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Management of postoperative nausea and vomiting in patients undergoing laparoscopic cholecystectomy

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Abstract The common and distressing complications of postoperative nausea and vomiting (PONV) are the main concern of 40–70% of patients undergoing laparoscopic cholecystectomy (LC). The first step in preventing PONV after LC is to reduce the risk factors involving patient characteristics, surgical procedure, anesthetic technique, and postoperative care. Particularly, the use of propofol-based anesthesia can reduce the incidence of PONV after LC. Second, prophylactic antiemetics including antihistamines (dimenhydrinate), phenothiazines (perphenazine), butyrophenones (droperidol), benzamides (metoclopramide), dexamethasone, and serotonin receptor antagonists (ondansetron, granisetron, tropisetron, dolasetron, and ramosetron) are available for preventing PONV after LC. Third, antiemetic therapy combined with a serotonin receptor antagonist (ondansetron, granisetron) and droperidol or dexamethasone is highly effective in the prevention of PONV after LC. Fourth, acupressure at the P6 point is a nonpharmacologic technique that is as effective as ondansetron for preventing PONV after LC. Knowledge regarding the risk factors for PONV and antiemetics is needed for the management of PONV after LC.

Keywords Vomiting · Antiemetics · Combination · Acupressure · Laparoscopic cholecystectomy

Laparoscopic cholecystectomy (LC), increasing common since 1980, is replacing open cholecystectomy. The laparoscopic approach causes less morbidity and mortality than open cholecystectomy. It also offers a shorter duration of surgery and less intense pain [1–3]. However, LC patients often experience postoperative nausea and vomiting (PONV) during the first 24 h after surgery. The reported incidence of PONV after LC varies from 50 to 70% [4–6]. The patient with PONV is predisposed to aspiration of gastric contents, increased intraocular pressure, psychological distress, and delayed recovery and discharge times [7, 8].

The vomiting reflex is a complex act coordinated by the vomiting center in the brainstem, which receives stimuli from the periphery via afferent neurons of the vagus nerves in the autonomic nervous system or centrally via the chemoreceptor trigger zone (CTZ), area postrema, or nucleus of the solitary tract [9, 10]. Many transmitters such as dopamine, histamine, and serotonin are involved in the process [7, 8].

Antiemetics commonly used in the prevention of PONV act at various stages of the emetic pathways by blocking different neuroreceptors [7, 8]. For patients undergoing LC, most of published trials indicate a reduction of risk factors for PONV, an improved antiemetic prophylaxis, a combination antiemetic therapy, and acupressure at the P6 point as a nonpharmacologic technique.

Reduction of risk factors for PONV

Factors affecting PONV after LC are patient characteristics, surgical procedure, anesthetic technique, and postoperative care [7, 8]. Several investigations have proposed the use of risk scoring systems based on logistic regression modeling to select patients for prevention of PONV

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[11, 12]. To avoid a complicated formulation of risk for PONV, four predictors have been defined: female sex, history of motion sickness or previous PONV, nonsmoking status, and use of postoperative opioids. The incidence of PONV is 10% if none of these risk factors are present, 23% if one is present, 61% of two are present, and 79% if four are present [13]. The incidence of PONV for female patients is three times that for males due to increased gonadotropin, estrogen, and plasma progesterone levels during their menstrual cycles [14].

Patients with a history of motion sickness or previous PONV are at increased risk for the development of emetic symptoms due to a low threshold for vomiting [7, 8, 15]. Cigarette smoking confers protection against PONV due to the presence of an antiemetic substance in tabacoo smoke [16], and thus the incidence of PONV appears to be less among smokers than among nonsmokers [17].

Surgical factors include operations (LC) with intraperitoneal insufflation of carbon dioxide (CO_2), which has an effect on residual stretching and irritation of the peritoneum [18] and duration of surgery [7, 8, 19]. Each 30-min increase in duration of surgery increases the risk for PONV by 60% so that a baseline risk of 10% is increased by 16% after 30-min [18].

