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Prevention of supine hypotension in pregnant women undergoing cesarean section with peridural blockage; preload *versus* rapid load

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SUMMARY

Objective: To ascertain if crystalloid preload administration of 1,000 mL, administered 10 minutes prior to peridural block for caesarean section is an effective method to preventive hypotension, when compared with a rapid administration of crystalloid immediately after block. **Method:** A clinical trial was conducted with two groups of 30 patients each. Group A was administered crystalloid preload of 1,000 mL as total volume ten minutes prior to peridural block; group B received a rapid administration of the same amount of crystalloid immediately after block. **Results:** the incidence of hypotension was similar in both groups: Group A, six patients (20%); group B, 10 patients (33.3%). The decrease of systolic blood pressure (SBP) lower than 30% compared with the baseline measurement was for group A (104 ± 12.3 mm Hg) versus group B (103 ± 12.1 mmHg) ($p > 0.05$). SBP ≤ 90 mm Hg was similar in both groups. **Conclusion:** The preload administration to patients undergoing caesarean section does not decrease the incidence of and severity of supine hypotension when compared with rapid administration of crystalloid when performing peridural block.

Key words: Preload, rapid administration, peridural block, hypotension.

RESUMEN

Objetivo: *Determinar si una precarga de 1,000 mL de solución cristaloide, administrada 10 minutos previos a la instalación del bloqueo peridural para cesárea, es un método efectivo para prevenir la hipotensión supina, comparándolo con una carga rápida al momento de la instalación del bloqueo.* ***Método:*** *Estudio longitudinal, prospectivo, comparativo, experimental y clínico. Con un total de 60 pacientes, repartidas en 2 grupos, con 30 cada uno.* ***Grupo A*** *recibió una precarga de 1,000 mL de solución cristaloide como volumen total, 10 minutos previo a la instalación de bloqueo peridural.* ***Grupo B*** *carga rápida de volumen a la misma dosificación, administrándose al momento de la realización del bloqueo peridural.* ***Resultados:*** *La incidencia de hipotensión fue similar en ambos grupos, precarga (6 pacientes 20%) carga rápida (10 pacientes 33.3%). La disminución de presión arterial sistólica (PAS) menor del 30% comparada con la basal fue: grupo A (104 ± 12.3 mmHg) vs Grupo B (103 ± 12.1 mmHg) obteniéndose una $p > 0.05$. La PAS menor de 90 mmHg fue igual en ambos grupos, no así en la disminución del 30% donde ocurrió en 36 ocasiones (grupo B) vs 16 (grupo A).* ***Conclusión:*** *La precarga de volumen otorga-*

da a pacientes sometidas a cesárea bajo BPD no disminuye la incidencia y severidad de hipotensión supina comparada con la carga rápida al momento de la instalación del mismo.

Palabras clave: *Precarga, carga rápida, bloqueo peridural (BPD), PAS, PAD, PAM, hipotensión, FC, FR, SpO_2.*

BACKGROUND

During the early stages of pregnancy, many complex physiological, anatomical and mechanical changes take place[1]. Cardiac output increases 30-50%, reaching its peak in the weeks 28-32, then, decreases slowly in the last weeks. Ueland et al, found that cardiac output decreases at the end of pregnancy, but this decrease is considerably lower in the lateral position than in the supine position[2,4,13].

Systolic blood pressure (SBP) of pregnant women increases at the end of pregnancy. The diastolic blood pressure (DBP) increases less than SBP. Central venous pressure and pulmonary artery occlusion pressure remain constant. Mean arterial pressure (MAP) decreases due to a generalized vasodilatation, which in turn reduces peripheral resistance. Maximum decrease of DBP is 10-15 mmHg. The position of the pregnant woman and the site in which measurement is taken influence the results[4-6].

At the end of the second trimester, the weight of the gravid uterus is enough to compress the inferior cava vein and the abdominal aorta in the supine position. Obstruction of the cava vein interferes with venous return. Furthermore, at the end of pregnancy 10% to 15% of women will have signs and symptoms of the supine hypotension syndrome. 1 out of 10 pregnant women will have hypotension, tachycardia, diaphoresis, nausea, vomiting, abdominal pain, dyspnea, dizziness and fidgety[12-15].

