Research

Effects of Thermal Protection in Patients Undergoing Body Contouring Procedures: A Controlled Clinical Trial

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Abstract

Background: Hypothermia is common in many plastic surgery procedures, but few measures to prevent its occurrence are taken.

Objectives: This study evaluated the effect of hypothermia in patients undergoing plastic surgery procedures and the effect of utilizing simple and inexpensive measures to prevent patient hypothermia during surgery.

Methods: A randomized controlled clinical trial was performed among 3 groups of patients who underwent body contouring surgery for longer than 3.5 hours. In group 1, no protective measures were taken to prevent hypothermia; in group 2, maneuvers were applied intraoperatively for the duration of the entire surgical procedure; and in group 3, measures were taken preoperatively and intraoperatively. The results were quantified and analyzed through a bivariate analysis, including degree of hypothermia, anesthesia recovery time, time spent in the recovery area, intensity of pain, cold perception, response to opioids, and nausea.

Results: There were 122 patients included in the study: 43 in group 1, 39 in group 2, and 40 in group 3. All patients in group 1 had a higher degree of hypothermia, longer recovery time from anesthesia, longer overall recovery time, increased pain, increased feeling of cold, and more nausea. These patients also required a greater amount of opioids compared with the patients in groups 2 and 3. Many of the results were statistically significant.

Conclusions: The adoption of simple and inexpensive measures before and during plastic surgery can prevent patient hypothermia during the procedures, leading to a shorter anesthesia recovery time and avoiding the undesirable effects associated with hypothermia. In addition, these measures may have significant economic savings.

Level of Evidence: 2

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Hypothermia is a significant and hidden obstacle in plastic surgery procedures. This event is often ignored during surgery despite all of the adverse effects caused by hypothermia during the early postoperative period. It is believed that 50-90% of patients develop hypothermia after surgery, even during surgical procedures lasting

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1 hour or less.[1] The primary issue is that if preventive measures are not taken, restoring normothermia can take up to 4 hours.[2] Both regional and general anesthesia deteriorate the protective mechanisms against hypothermia, but when both are combined, the risk is even greater.[3-10] In addition to the deleterious effects of hypothermia, including increased infection and its negative effect on blood clotting, resulting in increased bleeding, there are also effects related to shivering.[11-17] Shivering increases oxygen consumption, metabolic rate, respiratory effort, and the risk of morbid cardiac events, and it causes an unpleasant sensation and discomfort to the patient.[18-20] Other events produced by hypothermia that are not biometrically quantifiable but are also important are delayed awakening after general anesthesia, increased time to discharge from surgery to recovery area, and a longer stay in the recovery room.[21] Tremors observed after surgery cause more pain to the patient and therefore increase the need for opioids for pain management.

This results in increased nausea and vomiting. Nevertheless, all of these unwanted effects could be avoided if measures were applied to prevent hypothermia during surgery. Indeed, there are several procedures that are inexpensive, easy to implement, and highly effective.[22-26]

For these reasons, a surgical controlled clinical trial was performed in patients undergoing major plastic surgery procedures to evaluate the effects of hypothermia during the recovery period as well as to determine the effectiveness of simple and inexpensive measures for preventing hypothermia before, during, and after surgery.

METHODS

A randomized controlled clinical trial was performed at Clinica El Pinar in Bucaramanga, Colombia from February to November 2015. The Ethics Committee of Clinica El Pinar approved the study. The study was conducted in a hospital where no protective measures were previously taken to prevent hypothermia. For this reason, the Ethics Committee approved the inclusion of a control group. Intraoperative temperature was not even measured, and it was not known whether patients had hypothermia. However, many patients showed signs and symptoms of hypothermia during and after surgery. We therefore decided to carry out a study to demonstrate the importance of monitoring temperature and performing measures to control hypothermia. The Ethics Committee accepted the study to standardize a protocol for carrying out measures to prevent hypothermia.

The study included women between 18 and 55 years of age undergoing procedures lasting more than 3.5 hours, specifically either lipoabdominoplasty alone or in combination with breast augmentation. Only healthy patients who had no chronic diseases were included. Patients who had diabetes, were obese, or were heavy smokers, as well as patients with chronic diseases, were excluded. Patients with a BMI > 30.9 kg/m^2 and who were older than 55 years of age were also excluded.