Anesthesia-related factors include the choice of preanesthetic medication and anesthetic agent (nitrous oxide [N_2O], propofol). Premedication with opioids (morphine, fentanyl) increases the incidence of PONV by stimulating the central nervous system (CNS) opioid receptors [19]. The use of N_2O causes PONV by stimulation of the CNS with catecholamine release [19] and changes in middle ear pressure, resulting in traction on the membrane of the round window and consequent stimulation of the vestibular system [20].

Hartung [21] compared the incidence of PONV between patients who receive N_2O and those who receive anesthetics and analgesics without N_2O. He found an increased rate of PONV with the use of N_2O. In contrast, Taylor et al. [22] demonstrated that the use of N_2O had no clinical effect on surgical condition during LC and did not increase the incidence of PONV.

The use of propofol for maintenance of anesthesia has a positive effect on PONV reduction [23]. Patients with propofol anesthesia have a lower incidence of PONV after LC than those with thiopentone/halothane anesthesia [24]. Propofol possesses direct antiemetic properties [25], which is not a result of the lipid emulsion in the formulation of propofol [26].

Postoperative PONV factors are pain, dizziness, ambulation, oral intake, and analgesics (opioids), which increase the incidence of PONV after LC [7, 8]. Avoiding these PONV risk factors would result in less PONV for patients undergoing LC.

Improved antiemetic prophylaxis

Antiemetics used to prevent PONV after LC include antihistamines (dimenhydrinate), phenothiazines (perphenazine), butyrophenones (droperidol), benzamides (metoclopramide), dexamethasone, and serotonin receptor antagonists (ondansetron, granisetron, tropisetron, dolasetron, and ramosetron).

Antihistamines, which act on the vomiting center and the vestibular pathways, are particularly useful in the control of emesis [27]. Dimenhydrinate is an inexpensive antiemetic with an efficacy that might be considered clinically relevant without serious side effects [28]. Dimenhydrinate 62 mg administered intravenously (IV) after induction of anesthesia is effective in preventing PONV for female patients undergoing LC [29]. Prophylactic IV administration of dimenhydrinate 50 mg is as effective as ondansetron 4 mg in the prevention of PONV after LC [30]. Phenothiazines are effective in reducing of emesis by blocking dopamine receptors in the CTZ [31]. Perphenazine offers the advantages of low cost, slow intramuscular absorption, and long half-life elimination [32]. Perphenazine 5 mg administered IV after induction of anesthesia is effective for preventing PONV after LC [33]. Phenothiazines occasionally cause extrapyramidal adverse effects, ranging from restlessness to oculogyric crisis [7, 8]. Butyrophenones possess antiemetic activity as a result of their antagonistic properties at the dopamine receptors [33].

Droperidol has been widely accepted as the first-line therapy for the management of PONV [7, 8]. Droperidol 1.25 mg given as a single IV dose immediately before induction of anesthesia is effective for preventing PONV after LC [34]. Droperidol 1.25 mg administered IV at the beginning of surgery is as effective as tropisetron 5 mg in the preventing PONV in women undergoing LC [5]. When used with large doses (>2.5 mg), droperidol produces undesirable adverse effects including drowsiness, dysphoria, restlessness, and extrapyramidal signs [7, 8]. In 2001, the U.S. Food and Administration (FDA) issued an adverse events warning about droperidol because of its dysrhythmogenic effects such as prolonged Q wave–T wave interval (QT) syndrome [35]. However, after careful evaluation of all the reports submitted to the FDA, Habib et al. [36] concluded that none of the cases in which arrhythmia occurred after small doses of droperidol (<1.25 mg) showed evidence of a cause and effect relationship.

Benzamides have both central (CTZ and area postrema vomiting centers) and peripheral (gastrointestinal tract) antiemetic actions by blockage of dopaminergic receptors. They also increase esophageal sphincter tone and promote gastric emptying produced by the opioid analgesics [37].

