DISCUSSION

Shivering is an involuntary, oscillatory muscular activity that augments metabolic heat production. Vigorous shivering increases metabolic heat production up to 500-600% above base level.[68]

It is a frequent challenge to anaesthetists as it increases discomfort of the patients and surgeons as regards the mode of anaesthesia.It also interferes with monitoring of electrocardiogram, blood pressure and pulse oxygen saturation. In addition, it increases oxygen consumption, carbon dioxide production and lactic acidosis. It also increases the operative pain by stretching the surgical incision, increase the intraocular pressure and the intracranial pressure. Moreover, it is blamed for hemodynamic changes and increases in heart rate and cardiac output; and thus, it may cause distress to patients especially those with low cardiopulmonary reserve. [69]

Shivering, which occurs usually as a thermoregulatory response to cold weather, may also occur following general or neuraxial anaesthesia. Some of the causative factors of this type of shivering may be common to both, but some are particular to neuraxial anaesthesia.[70]

Shivering is a very common complication related to neuraxial blocks. Post-spinal shivering has been reported to occur in 56-63% of patients undergoing spinal anaesthesia in most of the recent studies.[71,72]

It is therefore encouraging to search for some simple and inexpensive interventions and medications that are effective in the prevention and treatment of this common as well as serious adverse effect of anaesthesia.[73]

The underlying mechanism of post-spinal shivering has not been fully established. Yet many efforts have been adopted to overcome the unwanted hypothermia in the perioperative period.[68, 73]

There are four principal reasons for hypothermia under spinal anaesthesia. Firstly, spinal anaesthesia leads to an internal redistribution of heat from the core to the peripheral compartment. Secondly, with loss of thermoregulatory vasoconstriction below the level of the spinal block, there is increased heat loss from body surfaces. Thirdly, there is altered thermoregulation under spinal anaesthesia characterized by a 0.58°C decrease in vasoconstriction and shivering thresholds. Lastly, during either general or regional anaesthesia, a patient's natural behavioral and autonomic responses to cold are unavailable or impaired, and each of general and neuraxial anaesthesia produces high risk for inadvertent perioperative hypothermia.[74,75]

Efforts have been made to prevent and treat this serious complication by various methods; such as warming of the operative room and patient, administration of warm IV fluids, use of warm and moist gases. In addition a variety of medications are also used. [75]

The current study was carried out to compare the effects of warm intrathecal bupivacaine versus cold intrathecal bupivacaine on shivering and haemodynamic stability in parturients candidate for elective cesarean delivery under spinal anaesthesia.

This study was carried out in El-Shatby Maternity Hospital, Alexandria University on 50 parturients ASA physical status I and II aged between 20- 40 years scheduled for elective cesarean delivery under spinal anaesthesia.

Patients were randomly assigned (double-blind,envelope randomization) into two equal groups (25 paients each) according to the local anaesthetic temperature:

Group W: Patients received 2ml heavy bupivacaine 0.5%(10mg)stored at room temperature (23 ºC) for 1 hour before time of injection (warm group).

Group C: Patients received 2ml heavy bupivacaine 0.5%(10mg) stored at 4°C (cold group).

Comparison between the two groups as regard demographic data showed no significant differences.

As regards changes in heart rate, there was no significant difference between the two study groups in the time period immediately before spinal anaesthesia.

In group W and C, all over the period of follow up after the spinal anaesthesia, there was no significant change in heart rate which may be explained by three reasons. Firstly, the level of the spinal sensory block required had not exceeded T6-7, i.e. there was no affection of the cardiac accelerator fibers which originate from T1-4. Secondly, the patients of the study were given adequate intravenous fluid preloading before the spinal anaesthesia, which compensated, to a great extent against the sympathetic block-induced by the spinal anaesthesia. Lastly, the patients of the study were young adults, ASA I-II, and with adequate cardiopulmonary reserve.

In agreement with this study, a study by Carpenter RL et al., [76], 952 patients undergoing spinal anaesthesia were randomly assigned to identify the incidence and risk factors for side effects of spinal anaesthesia. They concluded that most patients did not experience a significant change in heart rate after spinal anaesthesia and bradycardia developed in 13% of patients.

Comparison between the two studied groups showed no significant statistical differences at all the measured times.

In the present study, the mean arterial blood pressure (MABP) of the patients in the two studied groups showed no significant statistical differences among the two groups in the time period immediately before spinal anaesthesia.

