Can we predict postoperative nausea and vomiting (PONV)? - A study of three different scoring systems.  
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**Background:** In order to pick out patients who may benefit from prophylactic anti-emetic medication during surgery, it is of interest to evaluate risk factors for postoperative nausea and vomiting preoperatively by a simple scoring system.

**Material and methods:**
In this retrospective study we evaluated the ability to assess the risk of PONV by a pre-operative clinical score developed in our institution (U-score, 0-13 points) and two simple scoring systems from the literature (A-score, 0-4 points and K-score, 0-5 points). 120 patients were interviewed 24 hours after a surgical procedure. Possible risk-factors of PONV were scored and compared with the occurrence of PONV.

**Results:** 66% of the patients experienced PONV during the first 24 post-operative hours, no difference was seen between those who had received droperidol prophylaxis or not. A significant correlation (p<0.01) were seen in all scoring systems between occurrence of PONV and high score. With the U-score, 78% of the patients with a score>7 experienced PONV, while only 41% of those with a score<6 developed PONV.

**Interpretation:** We suggest that patients with a U-score>7 should receive effective prophylaxis, i.e: not droperidol only, against PONV. Further evaluation of different scoring systems should be tested in larger patient populations. Simplified systems, such as the A-score or K-score or simplified U-score, may be sufficient in uniform surgical populations. The U-score may be more universal because the anaesthetic method and use of post-operative opioids are also included.
Introduction:
Postoperative nausea and vomiting (PONV) is a very prominent problem for those patients who are affected, and PONV may also result in health injury, complications and increased costs (1). An increased knowledge and clinical experience with drugs capable of preventing PONV, such as neuroleptics and serotonin (5-HT3) antagonists have evolved in later years (1). Further, numerous studies have elaborated the risk factors of PONV, these may be related to aspects of the patient, the patients’ disease, the surgical procedure and the choice of anaesthetic method (1-5).

As the use of prophylactic antiemetic agents result in increased drug costs and may impose drug side-effects on the patient, it is important to limit the use of PONV prophylactics to those patients with a high risk of developing PONV. The use of prophylactics must also be weighted against the speed and efficacy of the alternative strategy, namely to wait and treat PONV in those cases which it turn out to be a problem.

Thus, there have been numerous attempts in the literature, on basis of epidemiological patient data, to develop algorithms of prediction of PONV risk in the individual patient on basis of information available before start of surgery (6-9). Two problems have been present with many of these algorithms: they are often derived from data in selected surgical or anaesthesiological populations without all possible risk factors involved; and they have often been complex mathematical formulas which is unpractical to use in everyday bedside routines.

The aim of the present study was to evaluate a risk score developed in our department, including the most important documented risk factors of PONV in a simple, clinically applicable form, which can be filled out in all patients before surgery. This scoring system, the Ulleval score or U-score, was compared with two simple, clinical scoring systems of PONV risk collected from the literature. Since some of our patients received PONV prophylactics as a part of the present peri-operative set-up, an evaluation of the efficacy of this prophylaxis was also a part of the study.

