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Meta-analysis of comparison between minimally invasive video-assisted thyroidectomy and conventional thyroidectomy

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Abstract. – OBJECTIVE: Comparing the minimally invasive video-assisted thyroidectomy (MIVAT) with conventional thyroidectomy in safety and clinical application.

STUDY DESIGN: A systematic review of the literature and meta-analysis.

MATERIALS AND METHODS: Randomized controlled trials comparing the MIVAT with conventional thyroidectomy were ascertained by methodical search using Medline, Embase, Pubmed, and The Cochrane Library. The trials data were extracted and statistical analyzed using STATA 11.0.

RESULTS: Nine trials were identified. Operative time was significantly less with conventional thyroidectomy than with MIVAT, while MIVAT was associated with less pain at 24 hours postoperatively. MIVAT was associated with less scarring and greater cosmetic result. There were no statistically significant differences for the presence of transient recurrent laryngeal nerve palsy and the presence of transient hypoparathyroidism.

CONCLUSIONS: MIVAT is a feasible, practical, and safe procedure with cosmetic benefit. It is a promising new technique for modern patients, with benefits over the established surgery.

Keywords:

Meta-analysis, Minimally invasive video-assisted thyroidectomy, MIVAT, Conventional thyroidectomy.

Introduction

Since the introduction of endoscopic parathyroidectomy by Gagner[1] in 1996 and endoscopic thyroidectomy by Huscher et al[2] in 1997, several thyroidectomy techniques have been introduced and developed over the past decade. Minimally invasive video-assisted thyroidectomy (MIVAT), which first described by Miccoli et al[3], combined the benifits of conventional and endoscopic thyroidectomy. MIVAT's operation procedure is similar to conventional thyroidectomy but has advantages in better recognition of the anatomic during surgery, less trauma, better cosmetic results[4].

MIVAT has potential possibility to be the golden standard for endoscopic thyroidectomy compared with conventional thyroidectomy though some factors have restricted the advance of MIVAT, including the patients who have the requisite small size of thyroid nodules that are most ideal for this technique. After more than a decade development of MIVAT, less meta-analysis comparing with result of conventional thyroidectomy and MIVAT has been reported.

The aim of this study is to comparing the minimally invasive video-assisted thyroidectomy (MIVAT) with conventional thyroidectomy in safety and clinical application.

Materials and Methods

Search Strategy

A systematic literature search of Medline (1950–Oct 2012), Embase (1974–Oct 2012), and Cochrane Library (2012, Issue 10) databases was undertaken. The database searching was performed by exposuring MESH words and truncation of the keywords. The search words were as follows: video-assisted (or MIVAT), minimally invasive, laparoscopy, thyroid surgery, open and conventional thyroidectomy. The search was restricted to English language articles.

Data Extraction

All randomized control trials (RCTs) that compared MIVAT with conventional thyroidectomy were identified. The year of publication and name of the first author was used to identify the

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Table I. Characteristics of studies.

