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Ondansetron or promethazine: Which one is better for the treatment of acute peripheral vertigo?

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ABSTRACT

Background: Vertigo is a common annoying complaint needing emergent treatment. There are various treatment options for this condition with different outcomes and side effects.
Objectives: Assessment and comparison of the effectiveness of Ondansetron and Promethazine in the treatment of acute peripheral vertigo.
Materials and methods: This clinical trial was conducted in an academic hospital in the north of Iran in 2017. A total of 170 eligible patients were randomly allocated to groups A: received intramuscular (IM) promethazine; and B: received intravenous (IV) Ondansetron, using quadripartite blocks. The severity of vertigo, nausea, blood pressure, heart rate, side-effects, need for re-administration, and the time to become asymptomatic were assessed before the injections, 30 min after and 2 h after the injections.
Results: Excellent improvement in vertigo occurred in both groups ($P < 0.001$), with a more significant reduction in the promethazine-treated group ($P < 0.001$). Nausea was reduced more significantly in the ondansetron-treated group ($P < 0.05$). There were more side-effects seen in the promethazine-treated when compared to the group with ondansetron treatment ($P < 0.001$). No significant differences were seen in the blood pressures between groups ($P > 0.05$). Heart rates were reduced in both groups but the changes were insignificant ($P > 0.05$). The ondansetron-treated group showed a greater need for re-administration of the medication (50.6% vs. 27.1%). The relief score was significantly higher in the ondansetron-treated group compared with the group received promethazine ($P < 0.001$). The time to become asymptomatic showed no statistically significant difference between groups ($p = 0.28$).
Conclusion: Our results indicated that while promethazine cures peripheral vertigo more efficiently, ondansetron is more beneficial for the improvement of nausea and vomiting.

1. Introduction

Vertigo is a sense of rotation or movement of the head and the body and is a common symptom [1,2]. It includes peripheral and central types [3–5]. Peripheral vertigo originates from the outside of the central nervous system (CNS) and includes benign paroxysmal positional vertigo (BPPV), labyrinthitis, vestibular neuritis, and Meniere's disease. Fortunately, each of these diseases presents with unique symptoms which helps the physician with the diagnosis through an outpatient examination [6–8]. Not only it is an annoying symptom, it almost always is accompanied by nausea and vomiting, accelerating the need for emergent treatment.

Vertigo-inhibiting medications include benzodiazepines, antihistamines, anticholinergics, and monoaminergic agents. These medications are mainly effective in the treatment of vertigo with the peripheral origin [9]. Promethazine is an H_1 receptor-blocker and a poor dopaminergic antagonist and is considered as one the treatment options for vertigo [10], as it contributes to the amelioration of nausea,

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vomiting, and to some extent vertigo itself [11–15].

Ondansetron is a serotonin receptor-antagonist that is used for treating nausea and vomiting. It is remarkably effective in the treatment of pregnancy nausea and vomiting, and also in the case of chemotherapy complications [16–18].

Given the very effective role of ondansetron in the treatment of vomiting, it could be introduced as the optimal treatment for symptoms of acute peripheral vertigo (APV) in emergency departments, if it would cure vertigo too. The present study was aimed to compare the effects of promethazine and ondansetron, two routinely used medication, on the treatment of vertigo.

2. Materials and methods

2.1. Study population and sampling method

The present study is a prospective head-to-head clinical trial, comparing the effects of promethazine (IM administration) with ondansetron (IV administration) on vertigo and nausea presented in patients with APV. First, it was registered in the Ethics Committee of Guilan University of Medical Sciences to obtain an approval code (IR.GUMS.REC.1396.437). Then, it was also registered at the Iranian Registry of Clinical Trials (IRCT code: IRCT20180129038543N1). Subjects were then selected through convenience sampling from all patients with peripheral vertigo admitted to the emergency department of a teaching hospital in the north of Iran from March to April 2018. The sample size was determined as 68 patients per group, as previously described by Eftekhari et al. [19] with a 95% confidence interval and 90% test power and the expected significant clinical difference of 1.5 in relief score (promethazine: 5.34 ± 3.1 vs. ondansetron: 6.4 ± 3.2). In the case of being excluded based on the eligibility criteria, patients were being replaced. Considering a dropout of 20%, the sample size per group was calculated as 85.

