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Impact of surgical volume and surgical outcome assessing registers on the quality of thyroid surgery

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The available evidence concerning the relationship between volume and outcome for thyroid surgery is assessed in this article. Morbidity forms the principal surrogate marker of thyroid surgery quality for which postoperative hypocalcaemia and recurrent laryngeal nerve injuries are most commonly reported upon. Whilst there is an abundance of published data for these outcomes, interpretation to recommend annual volume thresholds is challenging. This is due to a lack of consensus on definitions not only for outcomes but high and low volume surgeons. The evidence reviewed in this article supports the notion that high volume surgeons achieve superior outcomes in thyroid surgery quality though it is not possible to recommend minimal annual volumes on the basis of this evidence alone. Every thyroid surgeon should know their own outcomes and how they compare with their peers and engagement in thyroid surgery registries can facilitate this.

Introduction

Thyroid surgery is most commonly performed for thyroid cancers, benign disorders such as symptomatic goitres, autoimmune disorders, recurrent cysts as well as diagnostic procedures for

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indeterminate thyroid nodules. Advancement and accessibility to radiological imaging, as with screening programs, has generated a rise in the incidence of thyroid nodules and detection of thyroid cancer. This has resulted in higher rates of thyroid surgery which is expected to continue to rise [1].

In the middle of the nineteenth century the mortality for thyroid surgery approached 40%, mainly secondary to haemorrhage. Theodore Kocher transformed the outcomes of thyroid surgery using a combination of understanding of physiology, meticulous surgical technique and a thorough knowledge of his outcomes. By 1898 his mortality was 0.18% and his work in thyroid surgery earned him the Nobel prize in 1909 [2].

Despite modern day thyroid surgery utilising novel minimally invasive approaches and surgical adjuncts, it is not without morbidity although this rate is extremely low at (0.03–0.08%) [3]. Morbidity is inherent in technical aspects of the operation and heightened by the degree of surgery (total thyroidectomy replacing near total thyroidectomy and nodal dissection for cancers) and pathology (autoimmune disease and locally invasive malignancies). Morbidity is used as the surrogate marker of quality indicators in thyroid surgery, which we discuss later.

Since the pivotal paper published several decades ago in the NEJM investigating hospital outcomes and advancing an argument for centralisation of services [4] there has been an exponential rise in the published literature across all surgical specialities comparing outcomes with surgeon and institution volume. This largely advocates that specialisation and high volume leads to improved patient outcomes, efficient service provision and cost effectiveness with thyroid surgery being no exception [5]. Over 20 years ago Sosa et al. showed in a multicentre retrospective study that high volume surgeons had the lowest complication rates [6]. The paper suffers from the same limitations as many – it relies on coded data and the groupings into categories of volumes are arbitrary and inconsistent. Many other studies have suggested that quality of thyroid surgery depends on the experience of the thyroid operating surgeon. However, there is currently no consensus on the minimum number of operations per type of thyroid disease and per annual caseload of the individual surgeon in order to decrease the intra- and postoperative complication rate. The aim of this chapter is to summarise the current data about the requirements for minimum numbers to treat and methodological instruments in terms of outcome assessing registers to improve the quality of thyroid surgery.

We will review the literature on thyroid surgery volume and quality. As length-of-hospital stay is a surrogate maker for all complications (surgery and non-surgery related) we have focussed on the evidence regarding postoperative hypocalcaemia and recurrent laryngeal nerve (RLN) injury.

Measurements of thyroid surgery quality

The 2013 NHS report 'quality in the health system' defines quality as "care that is effective, safe and provides as positive an experience as possible" [7]. In the field of thyroid surgery various outcome measures and surrogate markers of thyroid surgery quality are reported in the literature. Broadly, these can be categorised as patient or hospital associated factors. Patient related factors include hypocalcaemia, recurrent laryngeal nerve injury leading to a voice/swallowing difficulties/tracheostomy, bleeding, quality of life and mortality. Hospital and economical outcomes include length of hospital stay, return to the operating theatre and cost of admission. Furthermore, In malignancy oncological outcomes are also used which include: overall survival, recurrence of disease, postoperative radioactive iodine uptake and lymph node harvest [8].