Study	Operation method	Num of patients	Age	Operative types			Pathological diagnosis		
				M/F	Total thyroidectomy	Thyroid lobectomy	Benign	Indeterminate	Carcinoma
Miccoli[4] et al (2001)	MIVAT	25	38 ± 12.5	3/22	9	16	8%	76%	16%
	CT	24	39.9 ± 12.8	3/21	10	14	20.80%	62.50%	16.70%
Miccoli[5] et al (2002)	MIVAT	16	41.7 ± 9.1	3/13	16	0	0%	0%	100%
	CT	17	46.1 ± 7.8	0/17	17	0	0%	0%	100%
Bellantone[6] et al (2002)	MIVAT	31	51.8 ± 1.6	4/27	0	31	NR	NR	NR
	CT	31	52.1 ± 1.8	7/24	0	31	NR	NR	NR
Chao[7] et al (2004)	MIVAT	52	39.5 ± 14.4	12/40	0	52	19.20%	80.80%	0%
	CT	59	42.1 ± 14.6	7/52	0	59	40.70%	59.30%	0%
Lombardi[8] et al (2005)	MIVAT	10	45.9 ± 12.7	0/10	10	0	0%	100%	0%
	CT	10	47.2 ± 12.8	2/8	10	0	10%	80%	10%
Hegazy[9] et al (2007)	MIVAT	33	39.8 ± 13.7	4/29	4	29	24.20%	75.80%	0%
	CT	35	37 ± 12.4	5/30	5	30	28.50%	71.50%	0%
Istvan[10] et al (2008)	MIVAT	15	39.9 ± 11.5	2/13	1	14	26.60%	73.40%	0%
	CT	15	41.1 ± 10.8	2/13	1	14	33.30%	66.70%	0%
Gouda[11] et al (2009)	MIVAT	38	40 ± 17	11/27	NR	NR	NR	NR	NR
	CT	38	42 ± 19	10/28	NR	NR	NR	NR	NR
JZ Di[12] et al (2011)	MIVAT	31	34.06 ± 5.88	3/28	31	0	0%	0%	100%
	CT	37	36.95 ± 6.29	6/31	37	0	0%	0%	100%

MIVAT, minimally invasive video-assisted thyroidectomy; CT, conventional thyroidectomy; NR, not referred.

studies. The primary outcome measures were patient reported pain with visual analog scale (VAS) and postoperative hypo-parathyroidism (hypocalcaemia) or transient (within 6 months) recurrent laryngeal nerve (RLN) palsy. The secondary outcome measures were operative time, patient scored postoperative cosmetic result with visual numeric scale (VNS) ranged from 0 to 10.

Statistical Analysis

Data from eligible trials were entered into a computerized spreadsheet for analysis. The statistical analysis was performed using STATA 11.0. The weighted mean difference was calculated for the effect size of video-assisted thyroidectomy on continuous variables such as pain score, operating time and cosmetic score. Pooled odds ratios (relative risk) were calculated for the effect of video-assisted thyroidectomy on the discrete variables of postoperative hypocalcaemia and recurrent laryngeal nerve palsy. Pooled outcome measures were determined using random-effects models. Heterogeneity among the trials was assessed by Cochran's Q statistic, a null hypothesis test in which $p < 0.05$ is taken to indicate the presence of significant heterogeneity. The Egger test was used to assess the funnel plot for significant asymmetry, indicating possible publication or other biases.

Results

After examination of search, nine randomized trials that met the selection criteria were identified[5-13]. The total number of patients was 517. MIVAT was 251 patients (48.5%) and conventional thyroidectomy was 266 patients (51.5%). 84 males and 433 females (Table I).

Outcomes

Among perioperative outcomes (Table II), shorter operation time (WMD and 95% CI = 19.004[17.402, 20.607]) was statistically significant (Z = 23.24, $p = 0.000$) in favor of open thyroidectomy, while the reverse was true (Z = 24.91, $p = 0.000$) for VAS score of pain at 24 hours postoperatively (WMD and 95% CI = –2.503 [–2.700, –2.306]). A higher cosmetic result score was significant (Z = 38.62 $p = 0.000$) in favor of MIVAT (WMD and 95% CI = 3.060 [2.905, 3.215])

All nine trials reported postoperative recurrent laryngeal nerve palsy but there were no cases of hypocalcaemia in Bellantone et al., Chao et al. or Istvan et al. and, therefore, these trials were excluded from analysis. There was no significant difference in the occurrence of transient RLN palsy (OR and 95% CI=1.438 [0.591, 3.498], Z = 0.80 $p = 0.423$)

Table II. Measurements of outcomes depicted in studies.

