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REVIEW ARTICLE

A clinical review of estimating the accuracy of nasogastric tube insertion depth


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Abstract

Inserting a nasogastric tube (NGT) is a standard procedure performed by nurses. Assuring the correct position of the tip of the NGT in the stomach is crucial for maximising the treatment effectiveness and preventing complications due to NGT malposition. While the nose-ear-xiphoid distance is one of the simplest applied methods in estimating the depth of NGT, some studies reported that it is not accurate and is considered no longer safe and increasing the risk for NGT malposition. This literature review aimed to identify the most precise method for determining the NGT insertion depth. The article searched from some electronic sources, namely Sciencedirect and Google Scholar, using “nasogastric tube,” “placement,” “method,” “formula,” and “nursing” as the keywords and searching focused on the original research articles published in English between March 2017 – March 2022. Three pieces met the inclusion criteria. These three articles used different definitions and formulas in determining the accurate position of NGT in the stomach. Considering the rate of correct position resulting from the formulas, the xiphoid-ear-nose distance + 10 cm formula was considered the most appropriate formula to be implemented in the daily NGT tube insertion procedure. However, using this formula cannot altogether remove the risk of malposition. Therefore, confirming the position of the NGT using a gastric aspirate pH test or chest x-ray is very recommended.

Keywords: Nursing intervention; nutritional status; nasogastric tube; clinical practice; nursing care

Introduction

Nasogastric tubes (NGT) have been in use for more than a century, and they are still regarded as vital and resuscitative instruments in various medical disciplines for acute and chronic treatment (Vadivelu et al., 2023). NGT is beneficial as a conduit for the delivery of drugs and can sometimes be used for short-term parenteral nourishment in patients in critical condition (Lemyze, 2010). Moreover, NGT is also useful for decompressing the stomach in critically ill patients with intestinal blockage (Chauhan, Varma, Dani, Fertleman, & Koizia, 2021). Inserting a NGT is a common procedure performed by nurses. The NGT placement is needed to provide enteral nutrition, especially in critically ill patients who cannot meet their nutritional needs orally and are at risk for aspiration. Although NGT insertion is common and considered an easy procedure, inappropriate insertion may produce some unexpected conditions. The NGT insertion that is too short may place the tip of NGT in the oesophagus and increase the risk of aspiration. In contrast, NGT tube insertion that is too deep may result in the end of NGT entering the duodenum and prevent the food from being digested completely by the stomach (Santos et al., 2016). In addition, if the depth of the NGT is too deep, the NGT can bend, kink, or turn around toward the oesophagus (Sanaie et al., 2020).

A study also reported a high complication related to the NGT insertion procedure. Rabaut et al., (2022) identified various NGT-associated problems, particularly among stroke patients, such as 26% failed insertion, 42.8% inaccurate NGT insertion (20 cases of NGT tube placed in the lung, 97 cases in the gastro-oesophageal junction, and 78 the tip of NGT were not seen in the chest X-ray) and required reinsertion. Furthermore, they also reported 37 cases of coiled, kinked or resistance and 9 gastrointestinal bleeding issues. Another study said that the NGT insertion increases two to threefold the risk of gastrointestinal bleeding (Dennis & Hospital, 2005). Moreover, a review reported that NGT-

related adverse event is common among adult patients, including oesophageal complication, tube obstruction, and tube obstruction that requires hospitalisation (Paula et al., 2021). Thus, it is essential to carefully apply the procedure and ensure the correct depth of NGT to maximise the treatment effectiveness and prevent unexpected complications linked to NGT insertion and malposition.

There are some existing methods for NGT depth estimation. Estimating the depth of NGT insertion by measuring the distance of nose-ear-xiphoid (NEX) is one of the commonest used and taught in nursing school. However, recent literature found that estimating the depth of NGT insertion using the NEX formula is inaccurate and considered no longer safe (Chen et al., 2014; Ellet et al., 2005). Another study identified that the NEX method produces too short an NGT length (~48cm) to ensure the tip of NGT arrives in the gastric body (~63cm) (Taylor et al., 2014). Thus, conducting a further literature review is important to identify the formula results in the correct position of the NGT tip in the stomach. Therefore, the finding can be used by nurses to perform NGT insertion and administer enteral nutrition safely without causing any harm.