Materials and methods:
The study was undertaken in the period of May 15th to June 15th of 1999 as a retrospective study of the patients journal and an interview with the patients 24 hrs after end of a elective surgical procedure. The study was approved by the Regional Ethical Committee and the patients were requested for consent of being interviewed and for the collection of anonymous data from the hospital records. All adult, elective in-patients on the operating list for a full day on one of our
operating departments were studied. The operating
department was selected by random for each day during the
study period. All the patients were interviewed by the same
person and a structured questionnaire was used in order to
establish if any of the known risk factors of PONV were
present or not. The patients were also asked if any nausea or
vomiting had occurred after their surgery. In case of PONV,
the patients were also asked if some cause for the PONV was
evident, the duration and intensity of symptoms were noted;
further if treatment had been given and if the treatment was
perceived as efficient or not. The information from the
interview was matched with all available written
documentation on the patients condition after surgery,
including the journal and the nurse reports. PONV was
registered as present if it was documented either in the
hospital records or noted in the interview or in both sources.
Routine PONV prophylactics, droperidol 1.25 mg IV, was
given all patients scheduled for gynaecologic laparotomy or
breast cancer surgery.
During the study period all cases of PONV were treated by
metoclopramide 10 mg IV, repeated after 10 minutes if the
first dose was ineffective. If PONV was present 10 min after
the second dose of metoclopramide, the patient received
either ondansetron 4 mg or droperidol 1.25 mg IV as second
line treatment.
A PONV score, called the U-score (Ulleval score) (table 1)
was calculated in all patients based on information on 10
issues documented as important for PONV risk in the
literature (1-9). On an empirical basis every issue was
designated 0 or 1 point, whereas issues known to be strongly
associated with PONV could be given 2 or 3 points. A total
score of 0-13 points was possible by this system.
Further, in every patient a score based on the work of
Koivuranta et al. (K-score, 0-5 points)(8) and a score based
on the work of Apfel et al. (A-score, 0-4 points)(9) were
calculated.
The three different scores were compared with the actual
incidence of PONV and statistical correlation was calculated
by Pearsons correlation in the SPSS statistical software
programme. P<0.05 were considered as statistical significant.
Results:
A total of 120 patients were studied, no one refused to participate. The mean age was 58 years (range 14-88), 82% were female, the distribution of the patients as to surgical procedure is given i table 2. Table 1 shows how the patients were distributed for different U-scores.
60% of the patients had PONV during the first 24 postoperative hours. It was a clear statistical correlation between the presence of PONV and high score in all three scoring systems studied (fig 1-3, P<0.01). 50 patients (42%) had been given droperidol as PONV prophylactics. All these patients had a U-score of 5 or more, and 64% experienced PONV in spite of the prophylactic regimen.
19 patients (16%) had medium or much nausea or vomiting for more than 30 minutes during the postoperative observation period. 16 of these patients had a U-score of 6 or higher (13 had a score of 8 or higher) and 14 had received droperidol prophylactics.
Of precipitant causes for PONV, movement was mentioned by 28 patients (23%), eating or drinking by 15 patients (12%), whereas no one reported pain as a precipitating cause of PONV.
55 of the patients with PONV received metoclopramide IV, in 19 cases (35%) the treatment was efficient, whereas 36 patients (65%) received further treatment with neuroleptics or ondansetron.

Discussion:
Even with modern anaesthetic drugs and frequent use of droperidol prophylaxis, PONV is still a frequent problem, occurring in 60% of the patients in this study. If efficient prophylactics could reduce the incidence by 50% (10) this will represent a clinical benefit of NNT of 3.3. (NNT=Number Needed to Treat; 6 out of 10 have PONV at present, 50% reduction means 3 out of 10 with PONV, i.e. a benefit of 3 patients out of 10 saved from PONV). However, if prophylactics is given to all patients, this also means that 7 out of 10 patients will receive a drug they do not need (4 out of 10 will not have PONV anyway) or do not benefit from (3 out of 10 will still have PONV in spite of the prophylactics). This means that 7 out of 10 patients will be exposed to possible side-effects from a drug with no need or benefit, and that 70% of the drug costs for prophylactics is wasted. Thus, it will be of clear benefit if a simple, clinically applicable scoring system could pick out in advance those patients with a high risk of PONV and give them prophylactics. The patients with low risk do not need to be exposed for prophylactic drug, but should, of course, have the option of rapid and efficient treatment if PONV should occur anyway.
All three scoring systems tested in this study may be useful tools in this context. By our own U-score (0-13 points) 78% of those with a score of 8 or more had PONV, whereas those with a score of 5 or less had a 41% incidence. By K-score (0-5 points) of 3 or more 75% had PONV, whereas a score of 1 or 0 had an incidence of 28%. By A-score (0-4 points) of 3 or 4, 74% had PONV whereas a score of 1 or 2 had an incidence of 41%.

