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COMMENT

Happy 20th birthday to minimally invasive video-assisted thyroidectomy!

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On the 1999 December issue of *Journal of Endocrinological Investigation*, Paolo Miccoli preliminary reported the minimally invasive video-assisted thyroidectomy (MIVAT) [1]. Ten females and two males (mean age 37 years) with a cytological diagnosis of small microfollicular tumor (< 3 cm) were selected for MIVAT [1]. The procedures were successfully carried out through a 15 mm incision with fine instruments and a 5 mm endoscope [1]. Mean operative time was proper (85 min). No complications were registered.

The aim of MIVAT is resecting lesions in the thyroid gland with improved cosmetic outcomes [1, 2].

Today MIVAT continually allows surgeons to treat patients with benign and early malignant thyroid tumours using an endoscope [3].

The video assistance helps identify structures and minimises incision and dissection [4].

MIVAT is reported in clinical studies of endocrine surgery to provide beneficial effects including decreased

postoperative swallowing problems, better voice quality, less pain, faster recovery, and decreased incidence of wound-related complications, maintaining standard endocrine results such as the complication rate and procedure completeness [4].

MIVAT continues to be studied and questioned [5, 6].

Prior to the development of MIVAT, endoscopic thyroid surgery (ETS) was a haphazard affair for all surgeons. In the early days of laparoscopy and thoracoscopy, the value of these endoscopic techniques was unquestioned, but as these techniques were implemented, there were problems with the application of the endoscope in the neck: (a) no training was available for endoscopic surgery in the neck; (b) how to reach the neck structures visualised by the endoscope; (c) potential novel risks and complications related to gas insufflation in the neck; (d) the absence of a natural neck space and cavity; (e) instruments were not optimised for the ETS environment; (f) dissection and removal of the thyroid gland, (g) cutting vessels; and (h) bleeding control.

Miccoli developed an alternative endoscopic technique, and benefits that were obvious with the method were realised and patients were satisfied [1]. Nonetheless, Miccoli developed instruments and programmes to assess MIVAT skills and technical knowledge and prepared surgeons to introduce MIVAT techniques into their practise (Fig. 1).

Consequently, MIVAT principles have been transferred to novel and old techniques (Table 1). De facto, MIVAT has enabled surgeons to develop and safely apply novel endoscopic procedures, refining conventional open thyroid and parathyroid surgery.

MIVAT significantly influenced the field of open thyroidectomy and parathyroidectomy. For example, the MIVAT small (1.5 cm) incision has been transferred to the daily routine practise of open thyroidectomy. The surgeon no longer performs a neck incision that goes from ear to ear.

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Fig. 1 MIVAT is a reproducible, multi-institutional procedure. More than 100 centers from 35 countries applied the technique. There are training centers in Europe, Asia, USA and Latin America (Data set from personal communications and PubMed)

Occasional use of Kocher's long wound, rather than Miccoli's discrete, minimally invasive incision ETS use in endocrine surgery continues to expand and be of interest for surgeons in the minimally invasive surgical era. For two decades, studies focused on different types of approaches (that is, retro-auricular, trans-oral, axilla, areola, hybrid, and trans-trachea), their feasibilities, morbidity and mortality, learning curve, short- and long-term outcomes, oncologic concerns, indications and contraindications, and related technology [7].

Different ETS techniques have gained popularity and become the standard approach for resecting primarily early stage carcinomas of the thyroid, indeterminate nodules, gland volume goitres (<45 mL), RET carriers, and parathyroid adenomas [7]. Additionally, some patients request ETS due to its perceived aesthetic results [1–7].

As with all new procedures, the surgical community was slow to adopt ETS due to its cost, its perceived difficulty, and its limited use in general endocrine and head and neck surgery. Nonetheless, after many years of practise and robust clinical studies, ETS has attracted the interest of surgeons who prefer to treat some of their patients using an endoscope.

Furthermore, specialised robotic equipment enables surgeons to access lesions in the thyroid with improved exposure, sparing patients more complex procedures.

How did this happen?

MIVAT was/is the example, especially in shrewd patient candidacy and strengthening collaboration with endocrinologists.

MIVAT principles for patient selection exclusion criteria have been naturally translated to all novel ETS techniques offered (Table 2). The same principles for patient candidacy described in the December 1999 issue of the Journal of Endocrinologist Investigation are still applied to date by most ETS approaches [1].