2.1.1. Inclusion criteria

Patients with ages between 20 and 60 years old, showing symptoms of acute peripheral vertigo including acute true vertigo (a true sense of rotation or movement) which could be accompanied by nausea and vomiting, past or present hearing symptoms (e.g. tinnitus or ear fullness) and the lack of new concomitant neurological symptoms.

2.1.2. Exclusion criteria

Symptoms of BPPV proven by Dix-Hallpike maneuver, recent head trauma, known dystonia which may get worse by promethazine, sensitivity to promethazine or ondansetron, taking any CNS suppressants from 24 h before being admitted to the emergency department such as antihistamines, antipsychotics, opioid analgesics or tranquilizers, pregnancy, and unwillingness to take part in the study. The patients who were clinically and/or by brain imaging and audiometric tests have proven to have central vertigo were also excluded from the study, even if they had received treatment.

2.2. Intervention

Patients with an initial diagnosis of APV were randomly allocated to the groups A: received IM promethazine; and B: received IV Ondansetron, using randomized quadripartite blocks ($n = 85$ in each group). It was a double-blind trial and the patients and the evaluator were blind to the treatment groups. Medications were administered by an emergency nurse (M.Sc) in the hospital. Group A received 1 cc IM injection of promethazine containing 25 mg (50 mg/2 ml vials, Caspian Tamin Pharmaceutical Company) and 2 cc IV injection of saline solution. Group B received 2 cc IV injection of ondansetron containing 4 mg (4 mg/2 ml vials, Exir Medical Company) and 1 cc IM injection of saline solution. Patients were examined before, 30 min after, and 2 h after the injections. The severity of vertigo and nausea were assessed using the visual analog scale (*VAS*). The mean systolic and diastolic blood pressures and heart rates were also measured and recorded. Potential side effects, such as hallucination, blurred vision, apnea and sleepiness, the need for re-administration of the medications and the patients' satisfaction were assessed and recorded 30 min and 2 h after the administration. The time to become asymptomatic was also recorded.

2.3. Assessment measures

VAS is a criterion for measuring the severity of variables such as pain and provides physicians and examiners with a general assessment of the patients' current state with scores 0 to 10 based on a self-report [20].

The *Relief Score* consists of a valid scoring system involving different variables which are depended on the type of the disease, as for vertigo it involves variables such as nausea, vomiting and the patients' self-assessment of the treatment. The total relief score ranges from −6 to 9, on which nausea and vomiting are assessed based on a four-point Likert scale from “worsened (−3)” to “no changes (0)”, “reduced (2)” and “totally improved (3)”. The patient's self-assessment is measured by four options, including “No improvements (0)”, “fairly improved (1)”, “good (2)” and “excellent (3)” [19].

2.4. Data analysis

Normal distribution of the collected data was assessed by Kolmogorov-Smirnov (K-S) normality test. The parametric paired *t*-test was used to compare the *VAS* and relief scores before and after the intervention within both groups. The changes before and after the intervention were also compared between the two groups using the independent t-test. The non-parametric Mann–Whitney's *U* test and Wilcoxon's test were used when the assumptions for the *VAS* and relief scores did not follow the normal distribution. ANCOVA and repeated-measures ANOVA were used to compare the effects of the medications at different time points using Bonferroni adjustment. The regression analysis was also performed to adjust the patients' personal and baseline variables and assess the pure effect of drugs on vertigo. $P < 0.05$ was taken as the level of statistical significance. The analyses were carried out in SPSS version 21.

2.5. Ethical considerations

The medications used in this study were all based on known treatments for peripheral vertigo and/or nausea. The medication dosage was chosen based on the available guidelines (were also been used in Refs. [17–21], and). Two emergency medicine residents constantly and closely monitored the patients.

3. Results

This study was conducted on 170 participants, including 74 (43.5%) men and 96 (56.5%) women. The study groups were similar in term of gender (55.3% of the promethazine group and 57.6% of the ondansetron group were females) with no significant difference ($P = 0.757$). The overall mean of age was 47 ± 9.5 years, 48.84 ± 9.39 in the promethazine-treated group and 45.16 ± 9.29 in the ondansetron-treated group ($P = 0.011$).