All patients were managed with overnight hospitalization after surgery according to institutional protocols. Patients who did not undergo these surgeries or who spent less than 3.5 hours in surgery were excluded. Patients were included after understanding, accepting, and signing a written informed consent. All enrolled patients received the same anesthetic technique according to the clinic's protocol, which consisted of the following: total intravenous anesthesia (TIVA) with remifentanil and propofol, and endotracheal intubation with bispectral monitoring of the depth of anesthesia (bispectral index [BIS]). After intubation, an esophageal temperature sensor was inserted to monitor the core body temperature. At the end of surgery, the patients were moved to the recovery area and given heating blankets and forced hot air at 38°C (100.4°F).

RALLOC statistical software (version 6.0) (Boston College Department of Economics, Boston College, Chestnut Hill, MA) was utilized, and patients were randomized into three groups utilizing the Randomizer Pro App version 1.0 (Luigi Aiello, web and app developer, www.luigiaiello.org, Italy).

Statistical analysis was performed with Stata software version 10.0. Groups were compared utilizing the Mann-Whitney U test or Fisher's exact test, and the association between each of the independent variables and the observed outcomes was calculated by calculating relative risk (RR), 95% confidence intervals (95% CI) and *P* values.

Group 1: No Thermal Protection Measures

An esophageal temperature monitor was placed, and no control measure or temperature protection was undertaken either preoperatively or intraoperatively.

Group 2: Intraoperative Thermal Protection Measures

The following intraoperative protection measures were implemented: air conditioning to the operating room was turned off before entering the room, before making position changes during surgery, and half an hour before the end of the procedure; the room temperature was maintained between 20°C and 22°C (68-71.6°F) during surgery; subcutaneous fluids utilized for infiltration were kept at 37.5°C (99.5°F); the solutions for asepsis and antisepsis

were preheated to 37°C (98.6°F); and the exposed area was kept as dry as possible.

Group 3 received the same measures as group 2, but the group 3 patients were also warmed with hot air at 39°C (102.2°F) for 1 hour in a special chair prior to surgery.

Core body temperature was measured until the end of the surgical procedure to determine when the temperature decreased. All intraoperative variables were recorded by the anesthesiologist in a special format. The time between the end of surgery and awakening from anesthesia was recorded, as well as the time between the end of surgery and the arrival to the recovery room and the occurrence of shivering. Patients self-reported the subjective period during which they experienced cold sensations.

Endpoints of shivering, nausea, and feeling cold were evaluated solely by the head nurse in the recovery area. Shivering was assessed by observation, whereas nausea and "cold feeling" were evaluated by querying the patient every 5 minutes. Pain intensity was recorded on a scale from 1 to 10, and its duration was also documented. The total amount of morphine administered at the end of surgery and in the recovery area, the presence of nausea or vomiting in the recovery area, and the total length of stay in recovery before discharge were recorded. The head nurse or the anesthesia resident documented all of these variables in a special format. Patients were monitored until their body temperature reached 36°C (96.8°F), they left the recovery room, and they were transferred to the hospital floor.

Any patients with a core body temperature below 36°C (96.8°F) were considered hypothermic and were classified according to the system described by Kirkpatrick[5]:

Class 1 (36-35°C) (96.8-95°F)
Class 2 (34.9-32°C) (94.9-89.6°F)
Class 3 (31.9-28°C) (89.5-82.4°F)
Class 4 (below 28°C) (below 82.4°F)

RESULTS

Descriptive Analysis

This study included 122 patients who were distributed into 3 groups. Group 1 had 43 patients. Among the patients in this group, 28 had undergone lipoabdominoplasty alone and 15 had undergone lipoabdominoplasty in combination with breast augmentation. Group 2 had 39 patients, among whom 25 had undergone lipoabdominoplasty alone and 14 had undergone lipoabdominoplasty in combination with breast augmentation. Group 3 had 40 patients, among whom 28 had undergone lipoabdominoplasty alone and 12 had undergone lipoabdominoplasty in combination with breast augmentation.

Table 1. Distribution of Age and BMI in All Groups

	Age (years) Range, mean	BMI Range, mean
Group 1	30-54, 40.5	24-30.9, 26.5
Group 2	29-55, 42	23-30.5, 26.6
Group 3	27-54, 41.4	22-30.5, 26.2

BMI, body mass index.