Metoclopramide is an antiemetic used widely in clinical practice [7, 8]. Prophylactic IV administration of metoclopramide 10–20 mg reduces the incidence of PONV after

LC and is as effective as ondansetron 4–8 mg [38, 39]. Higher doses (>0.2 mg/kg) of metoclopramide is associated with extrapyramidal reactions such as akathisia and motor restlessness [7, 8].

Dexamethasone is an inexpensive and effective antiemetic drug with minimal adverse effects after a single-dose administration [40]. The exact mechanism of dexamethasone's antiemetic action is not fully understood. There have been several suggestions such as central or peripheral inhibition of the synthesis of prostaglandins or changes in the permeability of the blood–brain barrier to serum proteins [40, 41]. Dexamethasone 8 mg administered IV before surgery reduces the incidence of PONV among patients undergoing LC [6, 42]. Prophylactic IV administration of dexamethasone 5 mg is as effective as tropisetron 2 mg in the preventing PONV after LC [43].

Serotonin receptor antagonists (ondansetron, granisetron, tropisetron, dolasetron, and ramosetron) are highly effective in the prevention of PONV after LC [4, 5, 34, 43–51]. Their actions involve both central and peripheral mechanisms in the control of nausea and vomiting. Centrally, they bind competitively and selectively to serotonin receptors in the CTZ of the CNS. In addition to their central effects, they also block receptors in the gastrointestinal tract, which prevents the action of serotonin and inhibits emetic symptoms [52].

Ondansetron 4 mg administered IV immediately before induction of anesthesia reduces the incidence of PONV after LC [4, 44, 45] and is more effective than droperidol 1.25 mg or metoclopramide 10 mg [4, 34]. Oral disintegration of an ondansetron 8-mg tablet is as effective as ondansetron 4 mg administered IV in preventing PONV after LC [46].

Prophylactic granisetron administered IV (40 μg/kg) or given orally (2 mg) reduces the incidence of PONV in patients undergoing LC [47, 48]. Tropisetron 2–5 mg administrated IV before a surgical procedure [5, 43] is as effective as droperidol 1.25 mg [5] in reducing the incidence of PONV in patients undergoing LC. Dolasetron 12.5 mg administered IV immediately before induction of surgery reduces the incidence of PONV after LC [49, 50] and is as effective as ondansetron 4 mg [50]. Ramosetron 0.3 mg administered IV at the end of surgery is effective for preventing PONV after LC [51].

Serotonin receptor antagonists are generally well tolerated with few adverse effects [7, 8]. Headache is the most commonly reported adverse event in clinical trials of serotonin receptor antagonists for PONV after LC [4, 5, 34, 43–51].

Combination antiemetic therapy

None of the currently available antiemetics are entirely effective, perhaps because most of them act through the blockade of one receptor. Therefore, a combination of antiemetics with different sites of activity would perhaps be more effective than one drug alone [53]. Dexamethasone decreases chemotherapy-induced emesis when added to serotonin receptor antagonists (ondansetron) [54]. The mechanism by which dexamethasone enhances their antiemetic efficacy is not known, but it is hypothesized that corticosteroids may reduce levels of serotonin in neural tissue by depleting its precursor tryptophan. Antiinflammatory properties of corticosteroids may prevent the release of serotonin in the gut. Dexamethasone may potentiate the main effect of other antiemetics by sensitizing the pharmacologic receptor [55–57].