Method

To explore the NGT insertion formula, a literature review related to NGT insertion was conducted. The article searching strategy was carried out from electronic databases such as Science Direct and Pubmed using the keywords “nasogastric tube”, “insertion”, “formula”, and “nursing.” The literature search focused on the articles published between March 2017 – March 2022. The searched articles were then selected based on some criteria: published with full text available in English, original research, and topic related to NGT insertion estimation. The study did not include editorials, case reports, reviews, and other commentaries. We presented the article selection process in a figure (Figure 1).

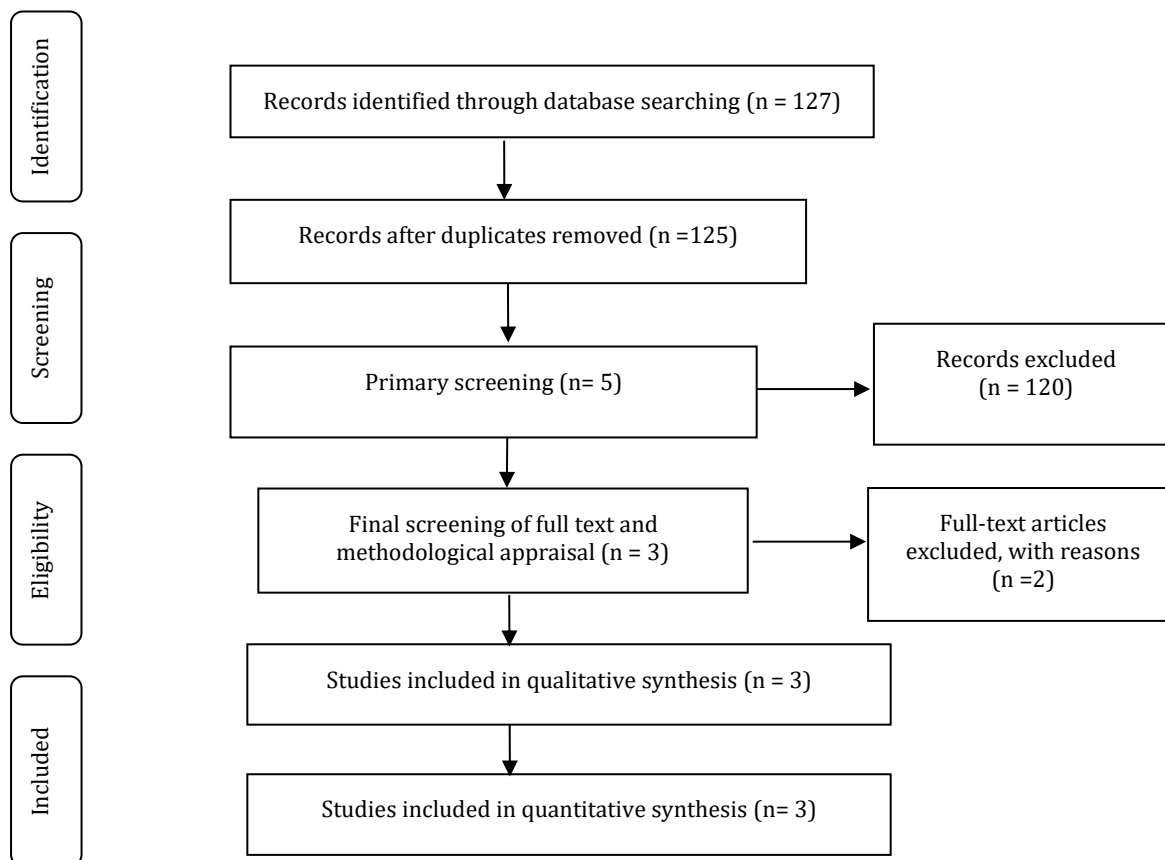


Figure 1. Study selection process using the PRISMA framework

Results

The total number of searched articles using the previous keyword was 127 articles. Three articles met the inclusion criteria. All three articles were observational studies, including the population of adult patients requiring NGT insertion, concluded in three countries, Singapore, Belgium, and the United Kingdom. Generally, patients involved as the participants were critically ill adult patients in the intensive care unit (Fan et al., 2019; Taylor, 2020a; Torsy et al., 2020), patients with medical or surgical problems (Fan et al., 2019), without laparotomy scar, burn, or time-limited sedation period (Taylor, 2020b). Among those three studies, Fan et al., (2019) evaluate four formulas to calculate the length of the nasogastric tube to be inserted as follow: (1) formula 1 (also known as Hanson_A formula) = ((distance from tip of nose to ear to xiphisternum-50 cm)/2) + 50 cm (Hanson, 1979), (2) formula 2 = 29.38 + 4.53*gender + 0.34*distance from nose to umbilicus with the head flat on the bed - 0.06*BB (gender = 1 for males, and 0 for females) (Ellet et al., 2005), (3) formula 3 = distance from xiphisternum to ear to nose + 10 cm (Taylor et al., 2014), and (4) formula 4 = distance from earlobe to xiphisternum to umbilicus - distance from tip of the nose to earlobe (Malta et al., 2013); while Torsy et al. (2020) using corrected Hanson's formula which is (nose-earlobe-xiphoid distance x 0,38696) + 30,37 + 6 cm, and Taylor, (2020b) evaluate four formula as follow: (nose-ear-xiphoid), Hanson A, corrected Hanson's formula, and distance from xiphisternum to ear to nose + 10 cm.

Those studies confirm the accuracy of NGT insertion through X-ray (Fan et al., 2019; Torsy et al., 2020), aspirate pH measurement (Torsy et al., 2020), and electromagnetic-guided tube placement devices (Taylor, 2020b). After confirming the tip position in the stomach, Fan et al., (2019) focused on participants whose tip position was optimal, then compared the internal length of NGT insertion in those participants to the size of NGT using the four formulas. Since