The effects of position on the cardiac output are important for both the obstetrician and the anesthesiologist because supine hypotension during labor (without anesthesia) is associated with an 8% incidence of hypotension[11-17]; additionally, 15 to 20% of women in the active phase of labor will have aorto-iliac and cava vein compression. Compensation of the effects on these vasa occurs in two forms: First, cardiac return is deviated from the cava vein through the vertebral systems and azygos vein to the superior cava vein. Second, another compensatory mechanism is the increase of sympathetic activity that causes vasoconstriction, which in turns ameliorates hypotension; however, it is worth mentioning that the second compensatory mechanism is blocked below the level of anesthesia if general anesthesia is used[8].

Moreover, 60% of pregnant women requiring cesarean section will need an anesthetic technique, which in our milieu is regional anesthesia, through epidural blockage[3]. In cases where delivery through cesarean section is required, high levels of block anesthesia (T2-T4) are necessary to ensure the comfort of the woman. The main cardiovascular adverse event of extensive epidural anesthesia is maternal hypotension, secondary to sympathetic blockade that these high thoracic levels of anesthesia produce. The incidence of maternal hypotension secondary to epidural anesthesia for cesarean section varies from 5% to 80%. Maternal hypotension is more likely to occur in women that are not in labor (cesarean delivery) than in those who are in active labor and receive epidural anesthesia. This difference is probably because women in active labor that show up for non-elective cesarean delivery receive continuous intravenous hydration only immediately before the regional blockade is performed[7,16].

Therefore, a number of questions are raised due to this fact:

1. How can supine hypotension be prevented in these patients?
2. How is it possible to decrease the possibility of occurrence of supine hypotension syndrome in pregnant women undergoing cesarean section?
3. Why does the intensity of these problems varies among patients?
4. Is preventive hydration useful to avoid this syndrome after performing peridural blockage for cesarean section?

The goal of this study is to learn if a preload of 1,000 mL of crystalloid solution, administered 10 minutes before performing epidural blockade (EDB) for cesarean section, is an effective method to prevent supine hypotension, when compared with the administration of rapid load during blockade performance.

METHOD

The study was conducted using a randomized clinical trial design (5, 9, and 10) from March through September, 2005, in the labor & delivery room of the Hospital General de Zona 6 of the Mexican Institute of Social Security (IMSS), located in Xalostoc, Mexico.

To carry out the study and have a representative sample of patients that the hospital admits in a year, sixty participants were randomly selected among pregnant women programmed for elective cesarean section. All should have been

in the final stage of pregnancy, healthy and admitted to the labor & delivery room to undergo cesarean section under EDB. Patients were allocated randomly to either of two groups, with 30 participants each.

Group A (intervention) was comprised of healthy pregnant women programmed for elective cesarean section under EDB. They were administered 1,000 mL of Hartmann solution, ten minutes before performing EDB.

Group B (control) was comprised of healthy pregnant women programmed for elective cesarean section under EDB. They were administered 1,000 ml of Hartmann solution when EDB was being performed.

Monitoring of BP, heart rate, MAP, SpO_2 and respiratory rate, was performed at five-minute intervals in both groups, since the onset and until the end of the surgical procedure and when the patient was shifted to the recovery room.

Surveillance was accomplished with non-invasive electronic monitoring. The anesthetic technique was EDB at the 2nd and 3rd lumbar peridural spaces, using the air loss-of-resistance epidural technique. In both groups, the administered dosage was standardized to 300 mL of lidocaine 2% with epinephrine.

Hypotension was defined as the decrease of 30% or more of the systolic blood pressure from the baseline registry or SBP < 90 mmHg. We considered supine hypotension based upon: hypotension, changes in heart rate such as increase or decrease of 20 beats of difference with the baseline registry, dyspnea, chest or abdominal pain, dizziness, fidgeting, somnolence, headache, nausea and vomiting.

The incidence of hypotension, modifications of MAP (acceptable at 60 mmHg) heart rate, respiratory rate and arterial oxygenation were compared and registered in both groups. Refractory sympathetic hypotension was treated with intravenous bolus of 5 mg ephedrine and with an additional rapid infusion of Hartmann solution when needed. Treatment with ephedrine was repeated every five minutes if hypotension persisted or recurred[14].

DATA ANALYSIS

Descriptive statistics included estimation of measures of central tendency and standard deviation. Hemodynamic data were compared by using paired Student's t test and χ^2 test. Incidence of associated symptoms, use of ephedrine and sympathetic-sensory level reached were compared by using absolute numbers and percentages. Statistical significance was set at $p < 0.05$ value[5,9,10].