Two sources of data can be used to reach conclusions about volume and outcome; surgical registries and clinical trials. A registry is defined as a systematic collection of a clearly defined set of health and demographic data for patients with specific health characteristics, held in a central database for a predefined purpose [9]. Compared to clinical trials, registries strive to include the whole population with a certain disease or operation without any selection criteria. The disadvantage of this form of research is that the number of variables measured is small compared to clinical trials. On the other hand, clinical trials are often set in one institution and are open to publication bias – that is to say poor outcomes may not be published.

Hypocalcaemia/hypoparathyroidism

Clinical or biochemical post operative hypocalcaemia is a regularly reported outcome measure after thyroidectomy. It can result from damage to the parathyroid blood supply, intraoperative trauma or their inadvertent excision. All of these are influenced by the surgical approach and technique [10]. Post-operative hypocalcaemia can be transient with normocalcaemia returning within 6 months of surgery, or permanent (secondary to hypoparathyroidism) requiring life long supplementation with calcium and vitamin D [11]. However, interpretation is hampered by incomplete data entry and variation in practice. Furthermore, there is no agreed consensus on the definition of this complication which hinders interpretation the interpretation of published epidemiological data on postoperative hypocalcaemia [12].

Recurrent laryngeal nerve injury

Recurrent laryngeal nerve injury is the second commonly reported outcome measure that can delineate quality in thyroid surgery. Due to the close proximity of the nerve to the thyroid gland, the nerve is at risk of iatrogenic injury from stretching, thermal injuries, lacerations, crushing, and devascularisation leading to ischaemia [13]. However other operative factors such as damage to the external branch of the superior laryngeal nerve, cricothyroid muscle, inflammation, laryngeal oedema, trauma from intubation can all lead to vocal cord dysfunction [13].

Nerve injury results in vocal cord paralysis that can be transient or permanent. Injury can also cause other symptoms ranging from voice fatigue, difficulty swallowing, aspiration and, for bilateral injuries, the requirement for tracheostomy. These complications can result in loss of quality of life, loss of employment and further interventions to correct vocal cord palsies. Identifying nerve injury can be performed with postoperative laryngoscopy. However, the use of laryngoscopy is variable amongst surgeons and hospital units and is not standardised in whether it should be performed or the time frame for its performance.

Bleeding/haemorrhage

Postoperative bleeding/haemorrhage is a rare and feared event after surgery that is multifactorial in aetiology. The British Association of Endocrine and Thyroid Surgeons (BAETS) 5th audit report reports a rate of 1% that has not changed over years [14]. Bleeding poses a significant risk of death and hypoxic brain injury. It is a well-reported outcome measure in thyroid surgery but the outcome of the event of bleeding itself and subsequent impact on the patient is rarely reported in studies.

Mortality

Postoperative mortality after thyroid surgery is a rare occurrence. The BAETS audit report an incidence of 0.1% over a 5-year period [14]. Due to the infrequency of this outcome it is unlikely that surgeons would attain a volume of surgery through their career high enough to detect a mortality rate greater than five times the national average (indicating divergent practice) and thus performance within an expected mortality rate can not be considered proof of satisfactory performance [15].

Surgical volume impact on hypoparathyroidism/hypocalcaemia

Surgeon volume

The largest studies comparing volume and outcome in thyroid surgery emanate from retrospective cross-sectional studies from the United States using the Nationwide Inpatient Sample (NIS) discharge database. Loyo et al., analysed 871,644 patients over a 15-year period for all ablative procedures [16]. These consisted of isthmusectomy or partial thyroidectomy, unilateral lobectomy, complete thyroidectomy, other (unspecified) operations on thyroid glands, substernal thyroidectomy, including partial or complete substernal thyroidectomy, and neck dissection. Hypocalcaemia was determined by

International Classification of Diseases (ICD) codes from patient discharges and was restricted to the index hospital admission only. Therefore, only capturing immediate follow-up data leading to potentially under diagnosing hypoparathyroidism, which would require lengthier follow up. A high volume surgeon was defined as those who were above the 80th percentile of cases performed per annum. The study reported postoperative hypocalcaemia was significantly less likely for intermediate-volume surgeons (performing 9–23 thyroidectomies per year) and high-volume surgeons (performing more than 23 thyroidectomies per year). Adjusting for hospital volume, high volume surgeons had a significantly lower odds ratio (OR) of 0.7 (0.57–0.88) for postoperative hypocalcaemia compared with those that were not high volume. Furthermore, high volume hospital care (defined as greater than 76 thyroidectomies per year) was associated with significantly reduced risk of postoperative hypocalcaemia, OR 0.62 (0.48–0.80).