Combination antiemetic therapy often is effective for preventing PONV in patients undergoing LC [58–61]. The prophylactic antiemetic efficacy of combined ondansetron 4 mg and droperidol 1.25 mg administered IV immediately after induction of anesthesia is superior to that of droperidol alone in preventing PONV after LC [58]. A combination of granisetron 3 mg and droperidol 1.25 mg is more effective than each antiemetic alone administered IV before a surgical procedure in the prevention of PONV after LC [59]. Ondansetron 4 mg plus dexamethasone 8 mg administered IV before induction of anesthesia is more effective than ondansetron alone for preventing PONV in patients undergoing LC [60]. Dexamethasone 8 mg in combination with granisetron 40 mcg/kg administered IV before induction of anesthesia is more effective than granisetron alone in the prevention of PONV after LC [61].

Acupressure at the P6 point as a nonpharmacologic technique

As nonpharmacologic methods, acupuncture and acupressure have been evaluated in the prevention of PONV. In acupressure, manual stimulation is applied, whereas in acupuncture the skin is pierced with a needle. Most published articles indicate the efficacy of acupressure and acupuncture at the P6 (Neiguan) point located between the flexor tendons three fingerbreadths below the hand–wrist crease.

These nonpharmacologic techniques are more effective than placebo in reducing the incidence of PONV within 6 h postoperatively [62]. Application of acupressure at the P6 point 30 min before induction of anesthesia reduces the incidence of PONV in patients undergoing LC. Its efficacy is similar to that of ondansetron 4 mg, without adverse effects [63]. Acustimulation at the P6 acupoint using the ReliefBand (Woodside Biomedical, Carlsbad, CA, USA), a noninvasive, FDA-approved, portable, battery-powered, watch-like acustimulation device, reduces the incidence of PONV after LC [64].

Conclusion

For patients scheduled to undergor LC who are at high risk for PONV, reduction of risk factors for PONV and the prophylactic use of antiemetics should be considered. Knowledge regarding the risk factors for PONV and antiemetics is necessary for the management of PONV after LC.

