Gastric ultrasound in the determination of preoperative prandial condition

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Abstract

Introduction: Gastric content aspiration represents the main cause of death related to anesthesia. Gastric ultrasound seems to be useful for studying gastric content, especially in situations where fasting conditions do not exist or are unknown.

Objective: To describe the usefulness of ultrasound for the evaluation of gastric content.

Methods: A structured search was carried out with the descriptors: fasting; anesthesia; general anesthesia; ultrasounds, ultrasonography, stomach (MeSH), in the databases: Pubmed, Embase, SciELO and Cochrane Library.

Results: About 29 articles were found with relevant information for the development of this review.

Conclusions: Although gastric ultrasound appears to be a useful technique for the study of gastric content, the impact that this may have on the incidence of pneumonic aspiration is unknown, so more studies are needed

to promote its routine use in clinical practice.
Key words: Ultrasound, stomach, fasting, anesthesia (MeSH).
Resumen

Introducción: La aspiración de contenido gástrico representa la principal causa de muerte relacionada con la anestesia. El ultrasonido gástrico parece ser útil para el estudio del contenido gástrico, en especial en situaciones donde no existen o se desconocen las condiciones de ayuno.

Objetivo: Describir la utilidad del ultrasonido para la valoración del contenido gástrico preoperatorio.

Metodología: Se realizó una búsqueda estructurada en las bases de datos Pubmed, Embase, SciELO y Cochrane Library con los descriptores fasting; anesthesia; anesthesia, general; ultrasonics, ultrasonography, stomach (MeSH)

Resultados: Se encontraron alrededor de 29 artículos con información relevante para el desarrollo de la presente revisión.

Conclusiones: Aunque el ultrasonido gástrico parece ser una técnica útil para el estudio del contenido gástrico, se desconoce su impacto en la incidencia de aspiración neumónica, por lo que se necesitan más estudios para promover su uso rutinario en la práctica clínica.
Palabras clave: Ultrasonido, estómago, ayuno, anestesia (DeCS).

Introduction

The fourth national audit project (NAP-4) of the Royal College of Anesthetist of the United Kingdom identified pulmonary aspiration of gastric contents as the leading cause of anesthesia-related death (1-3). Despite this, pulmonary aspiration is an infrequent event, with an incidence of approximately 1: 350000 anesthetics in adult patients; and 9.3: 10000 in pediatric patients (2). The clinical conditions predisposing to aspiration of gastric contents are related to alterations in gastric emptying or non-compliance with fasting guidelines and are described in Table 1(4).

> « *The relatively shorter times in children have been considered in view of the psychological damage as well as the physiological and metabolic effects of prolonged fasting.* »

Table 1. Clinical conditions predisposing to aspiration of gastric contents.

Table 1. Conditions that alter gastric emptying
Diabetes Renal failure Liver dysfunction Gastroesophageal reflux disease Pregnant women in labor Pyloric pathology Abdominal trauma Acute abdomen Ileus Opioid use
Source: taken from: (1,3,4)

Moreover, the clinical severity of the aspiration phenomenon is directly related to the composition and volume of the content, being the risk unacceptably high for solid and liquid content with volumes above 1.5 ml/kg of weight (1,5,6).

On the other hand, it has been described that gastric emptying time varies according to the type of food ingested. Thus, relatively shorter fasting times determine the condition of incomplete fasting, with a consequent increase in the risk of aspiration of gastric contents. Gastric ultrasound has been described as an efficient alternative for the study of gastric contents in real time, especially in circumstances where the fasting condition is not fulfilled or is not determined (1,7). The aim of the present article is to describe the usefulness of ultrasound for the assessment of gastric contents.

Methodology

A structured search was performed with the descriptors fasting; anesthesia; anesthesia, general; ultrasonics, Ultrasonography, stomach (MeSH), in the Pubmed, Embase, SciELO and Cochrane Library databases. The search was limited to human studies published in English and Spanish, but was not limited by publication date, age, or type of study. The quality of the studies found was assessed independently by two coauthors, through the implementation of the Critical Appraisal Skills Programme Spanish (CASPe) instruments for critical reading. The inclusion of the studies required the approval of the two reviewers, with disparate dispositions being settled through the participation of a third reviewer.