Only 50 subjects (29.4%) had previous history of vertigo, including 34.1% ($n = 29$) patients in the promethazine-treated group and 24.7% ($n = 21$) in the ondansetron-treated group ($P = 0.147$).

According to Mann–Whitney's *U* test, there were significant differences in the severity of vertigo at all time points between the two groups. The promethazine-threated group has shown to have significantly more severe symptoms at all time points, except for the before injections till 30 min after the injections ($P = 0.924$). According to the adjusted Bonferroni test, the changes were also significant at all

Table 1
The severity of the vertigo (VAS) and its changes in measurement time points in patients treated by Promethazine and Ondansetron.

Severity of vertigo		Study groups		
		Promethazine	Ondansetron	P**
Before injection	Mean ± SD	8.65 ± 1.08	8.29 ± 1.03	0.034
30 min after injection	Mean ± SD	5.51 ± 1.12	5.14 ± 1.07	0.011
2 h after injection	Mean ± SD	4.27 ± 2.43	5.24 ± 2.46	0.023
Chang from before injection till 30 min after injection	Mean ± SD	3.14 ± 1.00	3.15 ± 0.99	0.924
P*		0.001	0.001	
Chang from 30 min after injection till 2 h after injection	Mean ± SD	1.24 ± 2.25	−0.09 ± 2.46	0.001
P*		0.001	0.999	
Chang from before injection till 2 h after injection	Mean ± SD	4.38 ± 2.30	3.06 ± 2.41	0.001
P*		0.001	0.001	
(time effect) P***		0.001	0.001	

P* Adjusted Bonferroni P** Mann–Whitney *U* Test, P*** Friedman.

time points for ondansetron too, except for the changes between 30 min after and 2 h after injections ($P = 0.999$). Although according to Friedman's test the severity of vertigo showed a significant decrease in both promethazine- and ondansetron-treated groups, the amount of the decrease in the promethazine-treated group was higher (mean = 4.38 ± 2.30 vs. 3.06 ± 2.41) (Table 1).

Both groups were similar in terms of severity of nausea and vomiting before the intervention. Mann–Whitney's *U* test showed significant differences between the two groups in terms of the severity of nausea and vomiting in all other time points. The ondansetron-treated group showed a significantly more severe nausea and vomiting at all time points, except for the 30 min till 2 h after the injections ($p = 0.641$). According to the adjusted Bonferroni test, the changes were significant at all time points for ondansetron-treated group except for the changes between 30 min after and 2 h after the injections ($P = 0.064$). Although according to Friedman's test the severity of nausea and vomiting showed a significant decrease in both groups, unlike the severity of vertigo, the amelioration of nausea and vomiting was greater in the ondansetron-treated group (mean = 5.02 ± 2.79 vs. 3.98 ± 2.49) (Table 2).

Table 2
The severity of the nausea and vomiting (VAS) and their changes in measurement time points in patients treated by Promethazine and Ondansetron.

Nausea and vomiting severity		Study groups		
		Promethazine	Ondansetron	P**
Before injection	Mean ± SD	7.82 ± 1.97	8.35 ± 1.32	0.191
30 min after injection	Mean ± SD	4.68 ± 1.61	3.92 ± 1.55	0.002
2 h after injection	Mean ± SD	3.85 ± 2.58	3.33 ± 2.72	0.030
Chang from before injection till 30 min after injection	Mean ± SD	3.14 ± 1.53	4.44 ± 1.64	0.001
P*		0.001	0.001	
Chang from 30 min after injection till 2 h after injection	Mean ± SD	0.84 ± 2.13	0.59 ± 2.34	0.641
P*		0.009	0.064	
Chang from before injection till 2 h after injection	Mean ± SD	3.98 ± 2.49	5.02 ± 2.79	0.005
P*		0.001	0.001	
(Time effect) P***		0.001	0.001	

P* Adjusted Bonferroni P** Mann–Whitney *U* Test, P*** Fried Man.