Outcomes	Study	MIVAT	CT	*p* value
Operation times (min)	Miccoli et al (2001)	66.0±22.4	45.2±14.9	0.001
	Bellantone et al (2002)	81±3	62±4	0.001
	Chao et al (2004)	62.2±13	47±24.6	0.0001
	Lombardi et al (2005)	93±10.6	80.5±22.3	NS
	Istvan et al (2008)	68.5±18	43.3±14	0.001
	Gouda et al (2009)	62±21	46±5	0.0001
	JZ Di et al (2011)	143.9±19.2	105.4±37.0	0.0001
Postoperation pain	Miccoli et al (2001)	16.0±20.2	32.5±21.3	0.003
(VAS[a] 24h)	Bellantone et al (2002)	18±2	62±2	0.001
	Lombardi et al (2005)	9±9	14±7	NS
	Hegazy et al (2007)	15.6±18.5	27.3±20.4	0.05
	Gouda et al (2009)	2.6±0.2	3.4±0.6	0.0001
Cosmetic result (VNS[b])	Miccoli et al (2001)	9.2±1.0	8.0±1.8	0.01
	Bellantone et al (2002)	9.2±0.5	5.8±0.7	0.001
	Lombardi et al (2005)	9.3±0.8	8.4±1.0	0.05
	Istvan et al (2008)	7.9±1.2	4.9±1.3	0.015
	Gouda et al (2009)	9.1±0.5	4.9±0.6	0.0001
	JZ Di et al (2011)	3.23±0.71	1.76±0.60	0.0001
Transient RLN[c] palsy	Miccoli et al (2001)	2/25	1/24	NS
	Miccoli et al (2002)	3/16	0/17	NS
	Bellantone et al (2002)	0/31	0/31	NS
	Chao et al (2004)	3/59	5/52	0.39
	Lombardi et al (2005)	0/10	0/10	NS
	Hegazy et al (2007)	1/33	1/35	NS
	Istvan et al (2008)	0/15	0/15	NS
	Gouda et al (2009)	3/38	1/38	NS
	JZ Di et al (2011)	0/31	0/37	NS
Transient	Miccoli et al (2001)	0/25	1/24	NS
Hypoparathyroidism	Miccoli et al (2002)	1/16	0/17	NS
	Bellantone et al (2002)	0/31	0/31	NS
	Chao et al (2004)	0/59	0/52	NS
	Lombardi et al (2005)	1/10	1/10	NS
	Hegazy et al (2007)	1/33	0/35	NS
	Istvan et al (2008)	0/15	0/15	NS
	Gouda et al (2009)	2/38	2/38	NS
	Di et al (2011)	3/31	1/37	NS

a.VAS, visual analog scale ranged from 0 to 10; b.VNS, visual numeric scale ranged from 0 to 10; c, RLN, recurrent laryngeal nerve; NS, not significant.

All trials assessed patients for postoperative hypocalcaemia but there were no cases of hypocalcaemia in Bellantone et al, Chao et al or Istvan et al and, therefore, these trials were excluded from analysis. There was no significant difference in the occurrence of postoperative hypocalcaemia between the groups. Table III illustrates the pooled relative risk (OR and 95% CI = 1.569 [0.568, 4.337], Z = 0.87 p = 0.385).

Table III. Meta-analysis of operation results.

Perioperative comparisons	Studies	Participants	Statistical method	WMD [95% CI]	Test of overall effect
Operation time	7	416	WMD (fixed)	19.004[17.402, 20.607]	Z = 23.24, p = 0.000
Postoperation pain	5	275	WMD (fixed)	–2.503[–2.700, –2.306]	Z = 24.91 p = 0.000
Cosmetic result	6	305	WMD (fixed)	3.060[2.905, 3.215]	Z = 38.62 p = 0.000
Transient RLN palsy	9	517	OR (fixed)	1.438[0.591, 3.498]	Z = 0.80 p = 0.423
Transient hypoparathyroidism	9	517	OR (fixed)	1.569[0.568, 4.337]	Z = 0.87 p = 0.385

CI, confidence interval; WMD, weighted mean difference; VAS, visual analog scale; OR, Odds Ratio.

