathyroid gland was retained in situ. The movement of the recurrent laryngeal nerve was detected with a recurrent laryngeal nerve detector, and Berry's ligament was dissected after it was avoided. The lymph nodes are separated from top to bottom along the recurrent laryngeal nerve to the top of the thymus and laterally to the medial margin of the carotid sheath. The whole trachea and parathyroid lymph nodes of the affected side were removed. The wound was rinsed, and the drainage tube was placed next to the trachea, and extracted from the axilla and fixed. Finally, the incision is closed layer by layer.

All operations were performed by the exact same team of physicians.

## 1.4 Observation Indicators

① Operation-related indicators: operation time, intraoperative blood loss, postoperative drainage, incision length, length of inpatient days, etc., were compared within these two groups. ② Satisfaction with the cosmetic effect of the incision: 3 months after the operation, the evaluation of the cosmetic effect of the incision was collected by the hospital's self-made scale, which was grouped into four grades: intensive satisfied, relatively satisfied, general, not satisfied, total satisfaction = intensive satisfied + relatively satisfied; ③ Pain degree: Visual Analogue Scale (VAS) (Miler et al., 2020) was taken advantage for to mark the pain measure of athletic patients of the two groups 24h and 48h after surgery, with a total of 10. The higher the grade, the tougher the pain. (4) Complications: Neck discomfort, drinking water choking, postoperative bleeding, numbness of hands and feet, incision infection, hoarseness and other complications were observed in both groups.

## 1.5 Statistical methods

SPSS 18.0 was adopted through the period of analyzing statistics. The measurement data were in the expression as mean  $\pm$  standard deviation ( $\pm S$ ) and examined by T. Enumeration data were in the expression by example (n) or percentage (%) and tested by  $\chi^2$ .  $P < 0.05$  indicated statistically obvious distinctions.

## 2.RESULTS

### 2.1 Comparison of surgical indicators

The operative time and postoperative drainage volume in the observation group were fairly longer than those in the control group, and the intraoperative blood loss, incision length and inpatient days were pretty shorter than those in the control group. The distinction was statistically significant ( $P < 0.05$ ), as shown in Table 2.

**Tab. 2** Comparison of operation related indexes between the two groups ( $\pm s$ )

Time	Control group (n=30)	Observation group (n=30)	t	P
Operation time (min)	77.73 $\pm$ 11.66	123.37 $\pm$ 26.75	24.99	0.000
Intraoperative blood loss (mL)	30.62 $\pm$ 8.84	12.51 $\pm$ 3.80	9.04	0.000
Postoperative drainage volume (mL)	56.29 $\pm$ 11.90	100.19 $\pm$ 23.18	19.21	0.000
Incision Length (cm)	6.57 $\pm$ 0.42	3.83 $\pm$ 0.24	15.30	0.000
Length of hospital stay (D)	7.31 $\pm$ 0.83	5.08 $\pm$ 0.57	6.37	0.015

### 2.2 Comparison of the satisfaction with the cosmetic effect of incision

The observation group was considerably more satisfied with the cosmetic impact of incision than the control group, and the distinction was statistically obvious ( $P < 0.05$ ), see Table 3.

**Table 3** Comparison of two groups' satisfaction with incision cosmetic impact [n (%)]

Satisfaction	Control group (n=30)	Observation group (n=30)	t	P
Very satisfied	6 (20.00)	13 (43.33)	-	-
Satisfactory	11 (36.67)	14 (46.67)	-	-
General	12 (40.00)	3 (10.00)	-	-
Not satisfied	1 (3.33)	0 (0.00)	-	-
Total	17 (56.67)	27 (90.00)	6.534	0.018