Among the entire cohort, 81 patients (66.39%) had undergone lipoabdominoplasty alone and 41 (33.61%) had undergone lipoabdominoplasty in combination with breast augmentation.

There were no statistically significant differences with respect to variables such as body mass index and age among the 3 groups. The mean age of group 1 was 40.5 years (range, 30-54 years). In group 2, the mean age was 42 years (range, 29-55 years), and in group 3, the mean age was 41.4 years (range, 27-54 years). The mean BMI in group 1 was 26.5 kg/m^2 (range, 24-30.9 kg/m^2), the mean BMI in group 2 was 26.6 kg/m^2 (range, 23-30.5 kg/m^2), and the mean BMI in group 3 was 26 kg/m^2 (range, 22-30.5 kg/m^2). The distribution of age and BMI in each group is presented in Table 1.

There were 104 patients (85.25%) who developed hypothermia. Among these, 76 (73.08%) reported feeling cold during the postoperative period, 60 (57.69%) presented with tremors, and 88 (84.62%) required analgesia with morphine.

Regarding the temperature recorded before the surgical procedure, an average temperature of 36.42°C (97.55°F) ± 0.34°C (32.61°F), with a maximum of 37.3°C (99.14°F) and a minimum of 35.6°C (96.8°F) was observed. No patients in group 3, who were preheated prior to surgery, presented with hypothermia before surgery. The average temperature at the end of surgery was 34.08°C (93.34°F) ± 0.76°C (33.36°F), with a maximum of 37.7°C (99.86°F) and a minimum of 33.1°C (91.58°F).

The average duration of cold sensation for all patients was 19.59 ± 11.73 minutes (range, 2-40 minutes). However, groups 2 and 3 showed no significant differences during surgery with respect to cold sensation. The average shivering time recorded was 28.18 ± 15.78 minutes (range, 2-50 minutes). The average pain duration was 16.84 ± 17.39 minutes (range, 2-60 minutes). The average intensity of postoperative pain reported on a subjective scale from 1 to 10 was 4.40 ± 2.46, with a maximum of 9. The average required dose of morphine was 4.82 mg ± 2.51 mg, with a maximum administered dose of 10 mg.

Comparative Group Analysis

When comparing the 3 groups, significant differences were observed with respect to the variables associated with

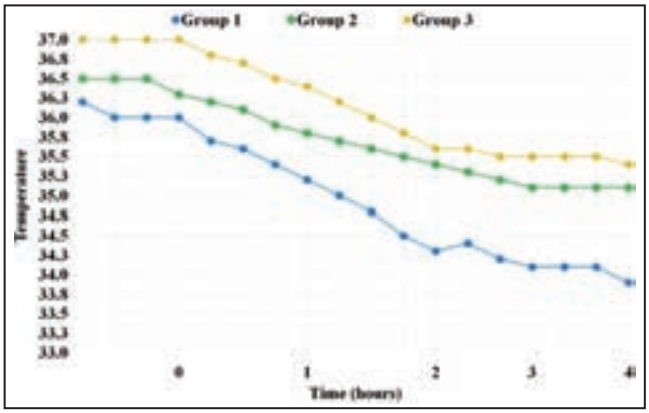

Figure 1. Decrease in intraoperative temperature in all groups.

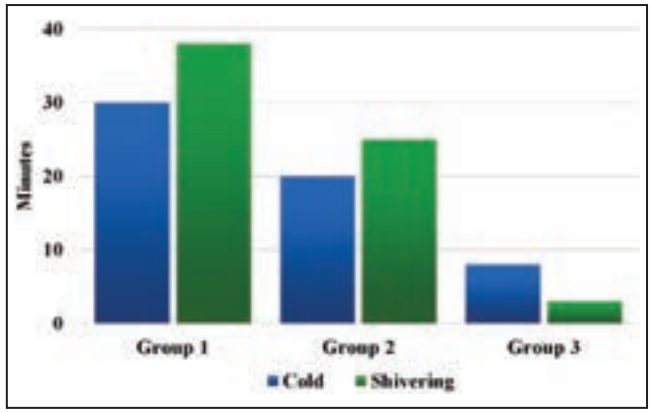

Figure 2. Duration of cold feeling and shivering in recovery room.

