Research Paper

Effect of *Citrus aurantium* on Pain Intensity and Blood Pressure in Gastrectomy

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Pain and impaired blood pressure are of the common postoperative complaints. Aromatherapy releases endorphins in the brain and forms a sense of well-being. Bitter orange (*Citrus aurantium*) is a sedative and sleep aid plant. The purpose of this study was to evaluate the effect of *Citrus aurantium* on pain intensity and blood pressure during gastrectomy. In the present study, 76 patients undergoing gastrectomy were selected by convenience sampling and randomly divided into two groups of 38 each. The intervention group received aromatherapy in the recovery room, in addition to routine postoperative care and the control group received placebo. Data collection tools included demographic profile questionnaire, numerical pain rating scale and physiological index record sheet. Blood pressure and pain intensity of patients were measured and recorded before the intervention, 30 min and 60 min after the intervention. Data were analyzed by statistical package for the social sciences software using descriptive and inferential tests at a significance level of $p<0.05$. The mean blood pressure before the intervention was 123.41±9.03 mm/Hg in the treatment group and 121.71±9.31 mm/Hg in the control group. The mean pain before the intervention was 6.02±0.84 in the treatment group and 5.83±0.43 in the control group. Statistical analysis showed that the treatment group had a significant decrease in systolic blood pressure and diastolic blood pressure at the two intervention times. In addition, the treatment group experienced a decrease in pain intensity at three times, with a mean rank of 3.32 before the intervention, 2.52 half an hour later and 1.42 an hour later. The postoperative aromatherapy with *Citrus aurantium* was effective in reducing systolic and diastolic blood pressure and relieving pain. This simple, uncomplicated, non-invasive and inexpensive method is recommended for use in controlling postoperative pain.

Key words: *Citrus aurantium*, postoperative aromatherapy, blood pressure, gastrectomy

Many surgical procedures are performed each year in the world for diagnostic, restorative and therapeutic purposes. Pain is a common side effect after all surgeries and surgical site pain is the main complaint after surgery from the perspective of patients[1]. Millions of people undergo surgery each year, including total or subtotal gastrectomy, which is one of the most common surgeries and induces significant and severe pain in the patient. Acute postoperative pain is one of the worst pains that humans experience; the more severe the pain, the more unfavorable hemodynamic and metabolic responses occur in patients[2]. Postoperative pain is one of the most important complaints of patients[3]. Despite 10 y of advances in pain control, many in the hospital and community complain due to lack of relief and recovery, with up to three-quarters complaining of pain in the hospital[4]. Although these medical advances are in the field of infectious and contagious diseases and serious efforts have been made in the past decades to manage pain in patients, pain is still considered as a major phenomenon for patients admitted to surgical wards[5].

Some of the complications of acute postoperative pain include gastrointestinal, coagulation, glandular, psychiatric and cardiovascular complications, such as hypertension, increased myocardial oxygen demand, coronary artery stenosis or ischemia and myocardial infarction. The pain is sometimes so severe that it can affect all systems of the body[6]. Changes in patient's blood pressure have been reported in all stages before and after induction of anesthesia during surgery and anesthesia immediately after surgery and extubation[7].

Postoperative pain is one of the most severe pains.

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Effective pain management after these operations is a multidisciplinary approach using pharmacological and non-pharmacological methods and is currently part of the surgical process[8]. Among the methods used to reduce pain are pharmacological and non-pharmacological or complementary methods[9]. Pharmacological therapies for pain control are often associated with side effects and in addition to numerous physical and mental side effects, drug dependence and tolerance for patients impose high health care costs on the healthcare systems[10]. In the aromatherapy, the released aroma affects the limbic system and increases a person's sense of calm[11]. The aromatherapy actually refers to the use of volatile oils or aromas extracted from aromatic plants for therapeutic purposes[12].