Fasting guidelines

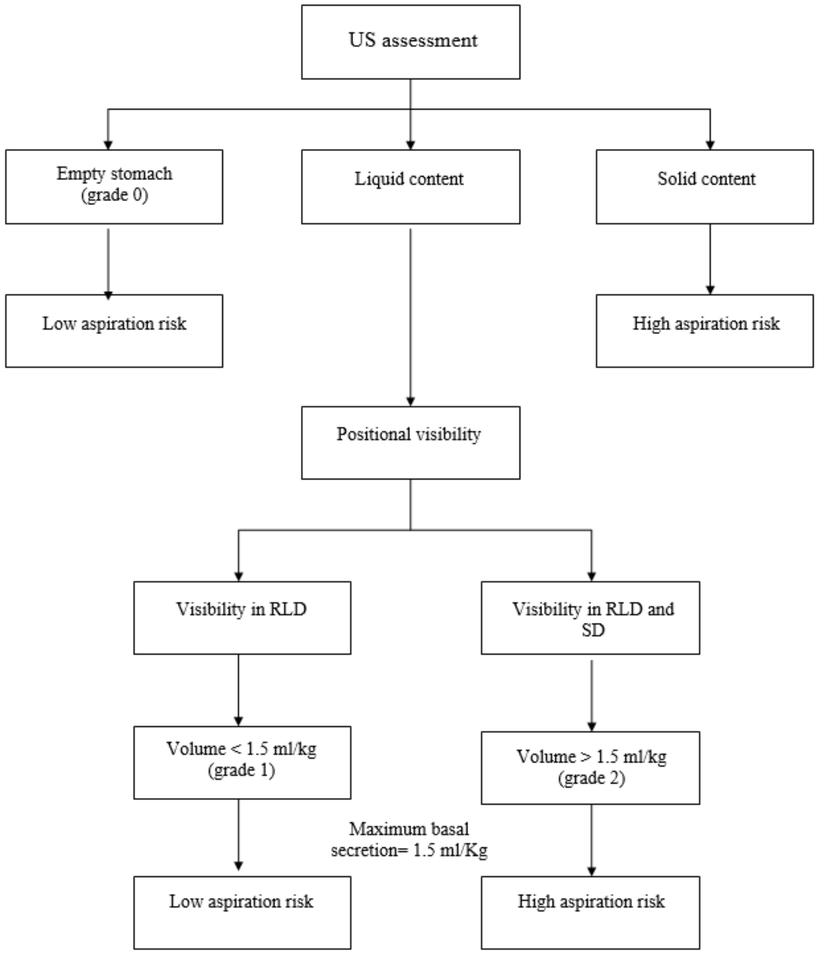
Fasting guidelines suggest a preoperative fast of 2 hours for clear liquids, 6 hours for non-clear liquids or light food and 8 hours for solid food in adult patients. In children, the guideline indicates 1 hour fasting for clear liquids, 4 hours for breast milk and 6 hours for formula or solids. The relatively shorter times in children have been considered in view of the psychological damage as well as the physiological and metabolic effects of prolonged fasting (8-10).

Gastric ultrasound

Several studies have focused on generating algorithms to identify the increased risk of aspiration based on ultrasound visualization of the stomach. Qualitative assessment has been described, which can identify the prandial state, the characteristics of the contents (liquid, solid), as well as approximate the volume of the liquid contents. The initial purpose of gastric ultrasound is to determine the prandial state (full vs. empty stomach) (1).

The literature suggests that qualitative assessment should be performed by visualization of the gastric antrum: first in the supine decubitus (SD) and subsequently in the right lateral decubitus (RLD) (11,12). The absence of contents represents a low risk of aspiration, while the visualization of any solid content is considered a high risk. The finding of visualizable liquid content exclusively in the RLD has been correlated with volumes below 1.5 ml/kg of weight, an established cut-off point above which there is a high risk of aspiration. In contrast, visualization in both positions represents a volume above the established threshold, meaning a high aspiration risk or risk stomach (graph 1).

«The absence of contents represents a low risk of aspiration, while the visualization of any solid content is considered a high risk.»



On the other hand, the quantitative assessment involves the measurement of the transverse section area of the gastric antrum (TSAa), and there are no studies that report a difference between the measurement with the double tracing technique or with the technique of measurement of two diameters, which is somewhat more widespread (13). Thus, the TSAa corresponds to the product of the cephalocaudal and anteroposterior diameters of the antrum, multiplied by a factor of π/4 that corresponds to the mathematical formula for calculating the area of an ellipse: D1 x D2 x π/4.