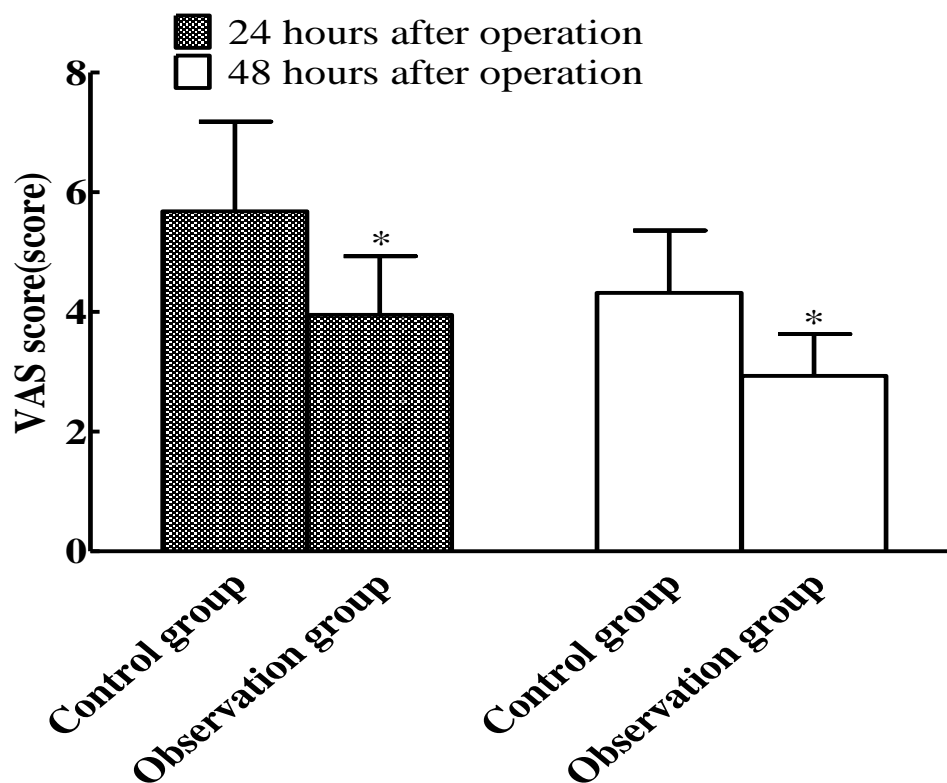
### 2.3 Comparison of postoperative pain degree

VAS scores of the observation group were considerably below those of the control one at the 24h and 48h after surgery, with statistically significant differences ( $P < 0.05$ ), see Table 4 and Figure 1.

**Tab. 4** Contrast of postoperative pain among the two groups ( $\pm$ s, score)

Time	Control group (n=30)	Observation group (n=30)
24 h after the operation	5.68 $\pm$ 1.50	3.95 $\pm$ 0.98*
48 h after the operation	4.32 $\pm$ 1.04	2.93 $\pm$ 0.70*

Note: compared with 24h after surgery, \* $P < 0.05$ ; In contrast with the control group, # $P < 0.05$ .



**Fig. 1** Contrast of postoperative pain among the two groups

Note: Compared with the control group, \* $P < 0.05$ .

### 2.4 Contrast in complications

The possibility of complications in the observation group was far below than that in the control one, with statistical significance ( $P < 0.05$ ), see Table 5.

Tab. 5 Contrast of complications within the two groups [ n (%) ]

complications	Control group (n=30)	Observation group (n=30)	$\chi^2$	P
Neck discomfort	6 (20.00)	2 (6.67)	-	-
Drinking water choking cough	1 (3.33)	0 (0.00)	-	-
Postoperative bleeding	1 (3.33)	0 (0.00)	-	-
Limbs numb	1 (3.33)	0 (0.00)	-	-
Infection of incision	1 (3.33)	1 (3.33)	-	-
Voice hoarse	3 (10.00)	2 (6.67)	-	-
Total	13 (43.33)	5 (16.67)	6.542	0.014

### 3.DISCUSSION

TC is derived from thyroid follicular epithelial malignant tumor disease, and most athletic patients can obtain a good prognosis after early active and effective treatment (Kim, Lee, Lee, & Seo, 2020). Traditional open surgery has a significant therapeutic effect on TC. However, scar tissue around 10cm is not only aesthetic, but also may lead to abnormal neck skin and cause dysphagia (Memeh et al., 2021). And endoscopy can be characterized by less trauma, less scar and quick recovery (Vidal, Delgado-Oliver, Pino, & Vilaça, 2018). The axillary approach can make the incision covered under the clothes (Mlees, El-Sherpiny, & Moussa, 2020; Vidal et al., 2018). In addition, the non-inflatable cavity construction method effectively avoids cerebral edema, respiratory acidosis, CO<sub>2</sub> embolism, subcutaneous emphysema and other complications caused by CO<sub>2</sub> (Jantharapattana & Leelasawatsuk, 2020). However, few studies have explored the effects of inflatable endoscopic surgery through axillary approach on the pain degree and complication rate of invalids with unilateral TC. It can be indicated by the research that inflatable endoscopic surgery through axillary approach is able to potently alleviate the pain measure and the incidence in complications in invalids with unilateral TC. The reasons are as follows.