ETHICAL ASPECTS

According to the Helsinki declaration and to the World Code of Medical Ethics, the purpose of this study was to improve a preventive procedure to benefit patients. Written informed consent was obtained from the patient and/or responsible relative. They received information that this study would not damage the physical or mental integrity of the participant; also, that the study represented no risk to the life or health of the patient and that participating in the study would not incur any additional costs.

RESULTS

In both groups, the age of the participants was similar. Median age was 26 *vs* 27 years (Group A and Group B respectively). The median in both groups was 28 years old and the mode was 21 *vs* 30 years (Group A and Group B) (Table I).

In group A, the level of sensory block was considered to be at T6 (63.3%), followed by T4 (20%) and the remaining 17% was extended between T3 and T8, while in group B the level of sensory block was at T6 in 63.3%, T4 and T8 in 18.3% respectively.

These results in both groups had no influence in the blockade of cardioaccelerating fibers and the patients remained hemodinamically stable in this regard (Figure 1).

Six patients in Group A (20%) and seven patients in Group B (23.3%) required ephedrine (Figure 2).

At the beginning of the study, three registries of SBP and DBP were taken: At admission, during labor and when entering the surgical theatre. A greater difference in the period in which the patient was in the labor room when compared with the other registries was observed (Table II).

There were patients with supine hypotension in both groups. Patients in Group B had a higher incidence of SBP hypotension (< 90 mmHg) than patients in Group A (33.3% *vs* 20%). Additionally, 7 patients in Group A *versus* 9 patients in Group B (23.3% *vs* 30%) showed a 30% or lower decrease of SBP, The mean ± 1 SD of Group A was 104 ± 12.3 mmHg, while for Group B was 103 ± 12.1. (Median: 101 *vs* 103; Mode 103 *vs* 113 in groups A and B respectively) (Figures 3 and 4). The minimum registered value of SBP after PDB was 77 mmHg in Group A, and 70 mmHg in Group B. The ratio was 1:1.

Regarding the values of MAP < 60 mmHg, there was one patient in each group that had the following figures: median 79.1 ± 9.44 mmHg compared with 80.4 ± 8.66 mmHg. Median was 80 *vs* 82.3 mmHg and mode was 81.2 vs. 82 mmHg in group A and B respectively.

The hemodynamic constants were as follows:

Heart rate: mean 91.3 ± 12.2 *vs* 82.2 ± 13.4 (Group A and B respectively).

Respiratory frequency 21.7 ± 1.7 *vs* 21 ± 1.3 (Group A and B respectively).

SpO_2 95± 1.5% *vs* 96 ± 1.4% (Group A and B respectively).

Table I. Age distribution.

Age			
Group A Preload		Group B Rapid load	
Years	Frequency	Years	Frequency
17	2	17	1
18	3	18	1
19	0	19	2
20	2	20	1
21	5	21	2
24	1	23	3
26	1	24	1
28	1	26	3
29	3	27	1
30	2	29	1
31	1	30	5
32	4	31	2
33	2	32	1
34	3	33	4
		34	1
		38	1
$\overline{X}$ = 26.16 years		$\overline{X}$ = 27	
Median = 28.5		Median = 28	
Mode = 21 – 32		Mode = 30 – 33	
Range = 17		Range = 21	

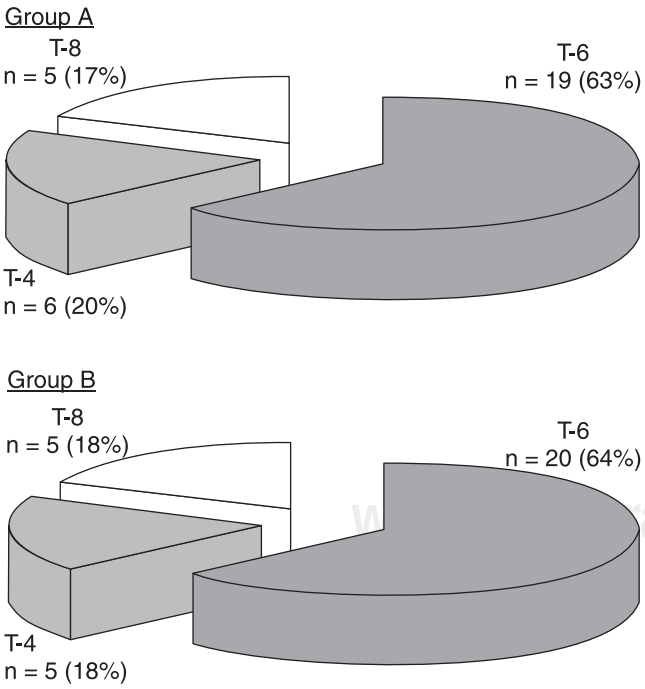

Figure 1. Sensory level.