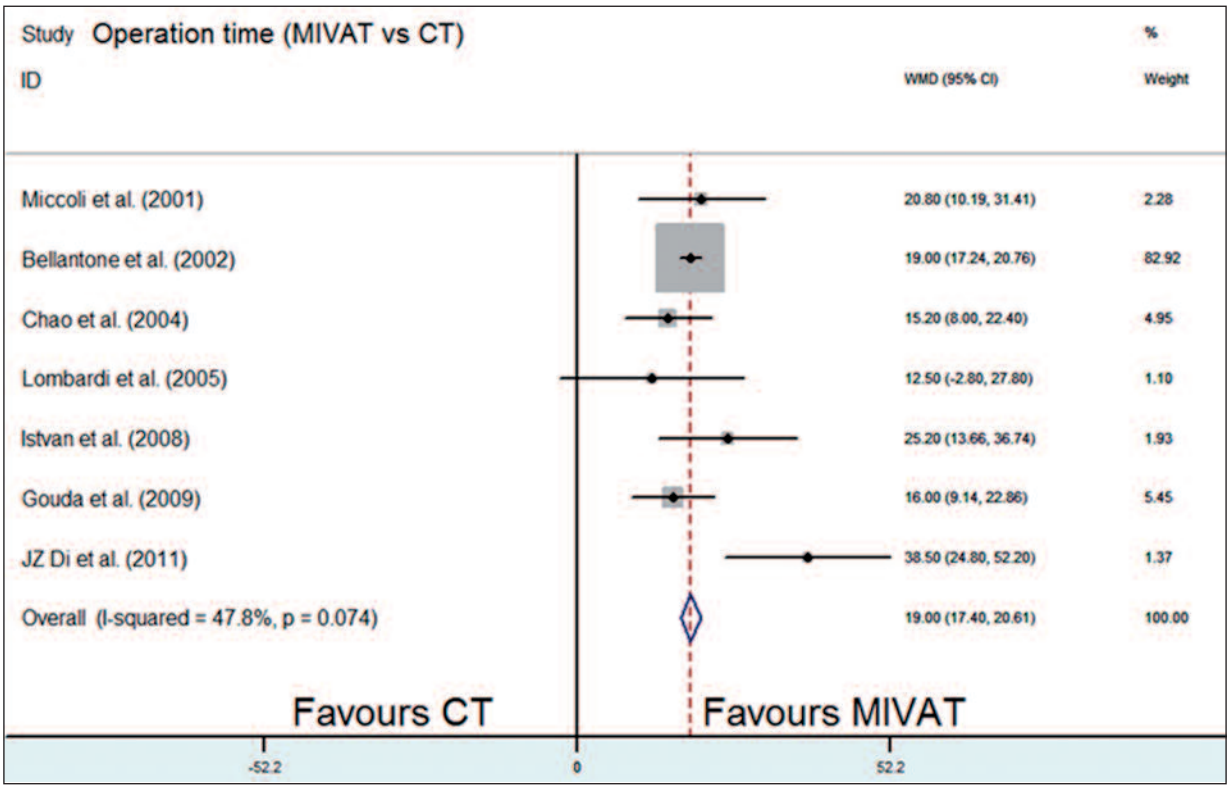

Figure 1. Meta-analysis of outcomes of operation time after MIVAT and conventional thyroidectomy (WMD, weighted mean difference; CI, confidence interval).