In each measurement time point, significant differences were observed between the two groups in terms of systolic and diastolic blood pressures ($p < 0.05$). According to the adjusted Bonferroni test, no significant differences were observed between groups in systolic blood pressures among the time points ($P > 0.05$). But, Friedman's test showed that the promethazine-treated group had a significant descending trend in blood pressures from before the injection until the end of the study ($P = 0.036$), while the reduction in blood pressures showed no significant changes in the ondansetron-treated group ($P = 0.314$) (Fig. 1). There were no significant differences between diastolic blood pressures in the two groups (Adjusted Bonferroni $P > 0.05$). According to Friedman's test, changes in diastolic blood pressures were also not significant within any of the groups at different time points ($P > 0.05$) (Fig. 2). The heart rate showed a descending trend in both the promethazine-($P = 0.017$) and ondansetron-($P = 0.002$) treated groups, however, the difference was not significant ($P > 0.05$) (Fig. 3).

The mean relief score was higher in the ondansetron-treated group in comparison with the promethazine-treated group (5.54 ± 1.22 vs. 4.93 ± 1.12) 30 min after the injections ($P = 0.016$). The same relationship was observed 2 h after injections as well (mean = 5.65 ± 3.81 vs. 5.03 ± 3.22; median = 7 vs. 5) ($P < 0.001$). Based on the relief scores, the ondansetron-treated group showed a better response to the medication when compared with the promethazine-treated group. Patients' self-reported assessments were significantly different between the two groups; 30 min ($P < 0.001$) and 2 h ($P < 0.001$) after the injections, and patients' satisfaction was higher in the ondansetron-treated group (i.e. there were more cases of a self-reported 'excellent' health assessment) when compared with the promethazine-treated group, both 30 min (24.7% vs. 4.7%) and 2 h (61.2 vs. 25.9%) after the injections.

Significant differences were seen in the side-effects between the two groups 30 min ($P < 0.001$) and 2 h ($P < 0.001$) after the injections, so that promethazine treatment developed more side-effects than the ondansetron treatment 30 min (58.8% vs. 11.8%) and 2 h (61.2% vs. 12.9%) after the injections. Sleepiness was the most common side-effect in both groups, although it was reported with a much higher frequency in the promethazine-treated group (54.1% vs. 10.6%).

There were no significant differences between the two groups in terms of the need for re-administration of the drugs 30 min after the injections ($P = 0.059$), but the differences became significant 2 h after injections ($P < 0.001$), and there was a higher need in the ondansetron-treated group in comparison with the promethazine-treated group (50.6% vs. 27.1%).

The mean and standard deviation of the time to become asymptomatic was 4.61 ± 1.43 h in the promethazine- and 4.86 ± 1.51 h in the ondansetron-treated groups, with no significant differences between them according to the independent *t*-test ($P = 0.28$).

4. Discussion

Vertigo is a very annoying symptom and is unbearable for the patient if left untreated. Nausea and vomiting regularly accompany this symptom as well, which cannot be left untreated either. Also, sometimes the side-effects of the treatments may cause other complications for the patient. Researchers have always sought to introduce effective therapeutic options with fewer side-effects for these conditions, especially a treatment resolving both vertigo and its associated symptoms at once. Promethazine is a common treatment for this complaint [10]. The present study compares ondansetron (often used to treat nausea and vomiting in various diseases) with promethazine in terms of their beneficial effects on vertigo and the linked nausea and vomiting.

In this study the severity of vertigo, the severity of nausea, systolic and diastolic blood pressures and heart rates were assessed before, 30 min after and 2 h after the injections. Medication side-effects and the need for re-administration of drugs were also assessed and the time to become asymptomatic was calculated.