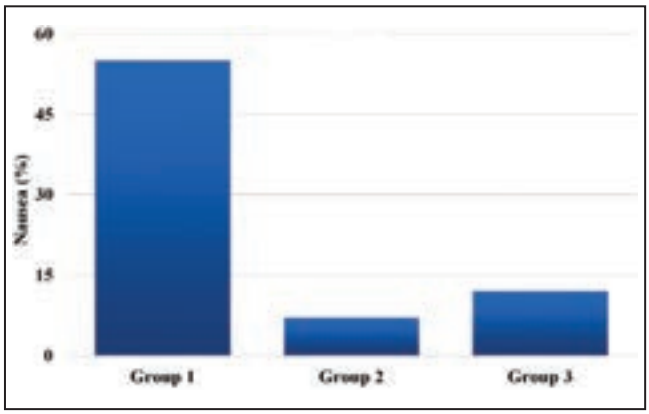

Figure 3. Percentage of patients experiencing nausea in recovery room.

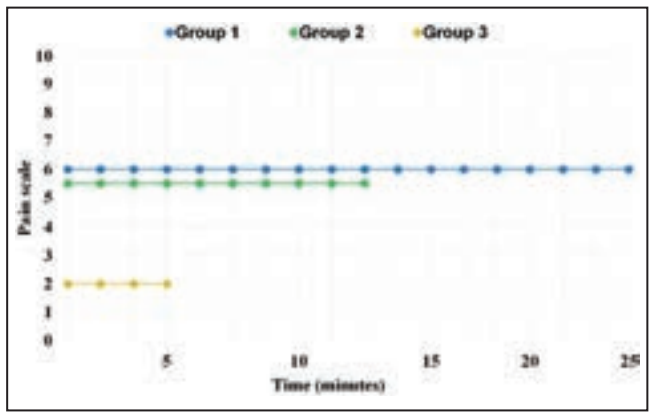

Figure 4. Average pain intensity and duration in recovery room.

pain, shivering, duration of cold sensation, and nausea. All patients in groups 1 and 2 developed hypothermia, compared with only 22 (55%) patients in group 3. The lowest temperature recorded at the end of surgery was observed in group 1 (Figure 1).

In group 1, tremors were present in 35 patients (81.40%) and nausea in 24 (55.81%). In group 2, 13 patients presented with tremors (33.33%) and 5 (12.82%) with nausea. In contrast, in group 3, only 12 patients had tremors (30.0%) and 3 (7.5%) had nausea. The subjective feeling of cold was similar among all groups; the highest prevalence was observed in group 3 with 30 patients (75%), followed by group 1 with 26 patients (60.47%) and group 2 with 22 patients (56.41%). However, the durations of hypothermia, shivering, and pain were very different. The average time of hypothermia was 30.42 ± 5.21 minutes (20 to 36 minutes) in group 1, 20.68 ± 11.15 minutes (10 to 40 minutes) in group 2, and 8.67 ± 4.82 minutes (2 to 15 minutes) in group 3. The average shivering time was also longer in group 1, with a duration of 38.28 ± 8.67 minutes (30 to 50 minutes), followed by group 2 with 25 ± 8.25 minutes (10 to 35 minutes) and group 3 with 3.92 ± 2.13 minutes (2 to 10 minutes) (Figures 2, 3).

Regarding pain intensity, group 3 reported lower pain levels, which correlated with lower morphine consumption for pain control, followed by group 2. All patients in groups 1 and 2 required pain management with morphine; however, only 15% of the patients in group 3 required morphine. The mean dose of morphine administered to patients in group 1 was 6 mg, whereas the doses for groups 2 and 3 were 4 and 2 mgs, respectively (Figures 4, 5).