Our patient material is too small and patient selective in order to conclude on which scoring system is best, and if some factors have been given too strong or too weak influence in the final scoring algorithm. The scoring systems of Apfel and Koivuranta are more simple than the U-score. However, they do not contain information on the use of general anaesthesia and the use of post-operative opioids, both aspects being shown to be of importance for the risk of developing PONV (1,11). It has also been shown that anesthesia maintenance with propofol reduce the risk of PONV (12). In our patient material these factors do not have any important impact on variation in scores, as 85% of the patients received general anaesthesia and 90% needed opioids postoperatively. If we pull out the three issues in the U-score associated with general anaesthesia and postoperative opioids treatment, we end up with a modified U-score of 0-8 points, with a good correlation for the occurrence of PONV (P<0.01). With such a modified U-score of 4 or higher, 77% had PONV; whereas a score of 0 or 1 was associated with a 39% incidence of PONV.

Our patient material is not representative for an average surgical population, as procedures with a high risk of PONV is too strongly represented; 63% of the patients belonged to the high risk group. In a patient selection with more ambulatory surgery, surface and peripheral surgery; the incidence of PONV would probably have been lower. Further, we have not studied children, where the incidence of PONV may be very high after surgery in the eye or ENT region (1).

It was disappointing that the use of droperidol prophylaxis still resulted in a PONV incidence of 64%. Many studies show that a PONV reduction of 30-50% is obtainable by use of droperidol prophylaxis, a figure similar or slightly lower to the potential reduction obtained by prophylaxis with a serotonin antagonist (1,13). It may be explained by the fact that all our patients with droperidol prophylaxis had high-risk (i.e. of PONV) surgery and had a general high risk of PONV (i.e. U-score of 5 or more). However, if we look at the 49 patients with U-score of 5 or more not receiving droperidol, they had a comparable PONV frequency of 61%. This may imply that the PONV risk by breast cancer surgery and gynaecological laparotomy is underestimated in our scoring
system and/or that droperidol 1.25 mg is not a very effective prophylactic agent to these patients.

It has previously been stated that pain can precipitate PONV (1,14). However, this statement is based on a single study more than 25 years old (14), which has not been confirmed in well designed recent research. Our data do not imply any such connection; no patient stated pain as a precipitating cause of PONV; whereas well known causes, such as movements and intake of food or fluids, were mentioned by many. However, our retrospective data should be interpreted with caution as it may be highly variable what the patients recall by an interview on this issue the day after.

It may be argued that crude incidence of PONV is a too rough criteria for use of prophylactics or not; as intensity, duration and whether nausea or vomiting is a dominating feature may be highly important as to the discomfort experienced of the patient. Our patient material is too small to say much on this issue, but only 16% of our patients had symptoms for more than 30 min during the observation period, or felt the symptoms to result in medium or much discomfort. However, by those patients with an U-score of 8 or higher; 37% had similar prolonged or evident discomfort. These figures may have been even higher if not efficient rescue medication was instituted. Our routine of first line treatment with metoclopramide do not seem to be sufficient, 65% of those treated needed further antiemetic treatment. This is in accordance with the literature (1,11) stating metoclopramide is only slightly more effective than placebo, with an efficacy rate of 30-50%. The efficacy of neuroleptics and serotonin antagonists is stated to be somewhat better (1,10). However, the highest efficacy is reported after multimodal treatment using two or more different antiemetic drug principles in combination (10,11).