Remaining with the NIS data, Kandil et al. investigated 46,261 patients over a 9-year period that underwent total thyroidectomies only [17]. High volume surgeons (defined as those performing more than 99 thyroidectomies per year), had a significantly lower incidence of postoperative hypocalcaemia at 4.7% compared to 9.4% in intermediate volume (10–99 thyroidectomies per year) and 12.1% in low volume (<10 thyroidectomies per year). Hauch et al., over a 6-year period of 62,722 unilateral and bilateral thyroid procedures found high volume surgeons (more than 99 thyroidectomies per year) had a hypocalcaemia incidence of 9.3% which was significantly lower compared to 12.1% and 13.7% in the intermediate (10–99 thyroidectomies per year) and low volume surgeon group (<10 thyroidectomies per year) respectively [18].

Interestingly there is a lower incidence of hypocalcaemia in the total thyroidectomy study group [17] in comparison to the total/unilateral thyroidectomy study group [18].

Using the Maryland Health Service Cost Review Commission dataset, Gourin et al. investigated variables associated with high volume care in 21,270 patients over a 19-year period and found the incidence of postoperative hypocalcaemia was 10% in patients undergoing total thyroidectomy [19]. High volume surgeons (>24 thyroidectomies per year) were 38% less likely to have recorded hypocalcaemia than those that performed fewer operations, which was significant. Interestingly, the authors report no significant association of postoperative hypocalcaemia when assessed for hospital volume (greater than 100 thyroidectomies per year vs. less than 100). Furthermore, Weiss et al. reported on 106,773 patients undergoing thyroidectomy and found that teaching hospitals (with residency programmes) had a significant 30% lower rate of hypocalcaemia than non teaching hospitals [20]. However, there was no association with postoperative hypocalcaemia and high volume hospitals (>100 per year).

In Californian centres, Meltzer et al. investigated postoperative hypocalcaemia within 30 days from a dataset of 8332 patients [21]. Comparing propensity matched patients undergoing going total thyroidectomy they found that surgeons performing 40 or more total thyroidectomies per year had a significantly lower rate of postoperative hypocalcaemia than those performing less than 20 thyroidectomies per year (4.9% vs. 7.0%, $p < 0.05$).

In the UK, Nouraei et al., studied 72,594 patients from a hospital administrative dataset spanning over 8-years [22]. They investigated in-hospital hypocalcaemia as well as hypocalcaemia post discharge if identified during a subsequent admission. The in-hospital hypocalcaemia incidence was 2.05% overall and was an independent risk factor in relation to surgeon volume, where surgeons performing over 75 thyroidectomies a year were 37% less likely to have postoperative hypocalcaemia. Interestingly post discharge hypocalcaemia incidence was less at 1.58% and there was no evidence of an association with surgeon volume reported. The low incidence could be explained by the reflection of recovering temporary hypoparathyroidism or biases in the methodology of identifying postoperative hypocalcaemia within the study due to its retrospective design.

Hospital volume

The evidence for an association with hypoparathyroidism and hospital volume is weak. Surgeon volume appears to be more significant with risk reduction than hospital volume. Rural and non teaching hospitals do appear to have higher rates of postoperative hypocalcaemia in North America with high volume surgeons tending to be saturated in teaching and urban hospitals [17,20].

How does volume impact on hypocalcaemia in autoimmune disease?