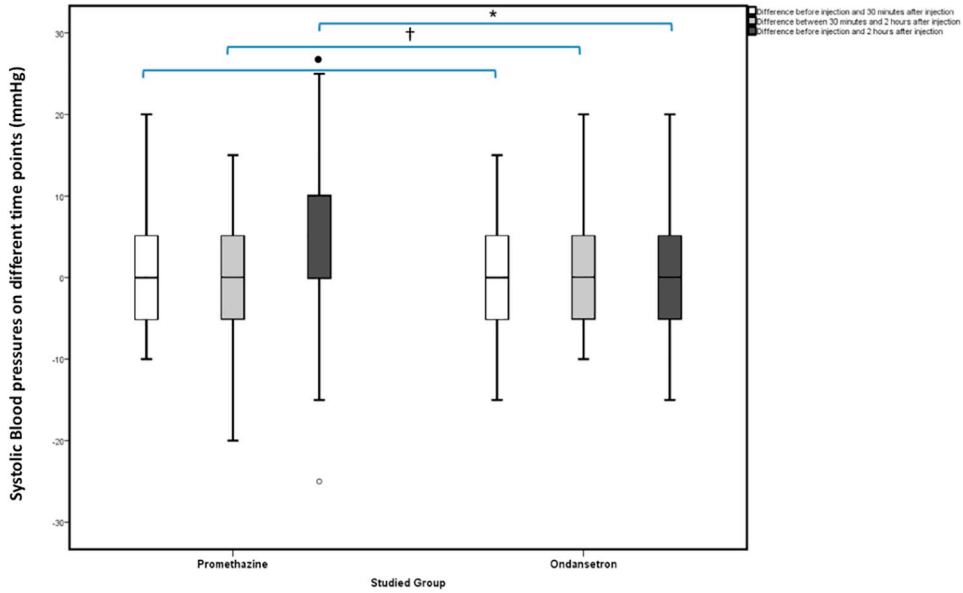

Fig. 1. Changes of the systolic blood pressures (mm Hg) during study and its difference between Promethazine- and Ondansetron-treated groups. Adjusted Bonferroni P: • $P = 0.958$, † $P = 0.093$, *$P = 0.152$.

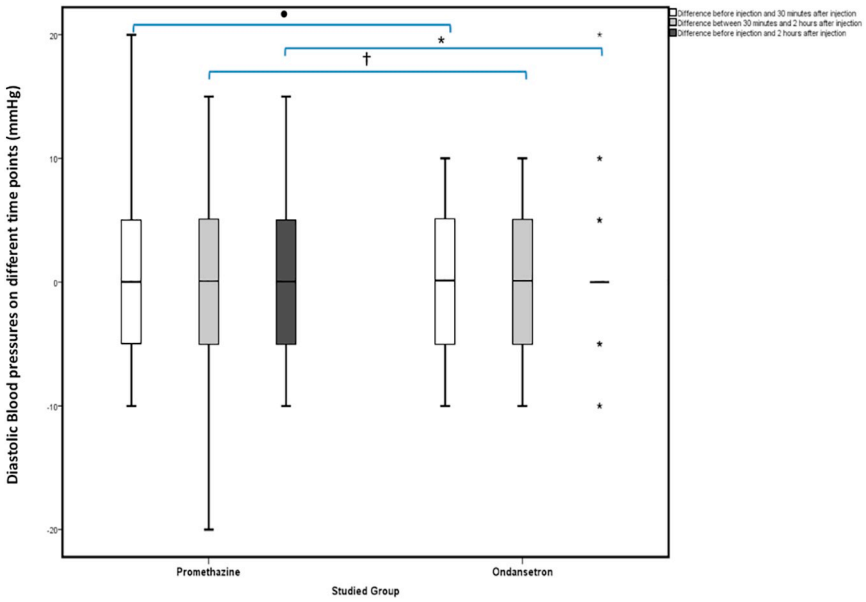

Fig. 2. Changes of the diastolic blood pressures (mmHg) during study and its difference between Promethazine- and Ondansetron-treated groups. Adjusted Bonferroni P: • $P = 0.223$, † $P = 0.398$, *$P = 0.483$.

There were no significant differences between the two groups in the severity of vertigo before and 30 min after the injections. Although the severity of vertigo had a significantly descending trend in both the promethazine- and ondansetron- treated groups, the reduction after 2 h was 1.5 fold higher in the promethazine-treated group when compared with the ondansetron-treated group. In a double-blind clinical trial conducted by Amini et al. in Iran in 2014, the effects of intravenous promethazine and intravenous lorazepam administration were compared and the results showed that the severity of vertigo has been reduced more by promethazine rather than by lorazepam ($P < 0.001$) [21]. In another clinical trial in Iran, Shafipour et al. (2016) compared the effectiveness of intravenous promethazine and intravenous diazepam; it has been shown that promethazine was more effective than diazepam in the treatment of vertigo [22]. Parallel to these studies, results from the present study also indicated that promethazine was significantly effective in the management of vertigo. Although the medications compared in the present study were different from those studied by Amini et al., promethazine was proved to be more effective in the management of vertigo compared to the previous studies.