**Conclusion:**
The use of simple clinical scoring systems preoperatively will increase the chance of predicting which patients will have a high risk of developing PONV. With a score of 8 or higher in our own developed U-score system we will recommend the use of antiemetic prophylactics. Droperidol, used alone, do not seem to be a very efficient prophylactic drug; it should either be replaced or, probably better, combined with another anti-emetic principle, such as an serotonin antagonist. For patient populations with a uniform use of general anaesthesia and/or post-operative opioids a simpler scoring system, such as the A-score, K-score or modified U-score, may provide equally good predictability. Further research should be carried out with
these scoring systems on larger and more varied patient population.
### Table 1: Ulleval score (U-score) for PONV risk

<table>
<thead>
<tr>
<th>Question</th>
<th>No (%)</th>
<th>Yes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Is the patient younger than 60 years of age?</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>2) Is the patient a female between 15 and 50 years?</td>
<td>73</td>
<td>27</td>
</tr>
<tr>
<td>3) Have the patient experienced PONV previously?</td>
<td>81</td>
<td>7</td>
</tr>
<tr>
<td>4) Do the patient suffer medium or much from travel sickness?</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>5) Is the patient usually a non-smoker?</td>
<td>28</td>
<td>72</td>
</tr>
<tr>
<td>6) Will the patient receive general anaesthesia?</td>
<td>13</td>
<td>87</td>
</tr>
<tr>
<td>7) Will the patient be in general anaesthesia based on something else than propofol infusion for more than 90 min?</td>
<td>67</td>
<td>23</td>
</tr>
<tr>
<td>8) Will the patient receive loco/regional anaesthesia with opioid supplement intravenously?</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>9) Is the patient expected to need intravenous opioids postoperatively?</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>10) Is the patient scheduled for either strabismus surgery, laparoscopy, gynaecol.laparotomy, inner ear surgery or thyroid surgery?</td>
<td>37</td>
<td>63</td>
</tr>
</tbody>
</table>

* answer = “much” gives 2 points
** answer= yes gives 3 points (instead of 1) on this question
Addendum: As propofol anaesthesia less than 90 minutes are PONV protective; we have recently changed as follows:

Quest 6: answer= no, gives 0 point, answer =yes, gives 1 point

Quest 7: Will the patient received general anaesthesia with something else than propofol infusion for: a) less than 30 min = 1 point   b) between 30 and 90 min = 2 points  c) more than 90 min = 3 points
Table 2  Surgical procedures in the study patients, n (%):

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gynaecologic laparoscopy</td>
<td>6</td>
<td>(5)</td>
</tr>
<tr>
<td>Gynaecologic laparotomy</td>
<td>31</td>
<td>(25)</td>
</tr>
<tr>
<td>Gastro surgery, laparotomy</td>
<td>14</td>
<td>(12)</td>
</tr>
<tr>
<td>Mamma cancer surgery</td>
<td>19</td>
<td>(16)</td>
</tr>
<tr>
<td>ENT surgery</td>
<td>15</td>
<td>(13)</td>
</tr>
<tr>
<td>Orthopaedic surgery</td>
<td>28</td>
<td>(23)</td>
</tr>
<tr>
<td>Thyroid gland surgery</td>
<td>7</td>
<td>(6)</td>
</tr>
</tbody>
</table>
Figure texts:

**Figure 1:**
Ullevål-score (U-score) for PONV-risk based on the sum of 10 questions with individual score of 0-1 (or 2,3), see table 2. The figure shows distribution of 120 patients on different U-scores, with notification if PONV was registered or not.

**Figure 2:**
Apfel-score (A-score, 8,9) for PONV-risk based on the sum of four questions with individual score of 0-1 point (answer=no gives 0 point, answer = yes gives 1 point)
- Is the patient a female?
- Is the patient less than 60 years of age?
- Has the patient previously experienced PONV or travel sickness?
- Is the patient due for surgery with a high risk procedure?

The figure shows distribution of 120 patients on different A-scores, with notification if PONV was registered or not.

**Figure 3:**
Koivuranta-score (K-score) for PONV-risk based on the sum of five questions with individual score of 0-1 point (answer=no gives 0 point, answer = yes gives 1 point)
- Is the patient a female?
- Has the patient previously experienced PONV?
- Has the patient previously experienced travel sickness?
- Is the patient due for a procedure of more than 60 min duration?
- Is the patient a non-smoker?

The figure shows distribution of 120 patients on different K-score, with notification if PONV was registered or not.