The average time between the end of surgery and extubation and the patient's arrival to the recovery room was 55 minutes for group 1 (10 to 85 minutes), 36 minutes for group 2 (24 to 36 minutes), and 22 minutes for group 3 (10 to 70 minutes) (Figure 6). The average time spent in the recovery room until the patient was transferred to the hospital floor unit was 108 minutes for patients in group 1 (89 to 122 minutes), 84 minutes for patients in group 2 (60 to 102 minutes), and 63 minutes for patients in group 3 (50 to 70 minutes) (Figure 7). No surgical or anesthetic complications were observed during the study in any of

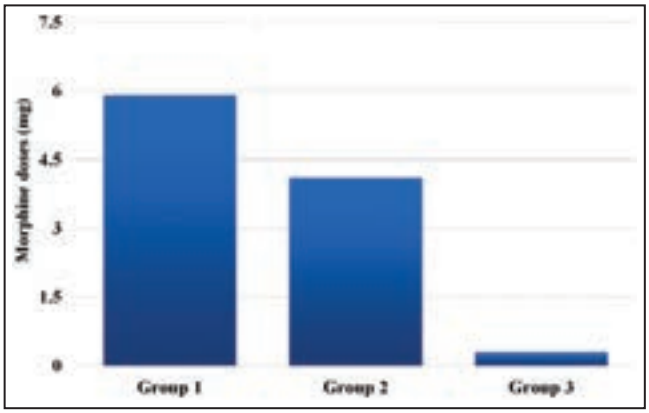

Figure 5. Total morphine dose in recovery room.

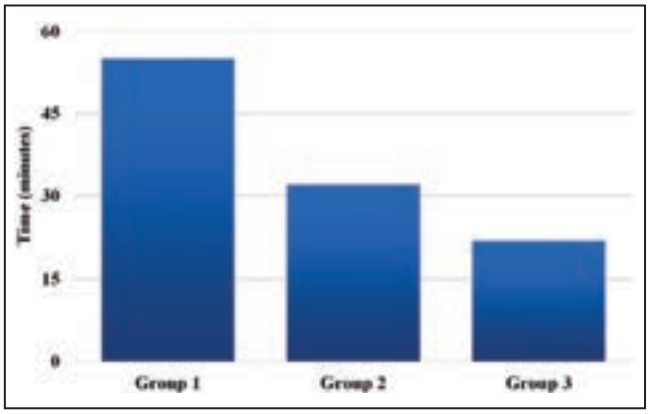

Figure 6. Time between end of surgery and arrival to recovery room.

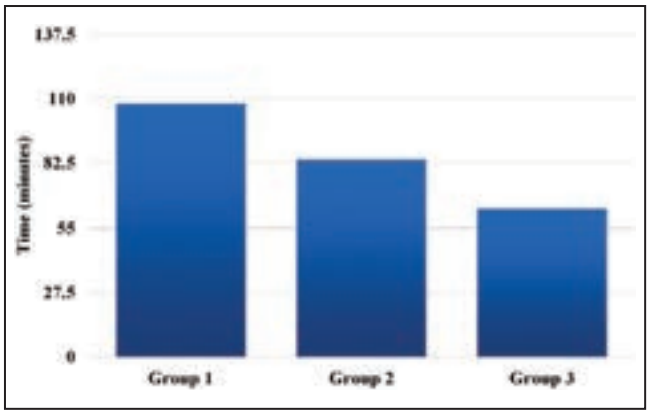

Figure 7. Total time in recovery room before discharge to hospital room.

the three groups. A summary of these results is presented in Tables 2 and 3.

Bivariate Analysis

A bivariate analysis was performed by considering the presence of hypothermia as the dependent variable. The independent variables were selected from the general data corresponding to the postoperative period. Nine statistically significant variables with $P < 0.05$ were identified.

The identified protective factors were intraoperative thermal protection, with an RR of 0.77 ($P = 0.0007$), and preoperative and intraoperative thermal protection, with an RR of 0.55 ($P \geq 0.0001$).

A lack of protective temperature actions was associated as a risk factor, with an RR of 1.27 ($P = 0.016$). Alternatively, patients who had a presurgical temperature lower than 36°C (96.8°F) were 1.21 times more likely to develop a greater degree of hypothermia ($P = 0.041$).

Feeling cold for more than 10 minutes and shivering for more than 5 minutes were identified as risk factors for hypothermia, with RRs of 1.52 ($P = 0.0090$) and 1.96 ($P \geq 0.0001$), respectively.