In the present study, the severity of nausea and vomiting were found to be significantly reduced in both groups over time. This reduction was clearly greater in the ondansetron-treated group, but the changes were not significant when the two groups were compared 30 min and 2 h after the injections. In a study conducted by Barret et al. (2011) on the superiority of ondansetron over metoclopramide, promethazine or a placebo saline in the treatment of nausea of any cause, ondansetron showed superiority only over the placebo saline [23], while in this study, ondansetron significantly reduced vertigo-induced nausea and vomiting more than promethazine. In another study, Darren Braude et al. (2008) compared ondansetron and promethazine in patients complaining of nausea of any cause, their results showed that the two medications had similar effects [24]. Unlike the two cited studies,

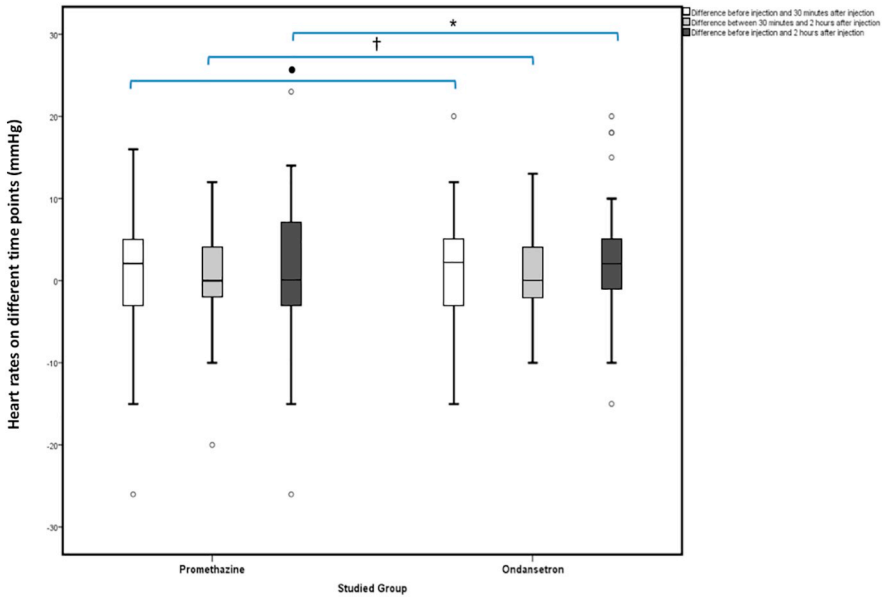

Fig. 3. Changes of the heart rates during study and its difference between Promethazine- and Ondansetron-treated groups. Adjusted Bonferroni P: • $P = 0.687$, † $P = 0.474$,* $P = 0.742$.

Relief score for nausea and vomiting		
−3	Get worse	Nausea
0	Has not changed	
2	Decreased	
3	Completely improved	
−3	Get worse	Vomiting
0	Has not changed	
2	Decreased	
3	Completely improved	
0	Lack of improvement	Patient satisfaction regarding treatment
1	Relative improvement	
2	Good improvement	
3	excellent Improvement	

The relief score used by patients for nausea and vomiting self-evaluation.

ondansetron had a significantly greater effect on controlling nausea and vomiting in the present study when compared to promethazine. It should be noted that in contrast with the present study, the etiology of nausea and vomiting was not clear in the cited studies, and inhomogeneous causes of nausea might have resulted in the disparity in the amount of effectiveness of ondansetron as a confounding factor. In a study in 2012, Eftekhari et al. compared the effect of promethazine and ondansetron on severe pregnancy-induced nausea and vomiting. Although a greater recovery was observed in the ondansetron-treated group, and although one patient in the ondansetron- and six in the promethazine-treated groups did not respond to the treatment (and these figures indicate the more favorable response to ondansetron), the difference between the two groups was not statistically significant [19].

