Editorial

Cost-effectiveness of intraoperative neural monitoring in thyroid surgery: comment on "*Analyzing cost-effectiveness of neural-monitoring in recurrent laryngeal nerve recovery course in thyroid surgery*"

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Comment on: Wang T, Kim HY, Wu CW, *et al.* Analyzing cost-effectiveness of neural-monitoring in recurrent laryngeal nerve recovery course in thyroid surgery. Int J Surg 2017;48:180-8.

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I read with interest the article by Wang and colleagues "*Analyzing cost-effectiveness of neural-monitoring in recurrent laryngeal nerve recovery course in thyroid surgery*", published in the *International Journal of Surgery* (1). The authors analyzed the cost-effectiveness of intraoperative neural monitoring (IONM) in thyroidectomy using a Markov decision model. They concluded that IONM is cost-effective when the rates of recurrent laryngeal nerve (RLN) palsy reach 38.5% (1). This is almost impossible in a clinical setting, implying that IONM is not currently cost-effective.

IONM of the RLN in thyroidectomy has been employed worldwide as an addition to direct visual identification, with the introduction of a noninvasive neural monitoring device. New surgical technologies can lead to increases in healthcare costs, and the additional cost of IONM creates concern from a societal perspective. However, only a few studies have addressed the issue of the cost of IONM (2,3). In fact, the IONM technique can hardly be cost-effective when only the direct costs of IONM are taken into account, although the cost per procedure decreases with increasing use (4-6).

Rocke *et al.* analyzed the cost-effectiveness of IONM of the RLN using a decision-tree model in three groups: routine use of IONM; selective use of IONM for high-risk patients including reoperations, substernal goiters and thyroid cancer; and visual identification of the RLN only, without IONM (2). In the results, the visual identification of the RLN without IONM was more cost-effective than routine or selective use of IONM. Direct visual identification of the RLN resulted in savings of $179.4 and $683.2 per patient, and led to an improvement of 0.001 and 0.004 in quality-adjusted life-years, over selective and routine uses of IONM, respectively (2). In addition, if a surgeon can reduce the rate of vocal fold palsy (VFP) by 50.4% or more using IONM, compared to direct visual identification, then the selective use of IONM in high-risk patients would be the most cost-effective option (2). However, this is also impossible in reality.

It is still controversial whether use of IONM can reduce the rate of RLN injury in thyroid surgery. Some meta-analyses studies demonstrated the benefits of IONM in reducing the incidence of overall and transient VFP, compared to direct visual identification (7-9). In particular, Wong *et al.* demonstrated significant reduction in both overall and transient VFP, in high-risk patients undergoing re-operation or those with malignancy or retrosternal goiter (9). The only randomized controlled trial (RCT) study, done by Barczyński *et al.* from a large Scandinavian database, demonstrated a significant reduction in transient VFP with IONM use (10). However, the meta-analysis

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done by Pisanu *et al.* reported that intermittent IONM did not provide significant reduction in postoperative VFP (11). The meta-analysis done by Higgins *et al.* also failed to show a statistically significant difference in the rate of VFP between IONM use and visual identification alone during thyroidectomy (12).

The reason for these contradictory results may be that numbers of patients involved and nerves at risk were not adequate to detect a statistically significant difference, due to the relatively low rate of RLN injury. Further studies with larger sample size are necessary to come to a clear conclusion. Dralle *et al.* suggested that several million patients would be necessary in order to have adequate statistical power to analyze small differences in the rate of RLN injury in thyroidectomy (13). Thus, achieving an adequate sample size in an RCT study, and especially in a single-center study, might be impossible.

Recently, Al-Qurayshi *et al.* also evaluated the cost-effectiveness of IONM using a Markov chain model, in a setting of bilateral thyroid surgery (3). In the results, the incremental cost-effectiveness ratio between the use and non-use of IONM was US $46,427 per quality-adjusted life-year. It is below the proposed willingness-to-pay, indicating that IONM is the cost-effective procedure (3). Also, a Monte Carlo simulation test in a hypothetical sample showed IONM to be the preferred procedure in 85.8% of the population (3). Therefore, the authors concluded that using IONM is cost-effective in patients undergoing planned bilateral total thyroidectomy, as a result of the avoidance of bilateral RLN injury through staged thyroidectomy.

In fact, it is very difficult to analyze the cost-effectiveness of IONM in thyroidectomy considering all factors influencing the procedure and its outcomes. A circumstantial analysis of the costs of IONM should include not only the direct costs but also the indirect costs associated with RLN palsy, such as rehabilitation costs including speech therapy, phonosurgery, and economic compensation for legal claims. The impact of the surgeon's experience with IONM and intraoperative time should also be considered. Moreover, the cost-effectiveness can depend on the culture, economy, social system, and health care system of different countries.

The Merriam-Webster dictionary defines 'cost-effective' as producing good results without costing a lot of money. Mosby's medical dictionary defines it as "the minimal expenditure of dollars, time, and other elements necessary to achieve the health care result deemed necessary and appropriate". Economic evaluation in healthcare is based on two factors, namely, the cost itself and the outcome of the activities. In order for a new surgical technology to be cost-effective, additional costs need to be balanced by demonstrable benefits that can either improve surgical outcomes, functional outcomes, and survival rate, or reduce long term associated costs.

"Cost-effective" does not always mean "cheapest" (14). It might be cost-effective if a new technology is either less costly and more effective, or costlier and more effective, than the competing ones.

In fact, there are several benefits of IONM that cannot be quantitatively measured, despite the additional cost of the IONM procedure compared to the visual identification. IONM in thyroid surgery helps to identify the nerve, map its course during the dissection, diagnose the type of RLN injury and improve surgical technique, and predict postoperative RLN function before concluding the procedure (15). In addition, it provides the concept of staged thyroidectomy in case of loss of signal on one side, in order to prevent bilateral VFP. Another advantage of IONM is the decrease in medicolegal liability, given the major concern legal issues have recently become.

In addition to intermittent IONM, continuous IONM might avoid impending nerve injury by detecting signal changes indicating traction injury or compression injury, although it is costlier than intermittent IONM.

In conclusion IONM in thyroid surgery currently seems not to be cost effective, compared with conventional direct visual identification of the RLN, if only the direct costs and a part of the indirect ones are considered. However, IONM might be cost effective if additional benefits are taken into account, such as the surgeon's comfort in identifying and confirming the RLN, and the prediction of nerve function, even if it is costlier than visual identification in terms of quantifiable costs.

Acknowledgments

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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