Candidates undergoing surgery are among the patients who experience the most severe pain during the first 48 h and many report moderate to severe pain even after a 4 d postoperative period[13]. Despite significant improvements in pain control, inpatients and outpatients suffer from postoperative pain. Evidence suggests that approximately 70 % of patients complain of severe pain on the 1st d after surgery. In addition to causing discomfort to the patient, the experience of pain can lead to complications and delay the recovery of the person undergoing surgery[14]. For years, the medical system believed that pain is an inevitable part of a patient's condition, pain is critical to a correct diagnosis, untreated pain has low economic costs, severe postoperative pain is inevitable and most patients exaggerate their pain. These ideas and legal issues are still prevalent in underdeveloped countries and in many cases, postoperative pain is considered a form of patient's exaggeration and demand for narcotics, and is not managed due to legal fears of drug addiction[15].

Due to the prevalence of acute pain after orthopedic surgery, which increases long-term complications and the duration of hospitalization of patients, as well as the exorbitant costs of patient care and the efforts of medical centers to increase the quality of care in recent years, the acute pain control guidelines after orthopedic surgery based on evidence-based process can be a reliable reference in providing high-quality medical and nursing services and reduce the length of hospital stay and costs for patients[16,17]. Due to the reduction of medical staff, especially nursing in medical centers in different hospitals around the world, this non-therapeutic method can be effective. The use of non-pharmacological methods can be effective, but in practice, it is observed that these simple, uncomplicated, non-invasive and inexpensive methods are not used in the national hospitals. Therefore, it seems necessary to make the right decision and use non-invasive pain control methods that can provide maximum help to patients. The aim of this study was to evaluate the effect of *Citrus aurantium* (*C. aurantium*) on pain intensity and blood pressure in gastrectomy.

MATERIALS AND METHODS

The present quasi-experimental design was performed on patients undergoing total or subtotal gastrectomy. Inclusion criteria included in this study were consciousness, ability to understand and describe pain, necessary cooperation from the patient, no history of respiratory allergies, asthma, allergic rhinitis, no hypersensitivity to plant substances according to the patient, no drug addiction (according to the patient and the medical record), no history of uncontrolled diabetes and neuropathy (due to pain disorder), a healthy sense of smell according to the patient, and no history of mental illness and cognitive disorders based on the patient's medical record. Exclusion criteria included out-of-routine drug abuse to relieve pain and instability of the patient's hemodynamic and physiological status. Considering a dropout of 5 %, 38 people were selected for each group. The research units were selected by convenience sampling and randomly divided into two groups of treatment (receiving aromatherapy with *C. aurantium* essential oil) and control (receiving placebo).

Data collection tools included demographic profile questionnaire, numerical pain rating scale and physiological index record sheet. Demographic characteristics included age, sex, educational level, marital status, employment status, insurance status, history of underlying disease, history of hand surgery, the patient's main complaint. All this information was completed in accordance with a medical record and through interviews and questions by the researcher. Physiological indicators in which the patient's vital signs including systolic and diastolic blood pressure were measured directly by the researcher and recorded directly, and vital signs of systolic and diastolic blood pressure were measured before the intervention, 30 min and 60 min after the intervention and recorded on the form. Pain intensity is measured by the numerical pain rating scale in the form of a graph between a rank

of 0-10, which was determined by the patient as a self-expression in this graph. Patients reported pain intensity on a numerical pain scale in three stages, before the intervention, half an hour and 1 h after the intervention. The instrument used to determine the time of pain intensity recording and physiological criteria after the intervention was the clock.

The data collection method included was the history of allergies to *C. aurantium* was examined the day before surgery in all the patients who need to enter the intensive care unit after surgery and was satisfied to participate in the study, and were excluded if the patient had a positive history of allergies. Patients undergoing surgery were usually cared for in the recovery ward for 45 to 60 min after surgery according to the anesthesiologist's instructions and then transferred to the ward for careful control of vital signs, bleeding and ongoing monitoring. In the treatment group, the patient received the necessary care and analgesia according to a routine schedule. In addition to receiving routine post-surgery care, they received aromatherapy as complementary medicine in the recovery room and ward. After entering the recovery room before receiving the routine analgesic drug (intravenous infusion of Apotel/acetaminophen at a dose of 1 g per 100 cc of normal saline) and before the intervention, while the patient was conscious, the pain intensity and physiological indices were measured. The drops were poured in the operating room during recovery so that the researcher poured five drops of *C. aurantium* at a concentration of 30 % on the pad (2×2)[14]. The pad impregnated with *C. aurantium* was placed at a distance of 5 cm from myopia to ten breaths. The pad was then attached to the collar of patient's scrubs and the patient inhaled the aroma of the *C. aurantium*-impregnated pad for half an hour. At the end of half an hour, pain intensity and physiological parameters were assessed and recorded[18,19]. After transferring the patient from the recovery room to the ward, while the pad was attached to the patient's collar, 1 h after the second recording, the pain and physiological criteria were re-examined and recorded.