In turn, there are several mathematical models, both in adult and pediatric patients that correlate the measured TSAa with a predicted gastric volume, whose validation has been possible thanks to the comparison of the ultrasound result with volumes of gastric liquid aspirated by means of an orogastric tube (12,14,15). Some of them are the following:

In adults (15): Volume (ml)= 27 + 14.6 x log [TSAa RLD (cm2)]- 1.28 x age (years).

Children (14): Volume (ml) = -7.8 + (3.5 x TSAa RLD (mm2) + (0.127) x age (months)

Discussion

Ultrasound has been proposed as a useful technique to assess gastric contents, with a sensitivity and specificity to exclude the diagnosis of risky stomach described around 100 and 97% (16,17). Despite this, there are no controlled studies that allow definitive conclusions to be drawn regarding the decrease in the incidence of aspiration as a precise outcome (1).

Studies aimed at validating the usefulness of gastric ultrasound have found an enormous variability in the rate of stomach emptying, and there may be patients with empty stomachs with significantly shorter fasting times, as well as individuals with at-risk stomachs despite having fulfilled the fasting guidelines. A study that assessed the progression of gastric emptying by applying a mathematical Pearls model found that 100% of individuals had an empty stomach 4 hours after ingestion of unclear liquids and 6 hours after consumption of solid food (18). In contrast, additional investigations have shown a non-negligible percentage of patients in whom risk stomach prevails despite adequate fasting time. Perlas et al (19) reported 3.5% of individuals with grade 2 classification. Gagey et al (7) found about 1% of pediatric patients scheduled for elective surgery with risk stomach. Chen et al (20), in patients with renal failure, found up to 17% of individuals in whom risk stomach (Pearls grade 2) prevails despite fasting guidelines. Van de Putte et al (21), in 538 healthy individuals under fasting guidelines, studied the incidence of risk stomach by ultrasound, finding 1.7% with solid content and 4.5% with liquid content with volume greater than 1.5 ml/kg. In addition, Ohashi et al (22) reported 2.7% of patients with stomach at risk.

On the other hand, the identification of the stomach at risk could lead to a better planning of airway management through the implementation of different alternatives, such as the use of the orotracheal tube versus the laryngeal mask, the implementation of a rapid intubation sequence versus the conventional intubation sequence, aspiration of gastric contents with an orogastric tube in an awake patient, postponing the surgical moment versus assuming the risk of aspiration based on surgical urgency (23,24).

In studies of patients scheduled for elective procedures with noncompliance with fasting guidelines, ultrasonographic assessment of the stomach induces modification of anesthetic technique or timing by 65-71%, with decreased surgical delays and no increase in the incidence of aspiration (25).

A study in which the stomach contents of 80 individuals requiring emergency IOT were assessed by US, reported 24% of patients with liquid con-

«Finally, it should be known that ultrasound is an operator-dependent technique, which is considered its main disadvantage.»

tents, of which two thirds were tributary to nasogastric tube drainage, with subsequent negative ultrasound control for stomach at risk (26).

On the other hand, although ultrasound can determine the qualitative and volumetric characteristics of the gastric contents, establishing a direct relationship with the risk of aspiration is difficult given the ethical problems of the study design and the low incidence of the outcome. Thus, the role of the clinical history in the evaluation of fasting conditions cannot be ignored (27).

For its part, the discussion of what should be the cut-off point for the weighted gastric volume for the determination of the stomach at risk continues. For the purposes of this review, a value of 1.5 ml/kg has been considered for adult patients and 1.25 ml/kg for pediatric patients, according to the studies of Perlas and Gagey et al (7,19). In turn, each cut-off point in volume correlates with an TSAa value, above which there is a stomach at risk (12,28).

Finally, it should be known that ultrasound is an operator-dependent technique, which is considered its main disadvantage. Thus, in spite of its high sensitivity and specificity to rule out the stomach at risk, it is feasible to find false negatives (1). Although gastric ultrasound seems to be an easy technique to learn and perform, more studies are needed to promote its routine use in clinical practice (29).

Conclusions

Although gastric ultrasound appears to be a useful technique for the study of gastric contents, the impact it may have on the incidence of pneumonic aspiration is unknown, so more studies are needed to promote its routine use in clinical practice. Incomplete fasting and lack of knowledge of the fasting status are the main indications for its use, especially in patients undergoing surgery or requiring urgent orotracheal intubation, in whom its implementation could improve the airway approach.

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