In group W and C, one minute after spinal anaesthesia, there was a significant decrease in the MABP. This might be explained by the spinal block-induced sympathectomy. Hypotension occurs as result of block of vasomotor tone which is primarily determined by sympathetic fibers arising from T5 to L1 innervating arterial and venous smooth muscles. Blocking of these nerves causes vasodilatation of the venous capacitance vessels, pooling of blood, and decreased venous return to the heart. [77] Seven patients in group W developed hypotension for which they received I.V. ephedrine, while there was six patients in group C developed hypotension for which they received I.V. ephedrine.

In agreement with the results of this study, Hartmann B et al., [78] studied the incidence and risk factors for hypotension after spinal anaesthesia induction. By using

automated data collection from 3315 patients, hypotension occurred in 166 patients. The analysis identified the following variables to be associated with hypotension after spinal anaesthesia: age, weight, height, body mass index, amount of colloid infusion before puncture, amount of bupivacaine 0.5% used, sensory block height of anaesthesia.

On comparing the two studied groups, statistically it was found that all over the period of follow up, it was found that there was no significant difference between both groups.

As regard S_pO_2 of the patients in the present study, there were no statistically significant differences between the two groups. All patients received supplemental oxygen 4Litres/min through facemask.

This constancy of the oxygen saturation within the normal range can be attributed to three reasons. Firstly, the fact that the patients included in the study were ASA I-II and devoid of any cardiac or pulmonary disorder which could have a reason for oxygen desaturation. Secondly, the use of supplemental oxygen via facemask also helped to maintain the normal oxygen saturation. Lastly, the highest levels of the spinal sensory and motor nerve block have not exceeded T6-7, thus sparing the main respiratory muscle, the diaphragm, which is innervated by C 3-5. [79]

In agreement with the results of this study, Steinbrook RA et al., [80] studied the effects of spinal anaesthesia with bupivacaine on resting pulmonary ventilation and on response to the single breath carbon dioxide test in 11 unpremedicated patients. They concluded that spinal anaesthesia was not associated with statistically significant changes in tidal volume, respiratory rate, minute ventilation, mean inspiratory flow rate, or the response to the single-breath Co_2 test.

Adequate core temperature monitoring is clearly indicated and recommended by the National Institutes for Health and Clinical Excellence's (NICE) Guidelines in all patients undergoing spinal anaesthesia for the management of inadvertent perioperative hypothermia and prevention of its serious subsequent complications.[81]

In the two study groups, there were no significant differences at the first 10 miutes after spinal anaesthesia in both axillary and core temperatures. This may be attributed to the fact that all the patients entered the study being normothermic as a base line for comparison later on.

Twenty minutes after spinal anaesthesia, there was significant decrease in axillary and core temperatures in the two study groups. Later on, all over the time periods of the study, there was significant decrease in axillary and core temperatures. This may be attributed to three principal reasons for hypothermia under spinal anaesthesia. First, spinal anaesthesia leads to an internal redistribution of heat from the core to the peripheral compartment, Secondly, with loss of themoregulatory vasoconstriction below the level of the spinal block; there is increased heat loss from body surfaces. Lastly, there is altered thermoregulation under spinal anaesthesia characterized by a 0.5°C decrease in vasoconstriction and shivering threshold.[73]

In agreement with results of this study, a study by Saito T et al., [82] Patients undergoing cesarean delivery were randomly assigned to spinal anaesthesia or epidural anaesthesia. Spinal anaesthesia was induced by injecting 2 mL 0.5% dibucaine into the L4-L5 interspace. Epidural anaesthesia was induced with 20 mL 2% mepivacaine injected into the L2-L3 interspace.

Thermal comfort and shivering were scored by a blinded observer.They concluded that thermoregulation was impaired more by spinal anaesthesia than epidural anaesthesia, Tympanic membrane temperatures initially decreased faster during spinal anaesthesia, but subsequently decreased at a rate of 0.5 degrees C/h in both groups.

In a study by Hynson JM et al., [83] Five healthy, nonpregnant volunteers were studied before and after induction of lumbar epidural anaesthesia to determine the cause of central hypothermia during epidural anaesthesia. They concluded that central hypothermia during the 1st hour of epidural anaesthesia does not result from heat loss to the environment in excess of metabolic heat production, but results primarily from redistribution of body heat from central to peripheral tissues.

Comparison between the two studied groups showed no significant differences at all the measured times in both axillary and core temperatures.

According to shivering score, In group W, 4 out of 25 patients suffered shivering grade 3 and needed to be given 25 mg pethidine intravenously at 50 minutes after spinal anaesthesia. According to the obtained results, warming bupivacaine to 23 degree C reduces the incidence and intensity of shivering. This decrease in the incidence of shivering with the group of patients given warm intrathecal bupivacaine in the spinal anaesthesia can be attributed to the existence of thermosensory mechanisms in the humanspinal canal.