Multiple studies have shown that autoimmune disease, specifically Graves' disease, is associated with higher rates of hypoparathyroidism. The majority of volume outcome studies adjust for thyroid pathology in their analyses. Kandil et al., observed that Graves' disease was a significant predictor for all cause postoperative complications for low and intermediate volume surgeons that was not observed in high volume surgeons preforming greater than 100 thyroidectomies per year [23]. In a national multicentre German study of 5846 patients, Thomush et al., reported high volume surgeons (10–50 procedures per year) treated significantly more patients with Graves' disease compared to low volume surgeons (<10 procedures per year) but had comparable rates of both early and permanent post-operative hypoparathyroidism [24], suggesting that high volume surgeons would have had a lower incidence of postoperative hypoparathyroidism if the pathology was similar in both of the surgeon volume groups.

How does volume impact on hypocalcaemia in malignant disease?

The majority of thyroid volume outcome studies report hypocalcaemia rates for surgeon volumes adjusted for thyroid diagnosis including cancer and for extensiveness of operation including nodal neck dissection. Adkinsson et al., examining differentiated thyroid cancer greater than 1 cm, identified no difference in permanent hypoparathyroidism between high (>30 thyroidectomies per year) and low volume surgeons (29 and less thyroidectomies per year) [25]. There do not appear to be other studies reporting on volume outcomes for the subset group of patients with thyroid cancer and hypo-calcaemia/hypoparathyroidism. As the studies described above have largely adjusted for diagnosis of cancer and neck dissection it would appear the available data suggest that hypocalcaemia rates for malignant diagnoses are lower in high volume surgeons.

Surgeon experience

Surgeon experience also appears to be an important factor that influences post operative outcomes. Duclos et al. investigated surgeon experience and found inexperienced surgeons and surgeons with 20 years or more experience are associated with hypoparathyroidism OR 7.56 (1.79–31.99) [26]. They reported a surgeon's experience had a concave association with their performance and those aged 35–50 years provided the safest care.

How does surgeon and hospital volume impact on post thyroidectomy hypocalcaemia?

Interpreting the data from the literature is hampered by the variations in definitions and the quality of the data analysed. There is often heterogeneity to the pathology for which a thyroidectomy is performed, for example combining multinodular goitre with Graves' disease which is known to independently alter the risk of hypoparathyroidism [24]. The large North American discharge datasets mostly collect data on immediate hypoparathyroidism. However, this is a much weaker outcome metric compared to long-term permanent hypoparathyroidism [27]. First time bilateral thyroidectomy in the BAETS dataset ($n = 8000$) showed a variation in late hypocalcaemia and a significance difference between surgeons with surgical performance likely being a contributing factor [28].

From the studies presented above it is clear that a relationship exists between surgeon volume and postoperative hypocalcaemia. Autoimmune disease, malignancy and nodal neck dissection are all associated with hypocalcaemia but this occurs less frequently in high volume practice. However, the literature does not stipulate a minimum number of operations per surgeon due to the hetero-geneity of the studies where the minimum number ranges from anywhere between 23 and 99 cases per year.

Surgical volume impact on recurrent laryngeal nerve injury

Surgeon volume

There are numerous studies in the literature examining the effect of surgeon volume on RLN injury in thyroid surgery although the time of assessment and definition of injury are inconsistent. The largest studies again emanate from the North American NIS discharge data. Loyo et al. reported that surgeon volume, with those performing more than 23 thyroidectomies per year, is associated with a lower incidence of RLN injury [OR = 0.7, p = 0.024] [16]. This was also supported by the work of Gourin et al. who reported that high volume surgeons (>24 per year) had lower rates of RLN injury (OR 0.46 0.28-0.75 P = 0.002) [19]. The incidence of RLN injury in this study was 1%. Al-Qurayshi et al., showed that although low volume surgeons (56 thyroidectomies or less per year) were more likely to use intra operative nerve monitoring, there was a higher risk of vocal cord palsy associated with low volume surgeons [29]. Kandil et al., reported an incidence of RLN injury of 1.23% in 46,261 patients undergoing total thyroidectomy only [17]. They observed that volume of thyroidectomy per year did not make a significant difference to hoarseness of voice but did for vocal cord palsy between volumes of <10, 10–99 and > 100 total thyroidectomies per year. Hauch et al. showed that there were more RLN injuries in patients undergoing total thyroidectomy compared to those with unilateral surgery which is most likely explained by doubling the "number of nerves at risk" from bilateral thyroid surgery [18]. Examining complications in total thyroidectomies alone they reported that although total thyroidectomy was associated with significantly higher risk of all complications compared to thyroid lobectomy even amongst high volume surgeons, the incidence of vocal cord paralysis and hoarseness of voice were surprisingly not significantly different in low volume (<10 thyroidectomies per year), intermediate volume (10–99 thyroidectomies per year), and high volume (>99 thyroidectomies per year). Meltzer et al., also reported there was no significant difference for vocal cord palsy being detected in the first 30 days post operatively in their propensity match study of Californian patients for both hemi thyroidectomies and total thyroidectomies if performed by surgeons with more than 40 cases per year compared to those with 20 or less cases per year [21].