Torsy et al., (2020) only evaluated the Hanson_B formula, all the participants inserted the NGT according to the calculation of the Hanson_B formula. Then the tip position was confirmed using aspirate pH measurement and chest x-ray. At the same time, Taylor, (2020b) compared the length of the optimal NGT position to the size of the four formulas. Fan et al., (2019) concluded that among participants whose the tip of NGT is in the optimal position, the xiphisternum to ear to nose + 10 cm formula has the least difference compared to other procedures, which is similar to the result of (Taylor, 2020b) study. At the same time, Torsy et al., (2020) study found that only 37,7% of participants whose the tip of NGT in the optimal position based on the Hanson_B formula. (**Table 1**).

Discussion

Based on the three articles reviewed, information obtained that estimating the depth of the NGT by measuring the distance between the nose-ear-xiphoid did not produce an optimal position. This is new knowledge that contradicts what was previously known. Research from Chen et al., (2014) showed that measuring the depth of the nasogastric tube using the nose-ear-xiphoid method is at risk of resulting malposition. From a total of 30 participants who had an NGT installed using the nose-ear-xiphoid method, only one participant had all of the NGT tube side openings reach the stomach; 96.7% of them had the position of the side holes of the NGT tube, which was too high or not all fully entered the stomach. Taylor et al., (2014) argued that the measurement of the nose-ear-xiphisternum distance as a determinant of the depth of the NGT is incorrect since the distance from the nose-ear-xiphisternum only estimates the distance from the nose to the gastro-oesophageal junction, resulting too short position of the NGT tip end and not reach the stomach properly.

The finding of this literature review suggests xiphoid-ear-nose + 10 cm formula provides the best estimation for the internal length of the nasogastric tube required. Two studies reviewed support this finding (Fan et al., 2019; Taylor, 2020b). As confirmed by the electromagnetic device and x-ray, the xiphoid-ear-nose + 10 cm formula resulted from the tip of the NGT position in the middle third of the stomach (Fan et al., 2019). It reached the gastric body flexure (Taylor, 2020b). There are various definitions regarding the correct position of the end of the NG tube. Hanson's (1979) stated that the right place for the end of the NGT tube is to pass through the oesophagus and not more than 10 cm from the gastroesophageal junction. Ellet et al., (2005) defined the correct position of the end of the NG tube, which is between 3-10 cm below the oesophageal junction. Meanwhile, (Taylor, 2020a) stated that the optimal position for the NG tube is when the end of the tube is in the area of the gastric body.