The report of a postoperative pain level of 4 on a scale from 1 to 10 (RR of 1.62, $P \geq 0.0001$), the need for analgesic morphine (RR 1.72, $P \geq 0.0001$) and the requirement of doses higher than 4 mg (RR 1.11, $P = 0.0119$) were all identified as associated risk factors.

The bivariate analysis data are presented in Table 4.

DISCUSSION

This study shows that hypothermia occurs frequently in plastic surgery patients and that simple protective measures against hypothermia are not regularly implemented. The most important measures for the prevention of hypothermia were warming the patient before surgery with forced hot air blankets at 39°C (102.2°F), preheating liquids for infiltration, and maintaining the temperature in operating rooms above 20°C to 22°C. (68-71.6°F). These measures are necessary, easy to implement, and inexpensive. Additionally, they have been shown to improve patients' experience during postsurgical recovery.[27]

The Ethics Committee of the hospital approved this study to develop protocols and measures to prevent this problem. The study hospital had data regarding hypothermia on operated patients, but the effect and implications of hypothermia during surgery and in the recovery area were not known to us.

In this study, hypothermia was present in 85% of patients undergoing major procedures such as lipoabdominoplasty or a combination of lipoabdominoplasty and breast augmentation. This finding is consistent with the established literature, in which hypothermia has been reported in 50% to 70% of patients 1 hour after initiating surgery.[28] In this study, the proportion of patients presenting hypothermia was greater, because the surgical time was longer than 3.5 hours.

Table 2. Qualitative Variables Between Groups

Variable	Group 1 Without protection		Group 2 Intraoperative protection		Group 3 Preoperative and intraoperative protection	
	n (%)	CI 95%	n (%)	CI 95%	n (%)	CI 95%
Cold	26 (60.47%)	0.452-0.756	22 (56.41 %)	0.401-0.726	30 (70 %)	0.551-0.848
Shivering	35 (81.40%)	0.692-0.935	13 (32.50 %)	0.173-0.476	12 (30.77%)	0.156- 0.459
Nausea	24 (55.81 %)	0.403-0.712	5 (12.50%)	0.017-0.232	3 (7.69 %)	-0.010-0.164
Morphine	43 (100%)	0	39 (100%)	0	6 (15 %)	0.034-0.265

CI, confidence interval.

Table 3. Quantitative Variables Between Groups

Variable	Group 1 Without protection		Group 2 Intraoperative protection		Group 3 Preoperative and intraoperative protection	
	Average- DS	Max-Min	Average- DS	Max-Min	Average- DS	Max-Min
Start temperature, °C (°F)	36.2 ± 0.21 (97.16 ± 32.37)	37.5-36.5 (99.5 ± 97.7)	36.15 ± 0.38 (97.07 ± 32.68)	36.3-36.0 (97.34 ± 96.8)	36.90 ± 0.20 (98.42 ± 32.36)	37.6-36.5 (99.68 ± 97.7)
Minimum temperature, °C (°F)	33.9 ± 0.42 (93.02 ± 32.75)	34.4-33.1 (93.92 ± 91.58)	35.11 ± 0.29 (95.19 ± 32.52)	35.5-34.5 (95.9 ± 94.1)	35.47 ± 0.28 (95.84 ± 32.5)	35.8-34.2 (96.44 ± 39.56)
Cold time, min	30.42 ± 5.21	36-20	20.68 ± 11.15	40 -10	8.67 ± 4.82	15-2
Shivering time, min	38.28 ± 8.67	50-30	25 ± 8.25	35-10	3.92 ± 2.13	10-2
Postoperative pain, min	6.1 ± 1.07	9-5	5.56 ± 0.94	8-5	1.37 ± 1.59	4-4
Minimum pain, min	28.48 ± 20.19	65-10	11.79 ± 5.55	30-10	3.78 ± 1.47	5-2
Morphine dose, mg	5.9 ± 2.99	15-3	4.07 ± 1.2	8-3	2 ± 0	2-2
Minimum waking up time, min	55.85 ± 27.41	85-10	32.46 ± 3.08	36.63-24.84	22.87 ± 10.30	70-10
Recovering room time, min	108.6 ± 20.3	98-118	84.22 ± 18.3	78.37-96.67	63.5 ± 12	55-67

DS, standard deviation.