From English administrative data Nouraei et al., found a vocal palsy incidence of 1.87% for 72,594 patients undergoing thyroid surgery over an 8-year period [22].

This study attempted to identify RLN injury by recording clinical activity acting as a surrogate to nerve injury such as visiting a speech and language therapist and episodes of surgical procedures for vocal cords post operatively. Surgeons performing more than 30 thyroidectomies per year were found to be protective of RLN injury. Surgeons performing between 10 and 19 thyroidectomies per year were also associated with fewer injuries but there was a peak of injury identified in the volume group performing 20–29 thyroidectomies per year. This was also observed in the BAETS data, where there was an increase in median RLN palsy rate between surgeons performing <25 annual cases and those performing 25–50 annual cases [30]. This perhaps implies there is a potential secondary learning curve for complex cases or surgeons undertaking <25 annual cases have selective surgical practices.

In the UK, the Registry of endocrine surgery has accumulated over 80,000 operations [14]. Despite a recommendation that all patients undergoing thyroid surgery should have a preoperative vocal cord check, the variation in practice ranges between 0 and 100%. The data clearly demonstrates that the recorded recurrent laryngeal nerve palsy rate is proportional to the rate of flexible laryngoscopy. The overall palsy rate is currently 1% and this is likely to be a significant under-reporting. Nevertheless, the data from this surgeon self-reported dataset has shown the median rate of RLN palsy fell from a median of 4.4% in surgeons performing less than 50 cases per year to 2.6% in those performing more than 100 cases per year [30]. When assessing only cases where laryngoscopy was routinely performed the risk fell from 6.25% in surgeons performing less than 50 cases per year to 3.4% in those performing more than 100 cases per year [30].

Hospital volume

Weiss et al., showed that high hospital volume in Californian hospitals (at least 100 thyroidectomies per year) was associated with lower rates of postoperative voice change (OR 0.4, 0.3–0.8) but does not

significantly lower rates of vocal cord paralysis (OR 1.0, 0.8–1.4) [20]. A teaching hospital status was however an independent predictor of risk of vocal cord paralysis (OR 1.5, 1.1–2.0). Gourin et al. also did not find an association of RLN injury and high volume hospitals (>100 per year) from NIS data [19]. In Germany, Dralle et al reported RLN injury rates of 0.72% for surgeons performing greater than 45 nerve-at-risk procedures per year compared with 1.06% in those with less than 45 nerve-at-risk per year ($p = 0.003$), with both groups having similar surgery types and pathology [31]. Low and medium size hospital was also a risk factor with OR 1.3.

How does volume impact on recurrent laryngeal injury in malignant disease?

It is well reported in the literature that nodal neck dissection is an independent risk factor for recurrent laryngeal nerve injury. In patients undergoing total thyroidectomy or completion thyroid surgery for DTC greater than 1 cm, Adkisson et al. found that RLN paralysis was significantly less in surgeons performing 30 thyroidectomies or more per year compared with those who perform fewer with the incident of recorded injury was 1.3% [25].

How does surgeon and hospital volume impact on post thyroidectomy recurrent laryngeal nerve injury?