Thus, 76 identical packages containing placebo solution with *C. aurantium* with codes 1 to 76 were prepared by the clinical pharmacist. One of the packages containing solution (unspecified) was selected by simple random method (random numbers) and used for the patient meeting the inclusion criteria. After consuming all the packages containing the solution, it was finally determined based on the codes which patients were in the control group (placebo) and which were in the treatment group (*C. aurantium*). In the control group, the patient received routine postoperative care in the recovery room and intensive care unit. After entering the recovery room before receiving the routine analgesic drug (intravenous infusion of Apotel/acetaminophen at a dose of 1 g per 100 cc of normal saline) and before the intervention, while the patient was conscious, the pain intensity and physiological parameters were measured. Five drops of placebo were instilled onto the pad (2×2) using a dropper. The pad impregnated with distilled water/placebo drops was placed at a distance of 5 cm from the nose to ten breaths. It was then attached to the collars of patient's scrubs. The patient inhaled the odor of the pad soaked in placebo drops for half an hour. At the end of half an hour, pain intensity and physiological parameters were assessed and recorded. After transferring the patient from the recovery room to the ward, while the pad was attached to the patient's collar, 1 h after the second recording, the pain and physiological criteria were re-examined and recorded. The patients in both treatment and placebo groups received painkillers routinely. At the study center, injectable Apotel/acetaminophen at a rate of 1 g per 100 cc of normal saline was routinely administered intravenously for patients. Placebo and *C. aurantium* solutions were coded in the same jars.

The participants were given sufficient explanations about the confidentiality of the information, the project methodology, as well as the objectives of the research and then signed an informed consent to enter the study. Data were analyzed by Statistical Package for the Social Sciences (SPSS) version 23 software using descriptive and inferential tests at a significance level of $p<0.05$.

RESULTS AND DISCUSSION

The mean age was 32.03±8.42 y in the treatment group and 32.71±9.88 y in the control group. The majority of the two groups (about 60 %) had a high school education level, most of them were self-employed and married, and the majority in both groups had an average economic level. The majority (above 90 %) in both groups had insurance support. The mean blood pressure before the intervention was 121.41±7.12 mm/Hg in the treatment group and 121.85±9.31 mm/Hg in the control group. The mean pain before the intervention was

6.92±0.84 in the treatment group and 5.53±0.12 in the control group.

Statistical tests showed a significant decrease in systolic blood pressure during both periods of intervention in the aromatherapy group. The mean rank was 3.32 before the intervention, 2.52 half an hour later and 1.42 an hour later. This decrease was effective in the control group only half an hour later and the increase in blood pressure was observed again 1 h after surgery, with a mean rank of 2.45 before the intervention, 1.59 half an hour later and 1.96 an hour later. This decrease was significant according to the Bunn-Bonferroni post hoc test. A Generalized Estimating Equation (GEE) by eliminating the time effect before intervention was used to prevent type I error in measuring systolic blood pressure during the intervention. Due to the level of significance, the time was not significant. Statistical tests revealed that the aromatherapy with *C. aurantium* has a facilitating effect on postoperative systolic blood pressure control (Exponentiation of the B Coefficient (Exp(B))=14.60), meaning that if the aromatherapy is prescribed, we will have a 14.60-fold odds ratio of lowering systolic blood pressure (Table 1 and Table 2).