In this study, we also investigated relief scores, which were higher in the ondansetron-treated group compared to the promethazine-treated group 30 min and 2 h after the injections. The variables used for relief scoring show that nausea and vomiting had the main role in this system. Since patients with ondansetron treatment were much more satisfied with their treatment of nausea and vomiting (and experienced an 'excellent' health condition more commonly) than the promethazine group, the higher relief score in the ondansetron compared to the promethazine group was expected. Meanwhile, Eftekhari et al., who used the same scoring scale, reported no significant differences [19], which can be explained by the lack of superiority of ondansetron over promethazine in reducing pregnancy-induced nausea and vomiting.

Systolic blood pressure showed a descending trend in the promethazine-treated group, but the changes were not significant in the ondansetron-treated group. There were also no significant differences between the two groups in terms of systolic blood pressures. The diastolic blood pressures did not show significant changes in either of the groups.

Significant reduction in the heart rates was observed in both groups, which might or might not be attributed to the medications. The heart rates may have also been changed due to nausea and vomiting and the related hyperventilation. Previous studies lacked discussing the heart rate changes and its possible causes.

According to the data obtained from this study, promethazine caused more side-effects than ondansetron. The most common side-effect was sleepiness, which was much more prevalent with promethazine (54.1% vs. 10.6%). Other issues such as hallucination, blurred vision and apnea were very rare (0% to 4%) and had almost the same prevalence in both groups. Parallel to our results Darren Braude et al. [23] also reported that sleepiness was more prevalent with promethazine. Eftekhari et al. [19] too, described similar results and sleepiness was a common side-effect of promethazine.

The need for re-administration of the drugs 2 h after the first administration was significantly higher in the ondansetron-treated group. A single dose of promethazine could improve vertigo more significantly. This finding directly affects the time needed to become asymptomatic, which was around 4 h in all patients in the promethazine group, and a repeat dose could obviously have a confounding effect on this variable.

Overall, vertigo showed a better improvement in response to the promethazine treatment, while ondansetron was superior in abating symptoms of nausea. Considering the fact that the time needed to become asymptomatic entailed the improvement in both nausea and vertigo. Studies on this subject did not assess the requirement of drug re-administration and the time to become asymptomatic.

5. Study limitations

The study limitations included the non-cooperating patients and unwillingness to take part.

6. Conclusion

Ondansetron and promethazine are both remarkably effective drugs in controlling vertigo and the linked nausea. While improvement in vertigo was better with promethazine treatment, over time, ondansetron was more effective in resolving nausea and vomiting. Ondansetron has shown to have fewer side-effects, but a single dose of promethazine was more effective than ondansetron. On the other hand, the need for drug re-administration was much higher with ondansetron. Surprisingly, the time to become asymptomatic was similar in both groups. In views of these findings, the patients presenting with severe vertigo and not-so-severe vomiting could be treated with promethazine. Conversely, patients presenting with very severe vomiting and not-so-severe vertigo could be treated with ondansetron. Future studies are recommended to compare a larger number of medications to provide a better clinical view for selection of the best medication with fewer side-effects.

Conflict of interest

The authors have no conflict of interest.