Chang et al (Chang et al., 2020) showed that endoscopic transaxillary thyroidectomy takes a long time. Xu et al. (Xu, Mu, Yang, & Liu, 2020) showed that endoscopic axillary approach can effectively improve the satisfaction of scar cosmetic effect in women with subcutaneous mastectomy for breast cancer. In this study, the time of operation in the observation group was considerably longer than that of the control one, and the satisfaction with the cosmetic effect of the incision was considerably more than that of the control group, which was basically coherent with the research conclusions of Chang and Xu. At the same time, this study also found that when comparing to the control group, the observation one had increased postoperative drainage, decreased the loss of blood, incision length and hospital stay. Combined with the above results, it is suggested that endoscopic surgery with inflatable and axillary approach for unilateral LC can prolong the operative time and increase

postoperative drainage. It can reduce the amount of intraoperative blood loss, incision length, inpatient days and other surgical indicators, and considerably meet the patient's requirements with the cosmetic impact of the incision. Traditional open surgery is the most important and preferred treatment for TC. However, surgical scar is one of essential elements impacting the mental health of athletic patients (Yang, Sun, Yang, Chen, & Duan, 2020). As a new surgical method, the non-inflatable endoscopic surgery through axillary approach has small incision and less trauma, which is conducive to postoperative recovery of athletic patients. Secondly, non-inflatable provides the operator with a clear surgical field, effectively avoiding frequent wiping of the lens during the operation, thus significantly improving the accuracy of operation (Prete et al., 2019). The subcutaneous tunnel of axillary approach has a small range and a short distance for subcutaneous separation, which reduces the separation area and then reduces the damage to other tissues. At the same time, the selection of small incisions of axillary fossa folds is beneficial to the establishment of surgical lacunae. At the same time, the incision is small and hidden, which effectively improves athletic patients' satisfaction with the cosmetic effect of the incision. In the observation group, the operation time was prolonged. It was considered that endoscopic unilateral axillary thyroidectomy required more flaps to be dissociated. Secondly, the chopstick effect of endoscopic instruments reduces the flexibility of surgery. More drainage in the observation group may be caused by too many free flaps.

Elzahaby et al (Elzahaby et al., 2018) showed that the postoperative pain score of endoscopic unilateral axillary thyroidectomy was significantly reduced, and the occurrence of complications, for instance, swallowing discomfort and paresthesia was greatly declined. In this study, VAS score of the observation group was in a lower state than that of the control group at 24h and 48h after surgery. Meanwhile, the incidence of complications was considerably lower than that of the control group. It was in completely accordance to the outcomes of Elzahaby's study, manifesting that inflatable endoscopic surgery through axillary approach is capable of validly alleviating the pain measure of athletic patients with unilateral TC and reduce the incidence of complications. Traditional open surgery requires incision of neck alba, which may lead to neck skin adhesion, and further cause swallowing discomfort and skin paresthesia (Oscé et al., 2021). However, the endoscopic lens of non-inflatable transaxillary endoscopic surgery can provide 5~10 times magnification effect, and it can also anatomize the thyroid gland from the side, thus having better identification of enlarged lymph nodes, recurrent laryngeal nerves and parathyroid glands. Under the advantages of endoscopic high-definition and magnification, lymph nodes can be effectively cleared, and the recurrent laryngeal nerve can be recognized and anatomized more conveniently. Identification and protection of parathyroid gland can reduce unnecessary injury, reduce pain degree and the occurrence of complications (Cong et al., 2022). At the same time, the separation through axillary approach close to



pectoralis major will not easily cause flaps burn. Non-inflatable can not only reduce CO<sub>2</sub> accumulation, mediastinal emphysema, subcutaneous emphysema and other complications, but also increase the definition of surgical field of vision with its built-in aspirator, which is conducive to the smooth operation.

The limitation of this investigation lies in the relatively tiny sample size, which may make the data in the result deviate from the actual value. At the same time, without long-term follow-up, it is not possible to determine the long-term efficacy of inflatable endoscopic surgery through axillary approach for unilateral TC. Therefore, it is of great necessity to enlarge the sample size and prolong the follow-up survey time for further validation studies.

In conclusion, compared with traditional open surgery, inflatable transaxillary endoscopic surgery can not only improve surgical indicators and athletic patients' satisfaction with the cosmetic effect of the incision, but also relieve the pain degree and lessen the occurrence of complications in invalids with unilateral TC, which is quite worthwhile for clinical reference.

**Declaration of conflict of interest:** None.

**Data Availability Statement:** The data used to support the findings of this study are available from the corresponding author upon request.

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