The results of Bunn-Bonferroni post hoc test in the aromatherapy group showed a significant decrease in diastolic blood pressure in both intervention periods, but not significant in the control group, with an average rank of 2.28 before the intervention, 1.89 half an hour later and 1.83 an hour later. The statistical analyzes demonstrated that the aromatherapy with *C. aurantium* alleviates postoperative pain (Exp(B)=1.73), meaning that if the aromatherapy is applied, we will have a 1.73-fold odds ratio of relieving pain.

The current study aimed to determine the effect of aromatherapy with *C. aurantium* on pain intensity and blood pressure in patients undergoing surgery. The results showed that this intervention had a significant effect on reducing systolic blood pressure and alleviated the pain in both groups.

This study showed that aromatherapy significantly reduced systolic and diastolic blood pressure after the intervention. Similar studies have reported that *C. aurantium* was effective in lowering patient's blood pressure after surgery[20]. Cho *et al.* evaluated the effects of aromatherapy on anxiety, vital signs and sleep quality of percutaneous coronary intervention patients in intensive care units, and reported that although there was no difference in systolic and diastolic blood pressure before and after the intervention, a significant difference was observed in the changes in systolic and diastolic blood pressure between the groups[21]. The results of a study comparing the effect of *C. aurantium* and *Salvia officinalis* aroma on post-cesarean section pain showed that the mean pain before the intervention was not significantly different. After the intervention, in the group treated with *C. aurantium*, the mean pain in the first, second, third and fourth stages of the intervention were significantly reduced compared to the control group. In all four stages of the intervention, there was no statistically significant difference in the mean pain intensity in the aromatherapy group with *C. aurantium*[22]. A meta-analysis and systematic review by Lakhan *et al.* revealed that aromatherapy reduces pain intensity and suggested that aromatherapy can successfully treat pain if combined with conventional therapies[23].

Due to the effects of such therapies as low-risk,

TABLE 1: DISPERSION OF SYSTOLIC BLOOD PRESSURE DURING THE INTERVENTION IN PATIENTS UNDERGOING SURGERY

Systolic blood pressure	Before the intervention		30 min after the intervention		60 min after the intervention		Friedman test
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
Treatment group	121.41	7.12	118.87	10.14	115.08	10.38	p=0.001, $X^2(2)=28.21$
Control group	121.85	9.31	118.03	11.35	119.82	11.81	p=0.001, $X^2(2)=13.32$

TABLE 2: GEE BY ELIMINATING THE TIME EFFECT BEFORE INTERVENTION

Effect	Wald Chi-square test	Degrees of freedom	Significance level	Exp(B)
Time	4.14	1	0.26	0.16
Group	1.9	1	0.69	0.009
Time×Group	12.25	1	0.000	14.60

cost-effective and easy treatments with limited side effects in medical care, many treatment and care centers in this field are expanding. The aromatherapy refers to the controlled administration of aromatic oils to maintain and promote physical and mental health, which can affect the mind, body and soul. In the aromatherapy, the resulting aroma can increase a person's sense of relaxation by affecting the limbic system[10]. Based on this research, it can be stated that aromatherapy with *C. aurantium* essential oil in the recommended amount does not cause any side effects and can have a significant effect on lowering systolic and diastolic blood pressure and relieving pain. Due to the declined systolic and diastolic blood pressure and relieved pain, the aromatherapy can be introduced as a new approach for controlling and managing pain and blood pressure. There were several limitations in this study, including ignoring the patient's mental tolerance threshold and pain habits, examining patient's mental state and pain habits in future studies. One of the strengths and novelty of this study was to evaluate for the first time the effect of *C. aurantium* on pain intensity and blood pressure in patients undergoing total or subtotal gastrectomy, so that no similar study was found in this context.

The results of the present study revealed that the administration of aromatherapy with *C. aurantium* after total or subtotal gastrectomy is effective in reducing systolic and diastolic blood pressure and in relieving pain. Therefore, this simple, uncomplicated, non-invasive and inexpensive method is recommended for use in controlling postoperative pain.

Conflict of interests:

The authors declared no conflict of interest.

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This article was originally published in a special issue,"New Advancements in Biomedical and Pharmaceutical Sciences" Indian J Pharm Sci 2022:84(2) Spl Issue "174-179"