Although 85% of patients developed hypothermia during surgery, with some patients showing temperatures as low as 33°C (91.4°F), only 62% reported feeling cold after arriving to the recovery room. In our study, 49% of patients experienced tremors as a way to restore their body temperature. This effect has been widely mentioned in previous studies.[29] It is quite possible that certain anesthetic drugs, such as propofol and opioids, provide a protective effect against shivering in the recovery room.

No patients were hypothermic before the beginning of surgery, but patient body temperature after 3.5 hours of surgery was significantly low (mean 34.08°C [93.34°F]). In group 1, the patients' temperature at the beginning of surgery was similar to that of group 2 patients (36.2°C [97.16°F] vs 36.15°C [97.07°F], respectively). As predicted, the group administered preheated hot air under pressure for 1 hour before entering surgery (group 3) had a higher temperature after starting surgery (36.9°C [98.42°F]). This 0.7°C difference is important for thermal protection. It is likely that raising external temperature may not increase internal temperature, but the temperature gradient between the central compartment and the peripheral temperature is reduced. As a result, less heat is lost during the first hour of surgery.[30,31] In our study, heat loss in the pre-heated group started at a temperature of 36.9°C (98.42°F) compared with 36.2°C in non-heated patients (97.16°F). We calculated an average temperature loss during the first hour of surgery of only 0.7°C in patients treated with preheated air vs a 1.5°C to 2.1°C (34.7-35.78°F) loss in patients who were not preheated.[32]

When comparing the presence of hypothermia at the end of surgery between the different groups, we found that all patients in groups 1 and 2 developed hypothermia at the end of surgery, whereas only 55% of patients in group 3 developed hypothermia. The average temperature of patients arriving to the recovery area was 33.9°C

Table 4. Bivariate Analysis

Variable	RR	Confidence interval 95%	*P* value
No protection*	1.27	0.29-0.47	0.0016
Intraoperative protection*	0.77	0.49-0.68	0.0007
Preoperative and intraoperative protection*	0.55	0.13-0.29	>0.0001
Required morphine*	1.73	0.74-0.89	>0.0001
Start temperature less 36ºC *	1.21	1.11-1.33	0.0419
Cold time < 10 minutes*	1.52	0.96-2.42	0.0090
Shivering time < 5 minutes*	1.96	1.05-3.65	>0.0001
Postoperative pain < 4*	1.62	1.22-2.16	>0.0001
Morphine dose < 4 mg*	1.12	0.99-1.26	0.0119

RR, relative risk. * Variables with statistical significance

(93.02°F) in group 1, 35.1°C (95.18°F) in group 2, and approximately 35.5°C (95.9°F) in group 3. These results suggest that when measures are taken to care for body temperature, patients experience fewer instances of hypothermia during their immediate recovery. When patients arrive to the recovery area, the protective effects of the measures undertaken to prevent hypothermia are more evident. Patients in all 3 groups reported subjective feelings of cold during the recovery period (60% in group 1, 56% in group 2, and 70% in group 3). However, the duration of this cold feeling varied drastically: 30 minutes in group 1, 20 minutes in group 2, and only 8.6 minutes in group 3. The incidence of shivering was also more pronounced: 80% of patients in group 1 had tremors compared with 30% of patients in groups 2 and 3. In addition to the presence of tremors as evaluated by the examiner, the duration of tremors varied greatly between the different groups. In group 1, shivering lasted for approximately 38 minutes, but the duration of shivering in group 2 was 25 minutes and in group 3 was 4 minutes. The literature indicates that feeling cold and experiencing tremors are the most remembered and traumatic undesirable events for a patient after surgery. These data show that measures for preventing heat loss before and during surgery improve thermal comfort and reduce the duration and intensity of tremors.[33,34]