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References

1. Cunningham AJ (1994) Laparoscopic surgery: anesthetic implications. Surg Endsc 8:1272–1284
2. Cunningham AJ, Brull SJ (1993) Laparoscopic cholecystectomy: anesthetic implications. Anesth Analg 76:1120–1133
3. Rose DK, Choen MM, Soutter DI (1992) Laparoscopic cholecystectomy: the anaesthetist's point of view. Can J Anaesth 39: 809–815
4. Naguib M, el Bakry AK, Khoshim MH, Channa AB, el Gammal M, el Gammal K, Elhattab YS, Attia M, Jaroudi R, Saddique A (1996) Prophylactic antiemetic therapy with ondansetron, tropisetron, granisetron and metoclopramide in patients undergoing laparoscopic cholecystectomy: a randomized, double-blind comparison with placebo. Can J Anaesth 43:226–231
5. Jokela R, Koivuranta M (1999) Tropisetron or droperidol in the prevention of postoperative nausea and vomiting: a comparative, randomised, double-blind study in women undergoing laparoscopic cholecystectomy. Acta Anaesthesiol Scand 43:645–650
6. Wang JJ, Ho ST, Liu YH, Lee SC, Liu YC, Liano YC, Ho CM (1999) Dexamethasone reduces nausea and vomiting after laparoscopic cholecystectomy. Br J Anaesth 83:772–775
7. Watcha MF, White PF (1992) Postoperative nausea and vomiting: its etiology, treatment, and prevention. Anesthesiology 77: 162–170
8. Kovac AL (2000) Prevention and treatment of postoperative nausea and vomiting. Drugs 59:213–243
9. Borison HL, Wang SC (1953) Physiology and pharmacology of vomiting. Pharm Rev 5:192–230
10. Wang SC, Borrison HL (1950) The vomiting center: a critical experimental analysis. Arch Neuro Psych 63:928–941
11. Apfel CC, Grein CA, Haubitz I, Goepfert C, Usadel J, Sefrin P, Roewer N (1998) A risk score to predict the probability of postoperative vomiting in adults. Acta Anaesthesiol Scand 42: 495–501
12. Sinclair DR, Chung F, Mezei G (1999) Can postoperative nausea and vomiting be predicted? Anesthesiology 91:109–118
13. Apfel CC, Laara E, Koivuranta M, Greim CA, Roewer N (1999) A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. Anesthesiology 91:693–700
14. Beattie WS, Lindblad T, Buckley DN, Forrest JB (1991) The incidence of postoperative nausea and vomiting in women undergoing laparoscopy is influenced by the day of menstrual cycle. Can J Anaesth 38:298–302
15. Smessaert A, Schehr CA, Artusio JF Jr (1959) Nausea and vomiting in the immediate postoperative period. JAMA 170: 2072–2076
16. Hough MB, Sweeney BP (1998) The influence of smoking on postoperative nausea and vomiting. Anaesthesia 53:932–933
17. Sweeny BP (2002) Why does smoking protect against PONV? Br J Anaesth 89:810–813
18. Iitomi T, Toriumi S, Kondo A, Akazawa T, Nakahara T (1995) Incidence of nausea and vomiting after cholecystectomy performed via laparotomy or laparoscopy (Japanese). Masui 44: 1727–1731
19. Jenkins JC, Lahay D (1971) Central mechanisms of vomiting related to catecholamine response: anaesthetic implication. Can Anaesth Soc 18:434–441