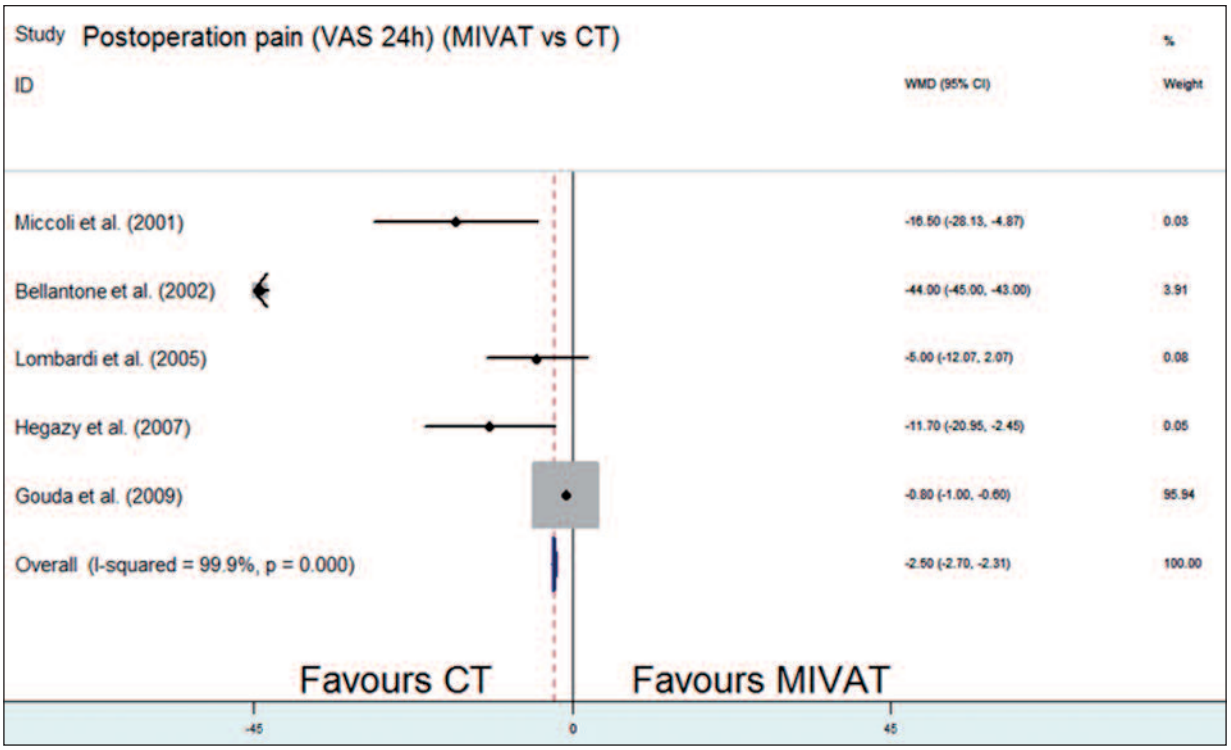

Figure 2. Meta-analysis of outcomes of postoperation pain (24 hours) after MIVAT and conventional thyroidectomy (WMD, weighted mean difference; CI, confidence interval).