All patients in group 1 reported pain for an average of 28 minutes and required morphine (an average of 6 mg) while in the recovery area. All patients in group 2 also reported pain and required morphine to mitigate their pain. However, the duration of their pain was only 11 minutes, and their average dose was lower (only 4 mg) without requiring additional doses. However, the largest difference with respect to postoperative pain was observed in group 3, in which only 15% of patients reported pain requiring morphine. These patients required only one dose of 2 mg of morphine, and their pain was mitigated in less than 2 minutes. We observed that pain sensitivity and duration are directly related to the duration of shivering induced by hypothermia. It was also observed that patients in group 1 had longer durations of both tremors and pain compared with patients in group 3, only 13% of whom presented with tremors and 15% of whom reported intense pain that was easily ameliorated with one dose of morphine. These results are attributed to the fact that strong and involuntary muscular contractions in inflamed liposuction and tummy tuck regions can worsen postoperative pain.[33,34] We also observed that poor thermal protection caused a higher incidence of nausea in the recovery area. This observation is certainly related to the presence of pain and the increased use of morphine. Accordingly, 55% of the patients in group 1 presented with nausea, whereas only 12% and 7% of the patients in groups 2 and 3 presented with nausea, respectively.

It is also important to note the need for and efficiency in maintaining body temperature in the operating room and the recovery area. The period between the end of surgery and the patient's arrival to the recovery area was on average 55 minutes in group 1, 36 minutes in group 2, and 22 minutes in group 3. The reason is that hypothermia decreases the metabolism of drugs utilized during surgery, such as propofol, vecuronium, and neostigmine.[35] In assessing the length of stay in the recovery area, we observed similar results. The average recovery time for patients in group 1 was approximately 108 minutes, whereas the average recovery times of groups 2 and 3 were 84 minutes and 63 minutes, respectively. The average length of stay in the recovery area at the hospital where this study was conducted was 61 minutes.

This difference in patients' transfer times from the operating room to the recovery area was in part due to our safety protocol. We kept all of our patients in the operating room until they were extubated, awake, and answering questions. We believe that this difference in patient transfer time was observed because hypothermia causes a delay in the elimination of the drugs utilized to maintain general anesthesia. This finding is in agreement with a prospective study reporting that the time of stay in the recovery area was 33% longer when no protective thermal measures were implemented. In our study, there was a 33% reduction in the time spent between the end of surgery and arrival to the recovery area among patients who received intraoperative protective measures vs those who received no protective measures. There was an additional 39% reduction between groups 2 and 3. Considering the overall recovery time before discharge to the hospital floor unit, group 1 spent 33% more time in the recovery area vs

group 2, and group 2 spent 25% more time in the recovery area vs group 3. These results are explained by all of the aforementioned reasons, including decreased drug metabolism, increased tremor, increased pain, higher doses of morphine, and secondary nausea.

CONCLUSIONS

The development of hypothermia during plastic surgery is the principal determining factor of undesirable effects during postsurgical recovery. Hypothermia is a hidden obstacle for most plastic surgeons and anesthesiologists, because temperature monitoring is always left in the background. The first step to preventing hypothermia is regular monitoring of the core body temperature. Moderate hypothermia is defined as an average temperature of 34°C (93.2°F) and is a phenomenon that occurs in 100% of patients who have major plastic surgeries, such as tummy tucks and liposuction, if protective measures are not implemented. Without these measures, most patients will experience tremors, cold sensations, pain, increased use of morphine, and secondary nausea because of opioid use.

All of these adverse events will lead to more pain and a longer stay in the recovery area. Therefore, it is highly recommended to utilize protective measures against hypothermia before and during surgery. The most effective protective measure before surgery is pre-heating the patient for 1 hour with forced air through blankets before entering the operating room. During surgery, the room temperature should be maintained at 21°C (69.8°F), and the washing liquid and infiltration solutions should be heated to 37°C (98.6°F). With these measures, patients will have minimal cold sensations, diminished tremors and pain, a reduced need for morphine, less nausea, and finally a 58% reduction in their stay in the recovery area. All these effects will translate to improved patient satisfaction, which is why simple hypothermia protection measures during plastic surgery would make the operating room more efficient and ensure patient satisfaction.

The purpose of the study was to evaluate the time required for patients to reach normothermia and the events surrounding that process. Our observational time ended when patients were transferred to their hospital room. We acknowledge that this study would be more complete if longer follow-up times and different types of surgical procedures were implemented. Therefore, it would be interesting to conduct a study with follow-up after hospitalization and a larger group of patients. Hypothermia is a well-known side effect of general anesthesia. There are many precautions that anesthesiologists can take to prevent or diminish the occurrence of hypothermia while in the operating room, yet it still has a very high incidence. We hope that our study helps alter future medical practice in treating this patient subpopulation.

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