20. Perreault L, Normandin N, Plamondon L, Blain R, Rousseau P, Girard M, Forget G (1982) Middle ear pressure variations during nitrous oxide and oxygen anaesthesia. Can Anaesth Soc J 29: 428–434
21. Hartung J (1996) Twenty-four of twenty-seven studies show a greater incidence of emesis with nitrous oxide than alternative anesthetics. Anesth Analg 83:114–116
22. Taylor E, Feinstein R, White PF, Soper N (1992) Anesthesia for laparoscopic cholecystectomy: is nitrous oxide contraindicated? Anesthesiology 76:541–543
23. Sneyd JR, Carr A, Byrom WD, Bilski AJT (1998) A mata-analysis of nausea and vomiting following maintenance of anaesthesia with propofol or inhalational agents. Eur J Anaesthesiol 15:433–445
24. Klockgether-Radke A, Piorek V, Crozier T, Kettler D (1996) Nausea and vomiting after laparoscopic surgery: a comparison of propofol and vomiting after laparoscopic surgery: a comparison of propofol and thiopentone/halothane anaesthesia. Eur J Anaesthesiol 13:3–9
25. Borgeat A, Wilder-Smith OHG, Saiah M, Rifat K (1992) Subhypnotic doses of propofol possess direct antiemetic properties. Anesth Analg 74:539–541
26. Ostman PL, Faure E, Glosten B, Kemen M, Robert MK, Bedwell S (1990) Is the antiemetic effect of the emulsion of propofol due to the lipid emulsion? Anesth Analg 71:536–540
27. Bonica JJ, Crepps W, Monk B, Bennett B (1958) Postoperative nausea, retching and vomiting: evaluation of cyclizine (marezine) suppositories for treatment. Anesthesiology 19:432–540
28. Kranke P, Morin AM, Roewer N, Eberhart HJ (2002) Dimenhydrinate for prophylaxis of postoperative nausea and vomiting: a mata-analysis of randomized controlled trial. Acta Anaesthesiol Scand 46:238–244
29. Eberhart LH, Seeling W, Bopp TI, Morin AM, Georgieff M (1999) Dimenhydrinate for prevention of postoperative nausea and vomiting in female inpatients. Eur J Anaesthesiol 16: 284–289
30. Kothari SN, Boyd WC, Bottcher ML, Lambert PJ (2000) Antiemetic efficacy of prophylactic dimenhydrinate (Dramamine) vs ondansetron (Zofran): a randomized, prospective trial inpatients undergoing laparoscopic cholecystectomy. Surg Endosc 14: 926–929
31. Stwart DJ (1990) Cancer therapy, vomiting and antiemetics. Can J Physiol Pharmacol 68:304–313
32. Steinbrook RA, Gosnell JL, Freiberger D (1998) Prophylactic antiemetics for laparoscopic cholecystectomy: a comparison of perpherazine, droperidol plus ondansetron, and droperidol plus metoclopramide. J Clin Anesth 10:494–498
33. Loeser EA, Bennet G, Stanley TH, Marchin R (1979) Comparison of droperidol, haloperidol, and prochlorperazine as postoperative antiemetics. Can Anaesth Soc J 26:125–127
34. Helmy SA (1999) Prophylactic antiemetic efficacy of ondansetron in laparoscopic cholecystectomy under total intravenous anaesthesia: a randomized, double-blind comparison with droperidol, metoclopramide, and placebo. Anaesthesia 54:266–271
35. McCormick C (2002) FDA alert: current FDA report on droperidol status and basis for "black box" warning. Am Soc Anesthesiol Newslett 66:19–20