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References

[1] Helminski JO, Zee DS, Janssen I, Hain TC. Effectiveness of particle repositioning maneuvers in the treatment of benign paroxysmal positional vertigo: a systematic review. Phys Ther 2010;90(5):663–78.
[2] Rupa V. Persistent vertigo following particle repositioning maneuvers: an analysis of causes. Arch. Otolaryngol. Head Neck Surg. 2004;130(4):436–9.
[3] Bhattacharyya N, Baugh RF, Orvidas L, Barrs D, Bronston LJ, Cass S, et al. Clinical practice guideline: benign paroxysmal positional vertigo. Otolaryngol. Head Neck Surg. 2008;139(5_suppl):47–81.
[4] Handa PR, Kuhn AMB, Cunha F, Schaffleln R, Ganança FF. Quality of life in patients with benign paroxysmal positional vertigo and/or Ménière's disease. Rev. Bras. Otorrinolaringol. 2005;71(6):776–83.
[5] Saberi A, Nemati S, Pourafshar P. Clinical, demographic, and paraclinic findings of central and peripheral vertigo. Journal of Guilan University of Medical Sciences 2014;23(91):1–7.
[6] Dorigueto RS, Mazzetti KR, Gabilan YPL, Ganança FF. Benign paroxysmal positional vertigo recurrence and persistence. Braz J Otorhinolaryngol 2009;75(4):565–72.
[7] Motasaddi-Zarandi M, Nemati S, Panahi R, Akbari M. Benign paroxysmal positional vertigo prevalence in Meniere's disease: is Meniere's disease a predisposing factor? Caspian Journal of Neurological Sciences 2015;1(1):7–11.
[8] Saberi A, Nemati S, Sabnan S, Mollahoseini F, Kazemnejad E. A safe-repositioning maneuver for the management of benign paroxysmal positional vertigo: Gans vs. Epley maneuver; a randomized comparative clinical trial. Eur Arch Otorhinolaryngol 2017;274(8):2973–9.
[9] Hashemi S. Comparison of the efficacy of canalith repositioning procedure and dimenhydrinate in the treatment of benign paroxysmal positional vertigo. 2002.
[10] Kerber K, Baloh R. Neuro-otology: diagnosis and management of neuro-otoligical disorders. Bradley's Neurology in Clinical Practice. 6th ed.Philadelphia, PA: Elsevier Saunders; 2016.
[11] Pang L, Chang R, Kuo C. Vertigo: part 1-assessment in general practice. Aust Fam Physician 2008;37(5):341.
[12] Gill S, Maltepe C, Koren G. The effectiveness of discontinuing iron-containing prenatal multivitamins on reducing the severity of nausea and vomiting of pregnancy. J Obstet Gynaecol 2009;29(1):13–6.
[13] Gnerre P, Casati C, Frualdo M, Cavalleri M, Guizzetti S. Management of vertigo: from evidence to clinical practice. Italian Journal of Medicine 2015;9(2):180–92.
[14] Schneider B, Klein P, Weiser M. Treatment of vertigo with a homeopathic complex remedy compared with usual treatments. Arzneimittelforschung 2005;55(01):23–9.
[15] Swartz R, Longwell P. Treatment of vertigo. Am. Fam. Physician 2005;71(6).
[16] Anderka M, Mitchell AA, Louik C, Werler MM, Hernández-Diaz S, Rasmussen SA. Medications used to treat nausea and vomiting of pregnancy and the risk of selected birth defects. Birth Defects Res A Clin Mol Teratol 2012;94(1):22–30.
[17] Basch E, Hesketh PJ, Kris MG, Prestrud AA, Temin S, Lyman GH. Antiemetics: American Society of Clinical Oncology clinical practice guideline update. J. Oncol. Pract. 2011;7(6):395–8.
[18] Zajonc TP, Roland PS. Vertigo and motion sickness. Part II: pharmacologic treatment. Ear Nose Throat J. 2006;85(1):25–35.
[19] Eftekhari N. A comparison of ondansetron and promethasin in treating hyperemesis gravidarum. Journal of Kerman University of Medical Sciences 2013;20(4):354–62.
[20] Jensen MP, Chen C, Brugger AM. Interpretation of visual analog scale ratings and change scores: a reanalysis of two clinical trials of postoperative pain. J Pain 2003;4(7):407–14.
[21] Amini A, Heidari K, Asadollahi S, Habibi T, Shahrami A, Mansouri B, et al. Intravenous promethazine versus lorazepam for the treatment of peripheral vertigo in the emergency department: a double blind, randomized clinical trial of efficacy and safety. J Vestib Res 2014;24(1):39–47.
[22] Shafipour L, Goli Khatir I, Shafipour V, Amini Ahidashti H, Yazdani Charati J. Intravenous promethazine versus diazepam for treatment of peripheral vertigo in emergency department. Journal of Mazandaran University of Medical Sciences 2017;27(149):88–98.
[23] Barrett TW, Dipersio DM, Jenkins CA, Jack M, McCoin NS, Storrow AB, et al. A randomized, placebo-controlled trial of ondansetron, metoclopramide, and promethazine in adults. Am J Emerg Med 2011;29(3):247–55.
[24] Braude D, Crandall C. Ondansetron versus promethazine to treat acute undifferentiated nausea in the emergency department: a randomized, double-blind, noninferiority trial. Acad Emerg Med 2008;15(3):209–15.