A significant limitation with cross sectional databases looking at short-term discharge data is that the incidence of true nerve injury is likely to be underreported, as they are not clearly detected in a consistent manner. This is likely due to the fact that it is not standard practice for patients to undergo postoperative laryngoscopy in all institutions. The incidence of nerve injury may be higher in patients that have laryngoscopy at institutions where this is not standard practice, as these patients may have a clinical suspicion of nerve injury. The BAETS audit data has shown that the incidence of RLN injury is significantly increased by an OR of 9.8 when routine laryngoscopy has been used as standard practice [30]. Considering the limitations of evaluating the end point it does appear that a correlation exist between annual surgeon volume and RLN injury. However, definitions of high volume in the literature have a broad range from greater than 23 to greater than 100 thyroidectomies per year. There is an association with nerve injury and nodal surgery, re-operative surgery and retrosternal thyroidectomy although no individual volumes can be drawn from the literature as the numbers are adjusted by regression-analysis from larger cross sectional studies. The same argument can be used for patients undergoing near total thyroidectomy for benign pathology compared to total thyroidectomy. What does seem to be clear within North American data, is that there is no association with hospital volume and nerve injury, this is in contradiction to the German study showing low and median volume hospitals were a risk factor for RLN injury [31]. It would seem logical that a binary outcome of nerve injury would be associated with technical surgeon ability rather than institutional pathways. Higher volume hospitals may have access to intraoperative nerve monitoring but its use does not solely reduce nerve injury [29].

Surgical volume impact on all complications

Most recently, Adam et al. utilising NIS discharge data demonstrated in a dose dependent fashion, reduction in risk of any post operative complication with increasing surgeon volume up to 26 total thyroidectomies per year [32]. This is the only study we identified aiming to identify a cut off value and not categorising surgeon volumes from percentiles of patient distribution, which lacks generalisability. Although, the cut off value was determined assessing for all complication categories high volume surgeons (>25 total thyroidectomies per year) had significantly less endocrine related complications (hypoparathyroidism and/or RLN injury) and shorter length of hospital stay.

Surgical volume impact on outcomes for thyroid cancer

The 5-year survival for differentiated cancer is over 95% and treatment is associated with very low mortality. Recurrence of disease remains a risk requiring long follow up and potential further treatment. Assessing cancer surgery for hypocalcaemia and RLN injury delivers an outcome measure of the

operation but does not provide quality metric information regarding adequacy of surgery and disease recurrence. With longer patient survival, the impact of thyroid cancer treatment on quality of life is not clearly understood.

Several studies have examined quality outcomes of thyroid surgery for malignancy with surgeon volume. Adkinsson et al., compared surgeons performing more than 30 procedures a year against fewer for differentiated thyroid cancer (>1 cm) [25]. They reported the percentage uptake of I^{131}, preablation Tg, and dose of given I^{131} were all significantly lower in surgeons with volumes greater than 30 procedures per year. There was no difference in disease recurrence between surgeon volumes up to a mean follow up time of 21 months. To obtain undetectable thyroglobulin and for patients with advanced disease (AJCC stages III/IV) a higher threshold of 50 procedures per year was thought necessary.

Kim et al., examined surgeon volume and the long term outcomes of 1103 South Korean patients with papillary thyroid cancer who had lateral nodal metastases [33]. They found a surgeon volume of more than 100 procedures a year was associated with significantly lower structural recurrence rate and lower rate of excision margin. However, they did not identify an association with surgeon volume and overall cancer-specific mortality.

With regards to re-operative surgery for thyroid cancer, Mitchell et al. found in their tertiary referral institution that avoidable reoperations were significantly higher from those with annual volumes of less than 20 procedures per year [34]. Suggesting that some low volume surgeons may not necessarily be selecting the correct operative procedure. Furthermore, Adkinsson et al. showed low volume surgeons were significantly more likely to perform two-stage thyroidectomy procedures [25].

Summary

Large cross sectional studies from North America and within Europe have shown that the quality of thyroid surgery is related to surgeon volume albeit with inconsistent definitions, measurements of outcomes and with the majority of data following short-term discharge data. It is well known that immediate postoperative complications after thyroid surgery do not necessarily translate to permanent complications [27].