In agreement with this results, study by Mehta et al., [84] A study was undertaken to determine the value of warm local anaesthetic and warm parenteral fluids in reducing the incidence of shivering following epidural anaesthesia in obstetrics. They concluded that the combined use of warm parenteral fluids and warm local anaesthetic significantly reduced the incidence of shivering.

In the current study, In group C, 56% of patients experienced shivering grade (3), 12% of patients experienced shivering grade (4)(i.e. 17 out of 25 patients) suffered shivering grades 3 or 4 and needed to be given pethidine intravenously.

Comparison between the two studied groups showed statistically significant differences at all the measured times with increase shivering score at group C.

Ponte J et al., [85] investigates the role of the temperature of the local anaesthetic injected extradurally. Forty patients admitted for elective cesarean section under epidural anaesthesia were studied; 20 were given bupivacaine warmed to 37 degrees C (warm group) and 20 were given bupivacaine stored at 4 degrees C (cold group); the occurrence of shivering in both groups was recorded. The overall incidence of shivering was 27.5%; two patients of the warm group and nine patients of the cold group shivered. This difference was statistically significant (P less than 0.03). The results suggest that there are thermosensory mechanisms in the human spinal canal.

In another study by Walmsley AJ et al., [86] 30 patients undergoing postpartum tubal ligation under extradural anaesthesia initially received bupivacaine at 4˚C, and the incidence of shivering was 47%. Further bupivacaine warmed to 41˚C was injected into 8 patients in whom the resultant shivering was marked. In 4 patients, the shivering stopped. The authors concluded that thermosensitive tissue within the spinal canal contributes to the shivering observed in association with extradural anaesthesia. This finding confirms our findings in this study.

SUMMARY

The current study was carried out in in El-Shatby Maternity Hospital, Alexandria University, on 50 parturients, aged 20-40 years old, ASA I-II, scheduled for elective cesarean delivery under spinal anaesthesia, after the approval from the Local Ethical Committee and informed written consents from all the patients of the study.

Patients were randomly allocated into two equal groups (25 patients each); group W (Warm group), group C (Cold group).

All patients had carried out elective cesarean delivery under spinal anaesthesia. Intravenous fluids preheated to 37°C were given to the patients before the spinal anaesthesia. The ambient temperature was measured by a wall thermometer and maintained at 23°C.Body temperatures (tympanic and axillary temperature) were recorded They were measured before intrathecal injection and 10 min intervals till the end of the operation and for 1 hour postoperative.

Subarachnoid anaesthesia will be instituted at either L3/4 or L4/5 interspaces. Hyperbaric bupivacaine (5 mg/ml) 10 mg will be injected using 25G Quincke spinal needle according to the following groups:

Group W: received 2 ml heavy bupivacaine 0.5% (10 mg) stored at room temperature (23˚C) for 1 hour before time of injection (warm group).

Group C: received 2 ml heavy bupivacaine 0.5% (10mg) stored at (4˚C) (cold group).

The presence of shivering was observed by an observer blinded to the study local anaeshetic administered.

The aim of this study was to compare the effects of warm intrathecal bupivacaine versus cold intrathecal bupivacaine on shivering and haemodynamic stability in parturients candidate for elective cesarean delivery under spinal anaesthesia.

The results of the present study showed that:

Comparison between the two groups as regard demographic data showed no significant differences.

Hemodynamic Parameters

- **Heart rate**

Comparison between the two studied groups showed no significant statistical differences at all the measured times.

- **Mean arterial blood pressure**

Comparison between the two studied groups showed no significant statistical differences at all the measured times.

- **Oxygen saturation**

Comparison between the two studied groups showed no significant statistical differences at all the measured times.

- **Changes in Axillary Temperature (°C)**

Comparison between the two studied groups showed no significant statistical differences at all the measured times.

- **Body Core Temperature Monitoring**

Comparison between the two studied groups showed no significant statistical differences at all the measured times.

- **Incidence of Shivering**

Group W:

4 patients (16%) with grade 3 shivering were given 25 mg meperidine IV.at 50 minutes after spinal anaesthesia.

Group C:

17 patients (68%) with grade 3 and 4 shivering (8 patients at 30 min,3 patients at 40 min and 6 patients at 50 min) were given 25 mg meperidine IV.

Comparison between the two studied groups showed significant differences at all the measured times with increase shivering score at group C.

CONCLUSION

From the present study, the following can be concluded:

The use of warm bupivacaine stored at room temperature (23˚C) for one hour before time of injection into the subarachnoid space can decrease the incidence and intensity of shivering in parturients candidate for elective cesarean delivery under spinal anaesthesia.