36. Habib AS, Gan TJ (2003) Food and drug administration black box warning on the perioperative use of droperidol: a review of the cases. Anesth Analg 96:1377–1379
37. Harrington RA, Hamilton CW, Brogden RN, Linkwwich JA, Romankiewicz JA, Heel RC (1983) Metoclopramide: an update review of its pharmacological properties and clinical use. Drugs 25:451–494
38. Wilson EB, Bass CS, Abrameit W, Roberson R, Smith RW (2001) Metoclopramide versus ondansetron in prophylaxis of nausea and vomiting for laparoscopic cholecystectomy. Am J Surg 181:138–141
39. Quaynor H, Raeder JC (2002) Incidence and severity of postoperative nausea and vomiting are similar after metoclopramide 20 mg and ondansetron 8 mg given by the end of laparoscopic cholecystectomies. Acta Anaesthesiol Scand 46:109–113
40. Henzi I, Walder B, Tramer MR (2000) Dexamethasone for the prevention of postoperative nausea and vomiting: a quantitative systematic review. Anesth Analg 99:186–194
41. Schimmer BP, Parler KL (2001) Adrenocorticotropic hormone: adrenocortical steroids and their synthetic analogs: inhibitors of the synthesis and actions of adrenocortical hormones. In: Hardman JG, Limbird LE, Molinoff PB, Ruddon RW, Gilman AG (eds) Goodman and Gilmann's the pharmacological basis of therapeutics, 10th edn. McGraw-Hill, New York, pp 1649–1677
42. Feo CV, Sortini D, Ragazzi R, DePalma M, Liboni A (2006) Randomized clinical trial of the effect of preoperative dexamethasone on nausea and vomiting after laparoscopic cholecystectomy. Br J Surg 93:295–299
43. Wang JJ, Ho ST, Uen YH, Lin MT, Chen KT, Huang JC, Tzeng JI (2002) Small-dose dexamethasone reduces nausea and vomiting after laparoscopic cholecystectomy: a comparison of tropisetron with saline. Anesth Analg 95:229–232
44. Cabrera JC, Matute E, Escolano F, Castillo J, Santiveri X, Castano J (1997) Efficacy of ondansetron in the prevention of nausea and vomiting after laparoscopic cholecystectomy (in Spanish). Rev Esp Anesthesiol Reanim 44:36–38
45. Liberman MA, Howe S, Lane M (2000) Ondansetron versus placebo for prophylaxis of nausea and vomiting in patients undergoing ambulatory laparoscopic cholecystectomy. Am J Surg 179:60–62
46. Grover VK, Mathew PJ, Hegde H (2009) Efficacy of orally disintegrating ondansetron in preventing postoperative nausea and vomiting after laparoscopic cholecystectomy: a randomised, double-blind placebo controlled study. Anaesthesia 64:595–600
47. Fujii Y, Saitoh Y, Tanaka H, Toyooka H (1998) Effective dose of granisetron in the prevention of postoperative nausea and vomiting in patients undergoing laparoscopic cholecyectomy. Eur J Anaesthesiol 15:287–291
48. Fujii Y, Tanaka H, Kawasaki T (2001) Prophylaxis with oral granisetron for the prevention of nausea and vomiting after laparoscopic cholecystectomy: a prospective randomized study. Arch Surg 136:101–104
49. Piper SN, Suttner SW, Rohm KD, Maleck WH, Larbig E (2002) Dolasetron, but not metoclopramide prevents nausea and vomiting in patients undergoing laparoscopic cholecyetectomy. Can J Anesthesiol 49:1021–1028
50. Walker JB (2001) Efficacy of single-dose intravenous dolasetron versus ondansetron in the prevention of postoperative nausea and vomiting. Clin Ther 23:932–938
51. Fujii Y, Uemura A, Tanaka H (2002) Prophylaxis of nausea and vomiting after laparoscopic cholecystectomy with ramosetron: randomised controlled trial. Eur J Surg 168:583–586
52. Bunce KT, Tyers MB (1992) The role of 5-HT in postoperative nausea and vomiting. Br J Anaesth 69:60S–62S
53. Rowbotham DJ (1992) Current management of postoperative nausea and vomiting. Br J Anaesth 69:46S–59S
54. Smith DB, Newlands ES, Rustin GJ, Begent RH, Howells N, McQuade B, Bagshawe KD (1991) Comparison of ondansetron and ondansetron plus dexamethasone as antiemetic prophylaxis during cisplatin-containing chemotherapy. Lancet 338:487–490
55. Youngs S (1981) Mechanism of decline in rat brain 5-hydroxytryptamine after induction of liver tryptophan pyrrolase by hydrocortisone: roles of tryptophan catabolism and kynurenine synthesis. Br J Pharmacol 74:695–700
56. Frederikson M, Mursti T, Furst C, Steineck G, Borjeson S, Wikblom M (1992) Nausea in cancer chemotherapy is inversely related to urinary cortisol excretion. Br J Cancer 65:779–780
57. Sager S (1991) The current role of antiemetic drugs in oncology: a recent revolution in patient symptom control. Cancer Treat Rev 18:95–135
58. Award IT, Murphy D, Stack D, Swanton BJ, Meeke RI, Shorten GD (2002) A comparison of effects of droperidol and the combination of droperidol and ondansetron on postoperative nausea and vomiting for patients undergoing laparoscopic cholecystectomy. J Clin Anesth 14:481–485
59. Fujii Y, Saitoh Y, Tanaka H, Toyooka H (1998) Prophylactic antiemetic therapy with granisetron–droperidol combination in patients undergoing laparoscopic cholecystectomy. Can J Anaesth 45:541–544
60. Elhakim M, Nafie M, Mahmoud K, Atef A (2002) Dexamethasone 8 mg in combination with ondansetron 4 mg appears to be the optimal dose for the prevention of nausea and vomiting after laparoscopic cholecystectomy. Can J Anesth 49:922–926
61. Fujii Y, Saitoh Y, Tanaka H, Toyooka H (2000) Granisetron/dexamethasone combination for the prevention of postoperative nausea and vomiting after laparoscopic cholecyetectomy. Eur J Anaesthesiol 17:64–68
62. Lee A, Done ML (1999) The use of nonpharmacologic technique to prevent postoperative nausea and vomiting: a meta-analysis. Anesth Analg 88:1362–1369
63. Agarwal A, Bose N, Gaur A, Singh U, Gupta MK, Singh D (2002) Acupressure and ondansetron for postoperative nausea and vomiting after laparoscopic cholecytectomy. Can J Anesth 49:554–560
64. Frey UH, Funk M, Lohleim C, Peters J (2009) Effect of P6 acustimulation on postoperative nausea and vomiting in patients undergoing a laparoscopic cholecystectomy. Acta Anaesthesiol Scand 53:1341–1347