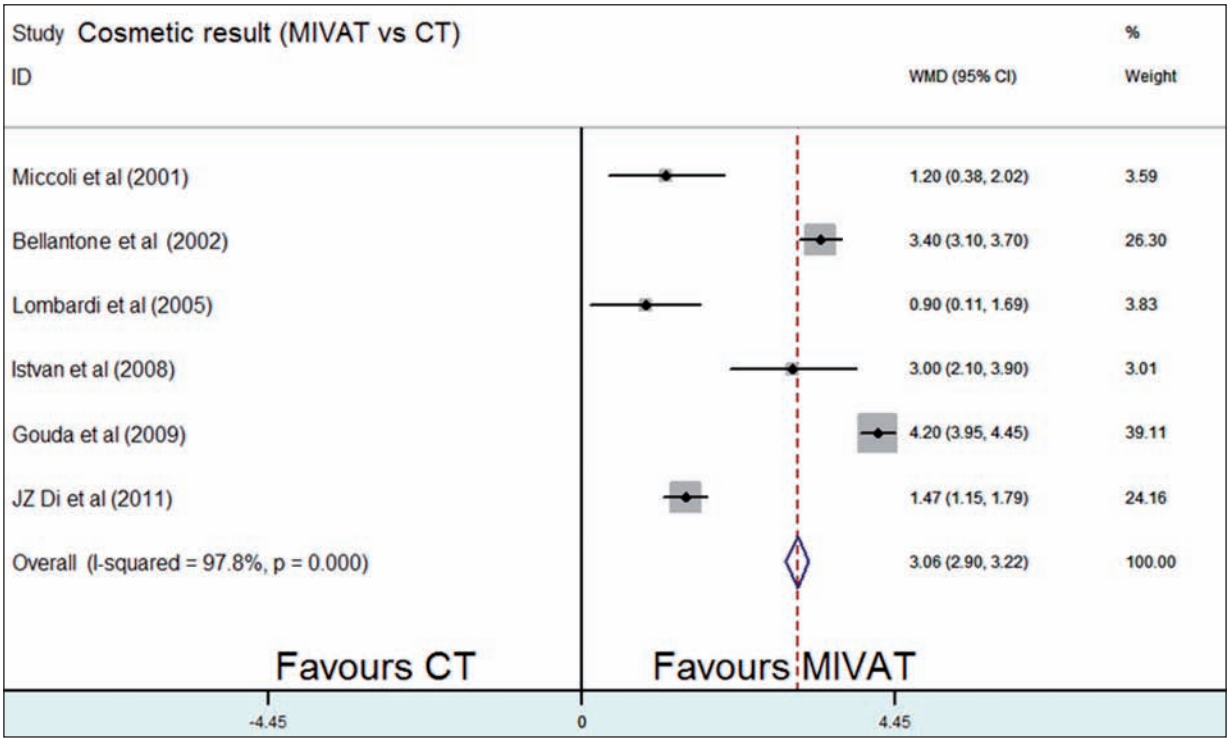

Figure 3. Meta-analysis of outcomes of cosmetic result after MIVAT and conventional thyroidectomy (WMD, weighted mean difference; CI, confidence interval).