Regarding those definitions, the reviewed article by Fan et al., (2019) believed that the optimal position of the NGT is in the middle third of the stomach. In addition, Fan et al., (2019) also stated that the optimal placement is influenced by the brand and type of tube used since each factory has a different distance from the farthest side hole. Xiphoid-ear-nose (XEN) + 10 cm formula is also easy to remember. Other procedures tested in the studies reviewed are relatively more complicated. XEN + 10 cm did not consider other factors such as age, height, and sex. A previous study by Taylor et al., (2014) found that adding interaction between XEN and age, size, and sex did not improve the percentage of variability explained in the study. However, using XEN + formula cannot completely reduce malposition risk.

Unfortunately, even using XEN + 10 cm, 86 of 200 (43,25%) participants still had the tip of NGT that fell short of the gastric body flexure and were potentially oesophageal (Taylor, 2020b). Therefore, confirming the position of the NGT using a gastric aspirate pH test or chest x-ray is very recommended.

Table 1. Study findings

Reference	Purpose	Formula explored	Accuracy test	Findings
Fan et al. (2019)	To evaluate formulas and the distance from the tip of the nose to the earlobe to the xiphisternum in estimating the length of NGT positioning	<ol style="list-style-type: none"> 1. Distance from tip of nose to ear to xiphisternum-50 cm)/2) + 50 cm (Hanson, 1979) 2. $29.38 + 4.53 * \text{gender} + 0.34 * \text{distance from nose to umbilicus with the head flat on the bed} - 0.06 * \text{BB}$ (gender = 1 for males, and 0 for females) (Ellet et al., 2005) 3. Distance from xiphisternum to ear to nose + 10 cm (Taylor et al., 2014) 4. Distance from earlobe to xiphisternum to umbilicus – distance from the tip of the nose to earlobe (Malta et al., 2013) 	X-ray	Distance from xiphisternum to earlobe to nose + 10 cm to provide the best estimate for the length of NGT required
Torsy et al. (2020)	To test the accuracy of the corrected nose-earlobe-xiphoid distance formula for NGT	Nose-earlobe-xiphoid distance $\times 0.38696 + 30.37 + 6$ cm.	Aspirate pH measurement and x-ray.	The tip of NGT positioned between 3-10 cm below the lower gastroesophageal sphincter was 37,7% and more than 10 cm below the gastroesophageal sphincter was 62,3%
Taylor (2020b)	To evaluate nose-earlobe-xiphoid, Hanson_A, Hanson_B, and xiphoid-earlobe-nose+10 to estimate the tube length from nose to gastric body against that measured by guided tube placement	Nose-earlobe-xiphoid (NEX), Hanson_A, Hanson_B, and xiphoid-earlobe-nose+10	Guided tube placement using an electromagnetic device	Compared to other formulas, xiphoid-earlobe-nose+10 cm has no significant difference with the actual length of NGT insertion from nose to the gastric body using electromagnetic guided placement

Conclusion

This review aimed to identify the most accurate formula for estimating the NGT depth. While various procedures exist, the xiphoid-ear-nose distance + 10 cm formula is considered the most precise method to ensure the tip of NGT arrives at the stomach body. Even so, this formula cannot completely remove the risk of malposition. Further research is needed to evaluate the risk factors of NGT malposition using this formula and how it impacts the outcome. Although confirming the position of the NGT using a gastric aspirate pH test or chest x-ray is very recommended, these procedures may need

additional cost. Therefore, studies regarding its cost-effectiveness are also required.

Author's declaration

The authors made substantial contributions to the conception and design of the study and took responsibility for data analysis, interpretation, and discussion of results. For manuscript preparation, all the authors read and approved the final version of the paper.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

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