Postoperative nausea and vomiting

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Abstract
Postoperative nausea and vomiting (PONV) remains a common clinical problem that increases patient morbidity, healthcare costs and affects patient satisfaction. This article outlines the physiology, reviews the available drugs and suggests a structure using risk stratification that helps to plan sensible clinical management.

Keywords Antiemetics; nausea; risk stratification; vomiting

Royal College of Anaesthetists CPD Matrix: 1A02; 2A07

Learning objectives

After reading this article, you should be able to:

- understand the risk factors for postoperative nausea and vomiting (PONV)
- understand the efficacy of antiemetic drugs
- plan and deliver an anaesthetic that will reduce the risk of PONV
- manage persistent nausea and vomiting postoperatively
- be aware of potential future advances in pharmacological and non-pharmacological management

Postoperative nausea and vomiting (PONV) has an incidence of up to 30%[1,2] and is one of the most feared side effects of anaesthesia, even above pain.[3] Although in most cases it is self-limiting, each episode of vomiting delays discharge from the recovery room, increases the risk of unplanned admission and may be associated with more severe complications including pulmonary aspiration, dehydration, electrolyte abnormalities, raised intra-cranial and intra-ocular pressures, wound dehiscence and oesophageal rupture.

The management of PONV involves risk stratification, prevention and treatment. This can utilize both pharmacological and non-pharmacological interventions.

Definitions

Nausea is the sensation of needing to vomit, which may include activation of central, sympathetic and parasympathetic responses.

Vomiting is the involuntary oral expulsion of gastric contents via coordinated autonomic, gastrointestinal and respiratory system activity. It can be considered in two phases. In the pre-ejection phase, sympathetic activation causes tachypnoea, tachycardia, hypertension, diaphoresis, pallor and hypersalivation. During the ejection phase, the epiglottis closes and forceful coordination of diaphragm, abdominal musculature and oesophagogastric constrictors leads to forceful expulsion of gastric and upper duodenal contents.

Pathophysiology of nausea and vomiting

The physiology of nausea and vomiting is complex and new pathways remain to be discovered. A good understanding of current knowledge helps explain the pharmacological targets and therapies detailed below. Two key areas of the brain are important in the action of vomiting: the vomiting centre and the chemoreceptor trigger zone (CTZ) (Figure 1).

The vomiting center (VC)

This lies in the lateral reticular formation of the medulla and receives afferent impulses via cranial nerves (CN) from the vestibulocochlear apparatus of the middle ear (CN VIII), carotid baroreceptor impulses (CN IX), gastrointestinal chemo- and stretch receptors (CN X) and aortic baroreceptors (CN X). It also receives afferents from higher cortical centres involved in pain, anticipation, memory, sight and fear as well as spinal cord afferents from peripheral pain pathways.

The VC coordinates actions of the smooth and striated muscles involved in vomiting via the 'special visceral efferent nerves', CN V, VII, IX, X and XI. These innervate the muscles of the face, neck and oropharynx in a coordinated fashion. Motor, sympathetic and parasympathetic outflow to the gastrointestinal tract and secretory organs are carried by the autonomic general visceral efferents of CN II, VII, IX and X. Finally efferent branches from the VC travel via spinal nerves to the diaphragm and abdominal muscles.

The chemoreceptor trigger zone (CTZ)

This lies in the area postrema in the floor of the IVth ventricle. It is functionally outside the blood—brain barrier and is sensitive to chemical stimulation via drugs and toxins present in the bloodstream. Its efferents act directly on the CTZ.

Neurotransmitters

A multitude of neurotransmitters are involved in the vomiting pathways, the important ones being histamine (via H_1 receptors) peripherally, dopamine (via D_2) both peripherally in the gastrointestinal tract and centrally, serotonin (via 5-HT_3) at the CTZ and acetylcholine (via muscarinic receptors) from vestibular apparatus. Other more recently discovered transmitters such as neurokinin-1 (substance P) also play a role in the emetic reflex.

Risk factors for PONV

Multiple factors combine to increase the risk of PONV. These are traditionally grouped into patient, surgical and anaesthetic factors (Table 1).