MIVAT includes essential patient selection for preoperative ETS planning, with a focus on reviewing patient- and thyroid disease-specific characteristics involved in the selection process, preparation for surgery, complications, and outcomes. Miccoli detailed the novel use of cytology, ultrasound (US), biochemical tests, and genetics to select ETS patients [1–6, 8].

The MIVAT patient selection criteria enable the endocrine surgeon to assess the possible risks of potential problems encountered in the peri-operative period for ETS.

Patients must undergo imaging to better characterise the lesion. Imaging includes thyroid gland volume, dominant nodule size, side and position, lymph node status, and US signs of thyroiditis. Similar biochemistry tests are also conducted to exclude thyroiditis. Genetics has also been used to identify RET gene mutation adult carriers for MIVAT and central compartment node clearance [6].

Table 1 Merits of minimally invasive video-assisted thyroidectomy (MIVAT)

Merits of MIVAT	Concept translation and implementation into open/endoscopic/robotic
Smaller neck incision for thyroid and parathyroid open, conventional surgery	O
Place an endoscope in the neck.	E/R
Thyroid, parathyroid glands, RLNs visualized from a TV screen	
Reproducible, clear patient selection and exclusion criteria	E/R
Standardized, step by step operation.	E/R
Endoscopic identification of anatomy and exposure of RLNs, and parathyroid glands	
Proper operative room setting, monitor placement and ergonomics	E/R
Feasibility	E/R
Safety	O/E/R
Cosmesis	O/E/R
Maintenance of standard endocrine results and morbidity	E/R
Truly minimally invasive surgery concept	E/R
Multi-istitutional, both academic and non-academic centers	E/R
Replaced some open thyroid and parathyroid procedures	E/R
Procedure of choice for diagnostic thyroid and parathyroid surgery (i.e., Bethesda III nodule, etc.)	E/R
Combines both thyroid and parathyroid gland disease	E/R
Describe how to manage endoscopically intraoperative and postoperative complication	E/R
Edit oncological concern	E/R
Introduction of technology into the neck (i.e., endoscope, clips, energy-based devices) commonly applied in laparoscopy	E/R
Gas-less procedure	E/R
Cost of hospitalization, hospital stay, pain, swallowing and voice disorders and recovery significantly reduced	E
Enhanced performance skills	O/E/R
Enhanced novel instrumentations	O/E/R
Availability of dedicated, proper instrumentation	
Personnel can be trained in endoscopy	E/R

Miccoli's technique has the excellence of being an example for both open and minimally invasive procedures of the endocrine neck, for both direct and remote endoscopic access. Principles of MIVAT have been successfully transferred and applied to most of endoscopic and robotic platforms

O open surgery, *E* endoscopic surgery, *R* robotic surgery, *RLN* recurrent laryngeal nerve, *MIVAT* minimally invasive video-assisted thyroidectomy

The selection base could then be subsequently enlarged, absolute and relative selection criteria were highlighted, and new indications and more complex interventions were added over time with surgical experience and the refinement of technology [9–11].

Although these selection modalities were acceptable, Miccoli proposed a strict revision of patient candidacy with endocrinologists according to the guidelines before surgery [1–6, 8].

MIVAT was/is a truly international platform for the exchange of scientific knowledge, safe development of new endocrine technologies, and education, which is reflected by its global application and the patients it serves worldwide (Fig. 1).

We think that the combination of MIVAT principles and good clinical practise will meet the future requirements and further contribute to the growth of endocrine surgery.

Table 2 MIVAT derived original criteria for ETS patient candidacy

Test	Detail assessment for ETS
Clinical examination	Previous surgery Previous neck irradiation Obese patients Clinically apparent nodal involvement
Ultrasound	Thyroid gland lobe size Thyroid gland volume No significant substernal extension Dominant nodule side Nodule size Sign of thyroiditis No evidence of lymph node metastases
FNA cytology	Benign lesion Bethesda III, IV Solitary well-differentiated malignant lesions
Biochemistry	Hyperthyroidism
Genetics	RET carriers

Miccoli has identified five important features (clinical examination, US, cytology, biochemistry and genetics) to select Patient for MIVAT. The same issues have been adopted to all ETS

MIVAT minimally invasive video assisted thyroidectomy, *ETS* endoscopic thyroid surgery, *RET* rearranged during transfection, *FNA* fine needle aspiration, *US* ultrasound imaging

Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to declare.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent This paper did not involve patients.

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