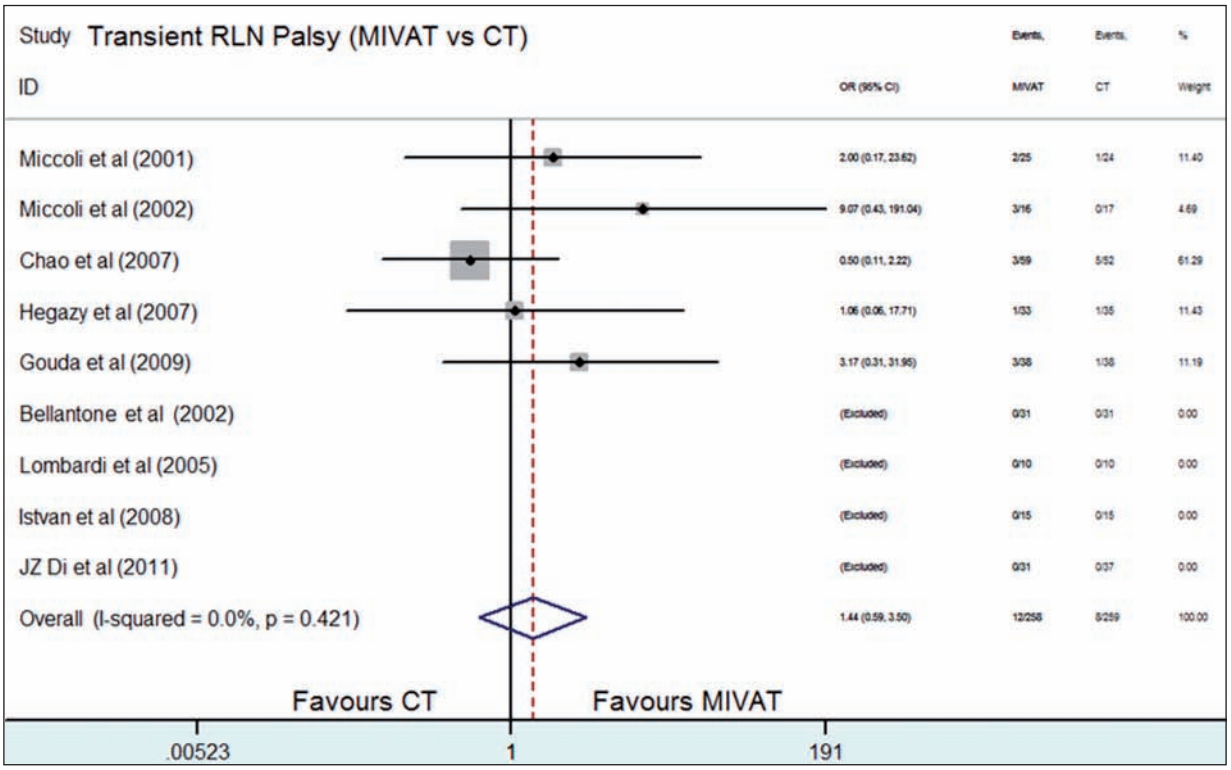

Figure 4. Meta-analysis of outcomes of transient recurrent laryngeal nerve palsy after MIVAT and conventional thyroidectomy (OR, odds ratio; CI, confidence interval).