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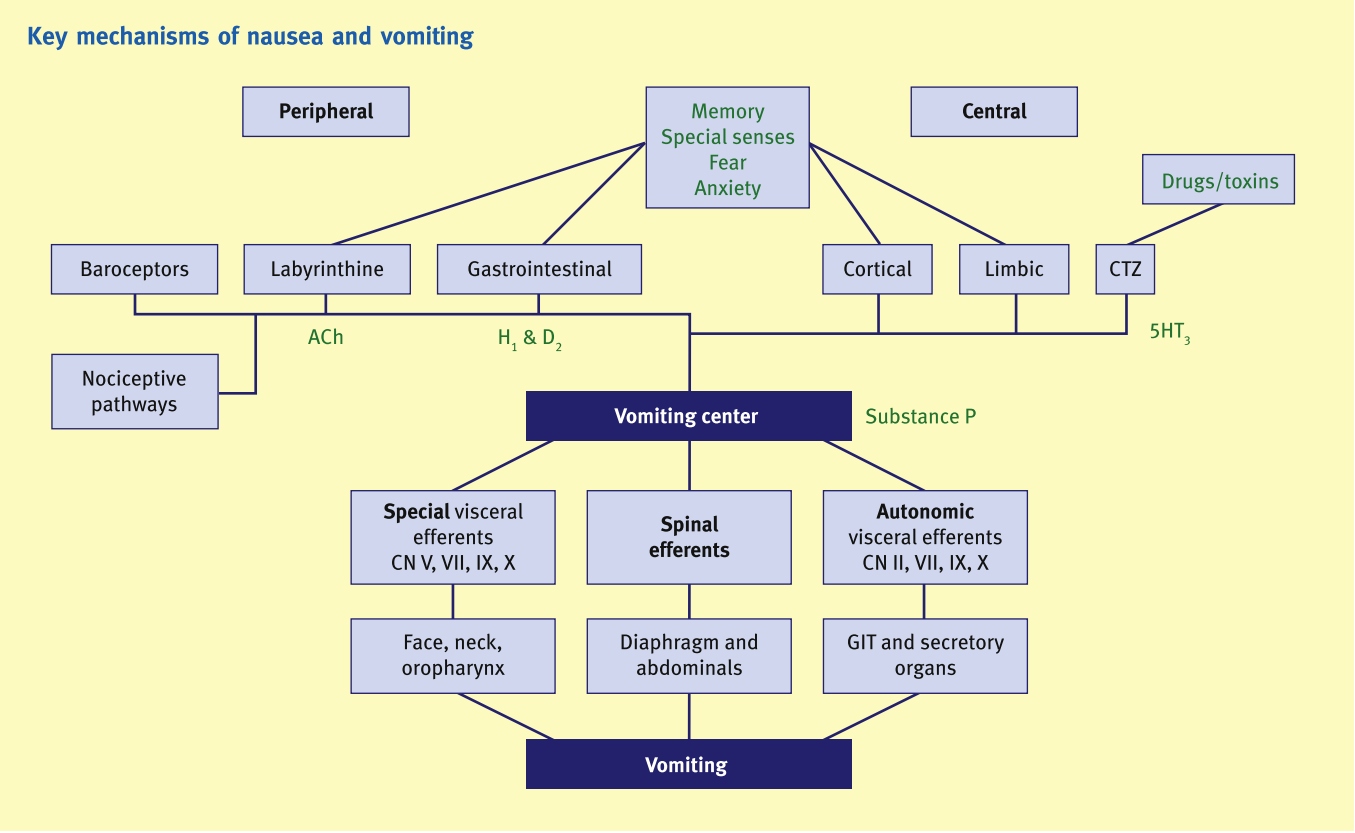

Figure 1

Patient factors

Although no single factor can predict PONV, strong predictors include female gender (which carries a threefold increased risk) and previous history. This demonstrates familial inheritance[4] possibly due to inherited genetic traits. Studies have demonstrated associations between PONV and specific genetic polymorphisms, such as specific single nucleotide traits of acetylcholine M3 subtype receptors (linked to motion sickness) as well cytochrome P450 genotypes[5] responsible for rapid metabolism of many drugs and toxins.[6] These could act as valuable targets in the future for patient specific pharmacogenetic targets.

Smoking is strongly linked to a reduced risk of PONV. Although mechanisms are not fully understood this could be through a variety of effects including hepatic cytochrome p450 enzyme induction,[7] down-regulation of the CTZ by recurrent exposure to emetogenic substances, or the presence in cigarette smoke of antiemetic substances. Several studies investigating the role of the nicotine patch in preventing PONV have not shown any benefit to this strategy and have even suggested the potential of nicotine therapy to increase the risk of vomiting.[8]

Patient age, although not included in any risk-scoring systems, probably has an effect at least in statistical terms. The evidence for this is conflicting. Some studies report no impact of age on incidence of PONV, while others support the commonly held belief that incidence rises from birth to a peak around the time of puberty.[9] Risk then falls approximately 10% with each decade of life.[10]

Surgical factors

In adult and paediatric cohorts, the risk of PONV is directly related to length of surgery. One study has estimated an increase in baseline risk of 59% per 30 minutes of surgical time.[11]

There is debate whether gynaecological surgery itself is a risk factor or the increased risk is related to the female patient group. In either event, these patients usually require a multimodal approach to symptoms.

Abdominal and laparoscopic procedures may be associated due to length of procedure rather than specific additional risk. In ENT procedures the risk may be related to vestibulocochlear involvement, permissive hypotension and ingestion of blood and debris from oropharyngeal soiling.

Anaesthetic factors

The emetogenic capacity of volatile anaesthetics and opioids appears to be dose related, with longer procedures far more likely to cause problems. Total intravenous anaesthesia techniques are associated with decreased risk of PONV, as is the use of regional only anaesthetic techniques.

The traditional use of neostigmine for the reversal of neuromuscular blockade is weakly linked with PONV (likely a direct chemoreceptor trigger zone effect). The use of sugammadex to