This chapter has reviewed the evidence in the literature regarding the relationship between volume (surgeon and institution) and patient outcome. It highlights a variability in definitions and protocols that make comparisons impossible and conclusions difficult to reach. Going forward, it would seem reasonable to expect that every thyroid surgeon should be aware of their own outcomes and how they compare with their peers. To achieve this goal, surgeons should engage with national or transnational registries. The community of thyroid surgeons should strive to reach a consensus in defining high, intermediate and low volume surgeons as well as defining complications such as hypoparathyroidism and creating protocols for post-operative laryngoscopy. There is evidence that higher surgeon volume is associated with better outcomes as would be expected. However this is not necessarily the case for institutional volume. The written evidence alone cannot answer what the minimum number of operations per surgeon should be for a particular thyroid pathology/procedure. This will only be achieved through open debate. Such conversations are challenging because individual surgeons can feel threatened and obstacles are typically thrown up to block change, for example resistance to changing patient flow on grounds of logistics, politics and funding. Success will only be achieved when the interests of the patient are put first during every conversation.

Practice points

Advantages of a registry over clinical trials.

- Aim to obtain a complete an unbiased view of all cases.
- It enables individual surgeons to benchmark their own practice with peers.
- Outcomes are a better reflection of real life' as opposed to best practice'.

Research agenda

In order to compare datasets, there needs to be a unified approach to the following:

- Definition of high, intermediate and low volume practice.
- Definition of temporary hypoparathyroidism.
- The timing of post-operative laryngoscopy (vocal cord check).
- The outcome of a return to theatre for haemorrhage.

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References

[1] Siegel R, Ma J, Zou Z, et al. Cancer statistics, 2014. CA: A Cancer J Clin 2014 Jan;64:9–29.
[2] Welbourne R. The history of thyroid surgery. 1st ed. New York: Praegel; 1990.
*[3] British Association of Endocrine and Thyroid Surgeons. In: Chadwick D, Kinsman R, Walton P, editors. Fourth national audit report. Henley-on-Thames. 4th ed. Dendrite Clinical Systems Ltd; 2015.
[4] Luft HS, Bunker JP, Enthoven AC. Should operations Be regionalized? New Engl J Med 1979 Dec 20;301:1364–9. Massachusetts Medical Society.
[5] Chowdhury MM, Dagash H, Pierro A. A systematic review of the impact of volume of surgery and specialization on patient outcome. Br J Surg 2007;94:145–61.
*[6] Sosa JA, Bowman HM, Tielsch JM, et al. The importance of surgeon experience for clinical and economic outcomes from thyroidectomy. Ann Surg 1998;228:320–30.
[7] National Quality Board. Quality in the new health system. 2013. London, UK.
[8] Schneider DF, Sippel RS. Measuring quality in thyroid cancer surgery. Adv Endocrinol 2014 May 22;2014:1–6. Hindawi.
[9] Solomon DJ, Henry RC, Hogan JG, et al. Evaluation and implementation of public health registries. Publ Health Rep (Washington, DC : 1974) 1991;106:142–50. SAGE Publications.
[10] Edafe O, Antakia R, Laskar N, et al. Systematic review and meta-analysis of predictors of post-thyroidectomy hypocalcaemia. Br J Surg 2014 Mar;101:307–20.
[11] Sitges-Serra A, Ruiz S, Girvent M, et al. Outcome of protracted hypoparathyroidism after total thyroidectomy. Br J Surg 2010 Nov;97:1687–95.
[12] Edafe O, Balasubramanian SP. Incidence, prevalence and risk factors for post-surgical hypocalcaemia and hypoparathyroidism. Gland Surg 2017;6:S59. AME Publications.
[13] Al-Qurayshi Z, Robins R, Hauch A, et al. Association of surgeon volume with outcomes and cost savings following thyroidectomy: a national forecast. JAMA Otolaryngology-Head Neck Surg 2016;142:32–9.
*[14] British Association of Endocrine and Thyroid Surgeons. In: Chadwick D, Kinsman R, Walton P, editors. Fifth national audit report. Henley-on-Thames. 5th ed. Dendrite Clinical Systems Ltd; 2017.
[15] Harrison EM, Drake TM, Neill SO, et al. Individual surgeon mortality rates : can outliers be detected ? A national utility analysis. BMJ Open 2016;6.
*[16] Loyo M, Tufano RP, Gourin CG. National trends in thyroid surgery and the effect of volume on short-term outcomes. The Laryngoscope 2013;123:2056–63.
*[17] Kandil E, Noureldine SI, Abbas A. The impact of surgical volume on patient outcomes following thyroid surgery. Surgery 2013;154:1346–53. Mosby, Inc.
*[18] Hauch A, Al-qurayshi Z, Randolph G, et al. Total thyroidectomy is associated with increased risk of complications for low- and high-volume surgeons. 2014. p. 3844–52.
*[19] Gourin CG, Koch WM, Pawlik TM, et al. Volume-based trends in thyroid surgery. Arch Otolaryngol Head Neck Surg 2010;136:1191–8.
[20] Weiss A, Parina RP, Tang JA, et al. Outcomes of thyroidectomy from a large California state database. Am J Surg 2015:1170–7. Elsevier Inc.
[21] Meltzer C, Klau M, Gurushanthaiah D, et al. Surgeon volume in thyroid surgery: surgical efficiency, outcomes, and utilization. The Laryngoscope 2016;126:2630–9.