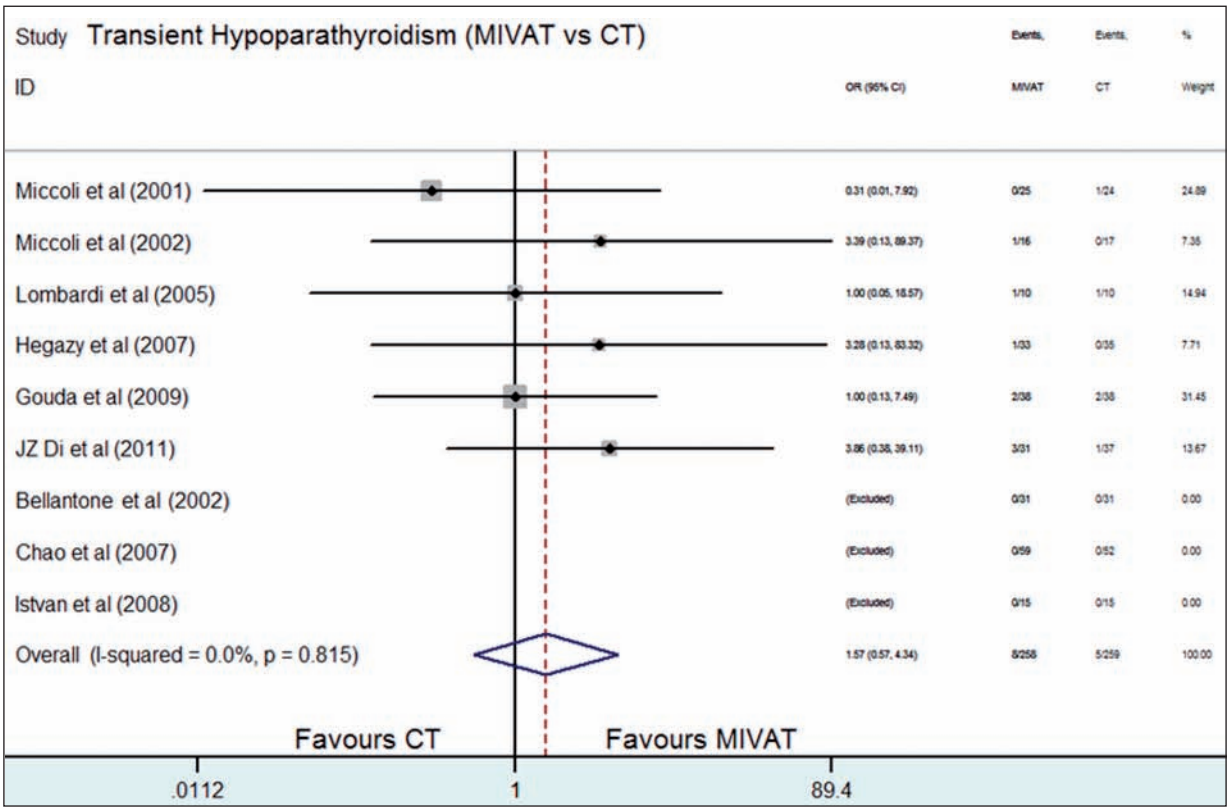

Figure 5. Meta-analysis of outcomes of transient hypoparathyroidism after MIVAT and conventional thyroidectomy (OR, odds ratio; CI, confidence interval).

Discussion

According to Miccoli's technique, the MIVAT was performed under general anesthesia orotracheal intubation with the patients been placed in a supine position. A 1.5-3.0 cm skin incision was made 2 cm above the sterna notch and the midline was exposed by retractors and a 30-degree endoscope was inserted in the skin incision. The operation procedure is similar to the established conventional thyroidectomy. Our meta-analysis is an updated true comparison of the MIVAT technique verses the conventional thyroidectomy.

The significant heterogeneity of the studies concerning operation time is possibly due to experience and technical evolution of the surgical instrumentation with MIVAT. The endoscopic thyroid surgery requires an adequate knowledge of anatomy, and a lot of experience in endocrine surgery and using endoscopic instruments. It also needs "learning curve" for the MIVAT procedure. According Di et al research[13], the probable reason for their long operation time is the operation method: ipsilateral total contralateral subtotal thyroidectomy and prophylactic central compartment node dissection.

The postoperative pain after surgery in 24 hours with MIVAT was lesser than with conventional thyroidectomy. It probably due to a number of factors as: the minimum skin incision, not dividing the strap muscles, less edema in the surrounding tissues, less trauma in surgery. Although postoperative pain was difficult to interpret as it was reported in units of standard deviation, the selected trials showed the result that patients prefer the MIVAT. Also, the small scar of MIVAT compared to the over 5 cm scar of conventional thyroidectomy improves the cosmetic scores.

With regard to the safety of MIVAT compared to conventional thyroidectomy pooled analysis of postoperative hypocalcaemia, recurrent laryngeal nerve palsy have shown no significant difference between the two groups. With respect to recurrent laryngeal nerve damage no cases occurred in arm of Bellantone et al, Lombardi et al, Istvan et al or Di et al. Considering postoperative hypoparathyroidism (hypocalcaemia), no cases occurred in either arm of Bellantone, Chao or Istvan. The risks of damage to the parathyroid glands and the recurrent laryngeal nerve are very low in conventional surgery, with the technique of enlarged images and

operation views for anatomic structures by endoscopy in MIVAT, the risk of recurrent laryngeal nerve or parathyroid glands damage should even less. The damage in MIVAT may probably due to experience in surgery and malignant thyroid tissues. Permanent recurrent laryngeal nerve palsy or postoperative hypoparathyroidism was not observed in all trials. Our research confirms that MIVAT is as safe as the conventional thyroidectomy. Only Di et al research showed long-term follow-up result for patients with "low risk" thyroid carcinoma and confirmed the safety.

Meta-analysis indicated that MIVAT was equal to conventional thyroidectomy outcomes but better cosmetic result. After more than a decade development of MIVAT, the number of the RCTs included is still small, which has limited the ability to compare the relative efficacy of the treatments.

Conclusions

MIVAT is a feasible, practical, and safe procedure with cosmetic benefit although it has the restriction of tumor size. MIVAT is a promising new technique for modern patients. The study still need large sample size and larger RCTs to prove the clinical practicability compared with conventional thyroidectomy.

Conflict of interest

The Authors declare that they have no conflict of interests.

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