*[22] Nouraei SAR, Virk JS, Middleton SE, et al. A national analysis of trends, outcomes and volume–outcome relationships in thyroid surgery. Clin Otolaryngol 2017;42:354–65.
[23] Hauch A, Al-qurayshi Z, Randolph G, et al. Total thyroidectomy is associated with increased risk of complications for low- and high-volume surgeons. J Surg Oncol 2014;21:3844–52.
[24] Thomusch O, Machens A, Sekulla C, et al. The impact of surgical technique on postoperative hypoparathyroidism in bilateral thyroid surgery: a multivariate analysis of 5846 consecutive patients. Surgery 2003;133:180–5.
[25] Adkisson CD, Howell GM, McCoy KL, et al. Surgeon volume and adequacy of thyroidectomy for differentiated thyroid cancer. Surgery (United States) 2014;156:1453–60. Elsevier Inc.
[26] Duclos A, Peix J, Colin C, et al. Influence of experience on performance of individual surgeons in thyroid surgery : prospective cross sectional multicentre study. Br Med J 2012;344:1–11.
[27] Lifante JC, Payet C, Ménégaux F, et al. Can we consider immediate complications after thyroidectomy as a quality metric of operation? Surgery (United States) 2017;161:156–65.
[28] Chadwick DR. Hypocalcaemia and permanent hypoparathyroidism after total/bilateral thyroidectomy in the BAETS Registry. Gland Surg 2017 Dec;6:S69–74. AME Publications.
[29] Al-Qurayshi Z, Randolph GW, Alshehri M, et al. Analysis of variations in the use of intraoperative nerve monitoring in thyroid surgery. JAMA Otolaryngology-Head Neck Surg 2016;142:584–9.
*[30] Aspinall S, Oweis D, Chadwick D. Effect of surgeons' annual operative volume on the risk of permanent Hypoparathyroidism, recurrent laryngeal nerve palsy and Haematoma following thyroidectomy: analysis of United Kingdom registry of endocrine and thyroid surgery (UKRETS). Langenbeck's Arch Surg 2019 Jun 28;404:421–30.
[31] Dralle H, Sekulla C, Haerting J, et al. Risk factors of paralysis and functional outcome after recurrent laryngeal nerve monitoring in thyroid surgery. Surgery 2004 Dec 1;136:1310–22. Elsevier.
*[32] Adam MA, Thomas ÃS, Youngwirth L, et al. Is there a minimum number of thyroidectomies a surgeon should perform to optimize patient Outcomes ? Ann Surg 2017;265:402–7.
[33] Kim HI, Kim TH, Choe JH, et al. Surgeon volume and prognosis of patients with advanced papillary thyroid cancer and lateral nodal metastasis. Br J Surg 2018;105:270–8.
[34] Mitchell J, Milas M, Barbosa G, et al. Avoidable reoperations for thyroid and parathyroid surgery: effect of hospital volume. Surgery 2008 Dec;144:899–907.