Student's t test was used to analyze these variables. Statistical significance of p value was set at 0.05. After comparing the means of both groups, the value of t was 0.438, which was not statistically significant ($p > 0.05$). We interpreted this as the means of both populations being similar. This does not imply accepting the null hypothesis, but there is not enough information to reject it.

DISCUSSION

The main objective of our study was to ascertain if a 1,000 mL preload of crystalloid solution given 10 minutes before performing PDB for elective cesarean section is an effective method to prevent supine hypotension, when compared with a rapid load of intravenous fluids when performing PDB. It was possible to demonstrate a relatively low incidence of hypotension in both groups. Administering a preload of crys-

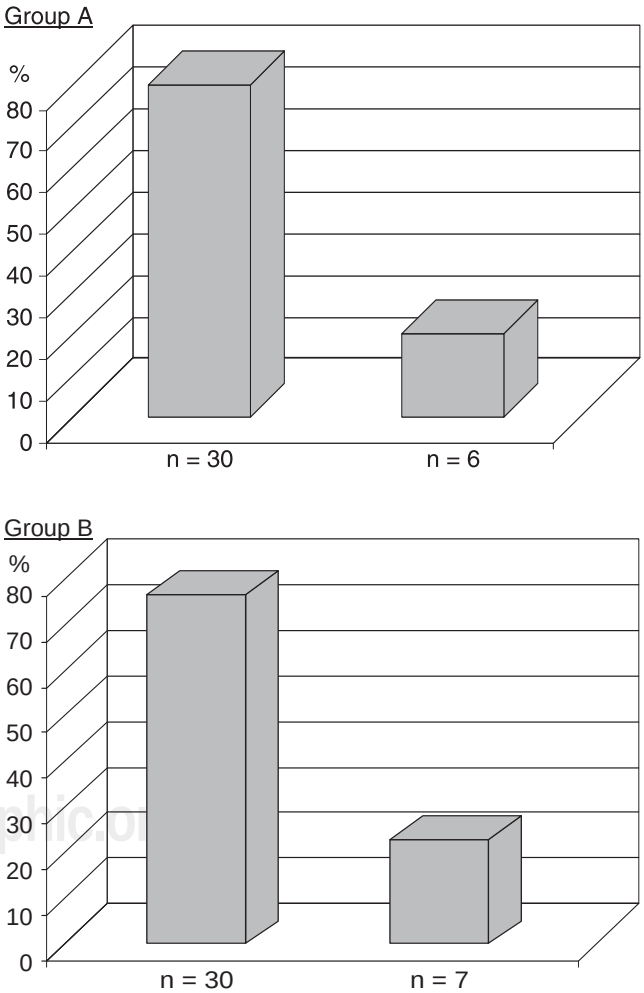

Figure 2. Use of ephedrine.

talloid solution does not avert supine hypotension after PDB for cesarean section. Seven patients in Group A and 9 patients in Group B had supine hypotension, and both study groups had the same number of hypotension episodes (121). No statistically significant differences were found.

CONCLUSIONS

Hypotension is a common adverse effect of PDB in pregnant patients undergoing cesarean section.

In the last decades, some authors are in favor and others against administering a bolus of intravenous fluids to pre-

Table II. Hemodynamic registries.

Registry	Group A	Group B
Admission	SBP 116 ± 14	SBP 116 ± 10
	DBP 73 ± 10	DBP 74 ± 7
Labor	SBP 117 ± 8	SBP 110 ± 8
	DBP 80 ± 8	DBP 72 ± 8.5
Surgery	SBP 118 ± 15	SBP 119 ± 13
	DBP 73 ± 12	DBP 73 ± 13

SBP = systolic blood pressure, DBP = diastolic blood pressure

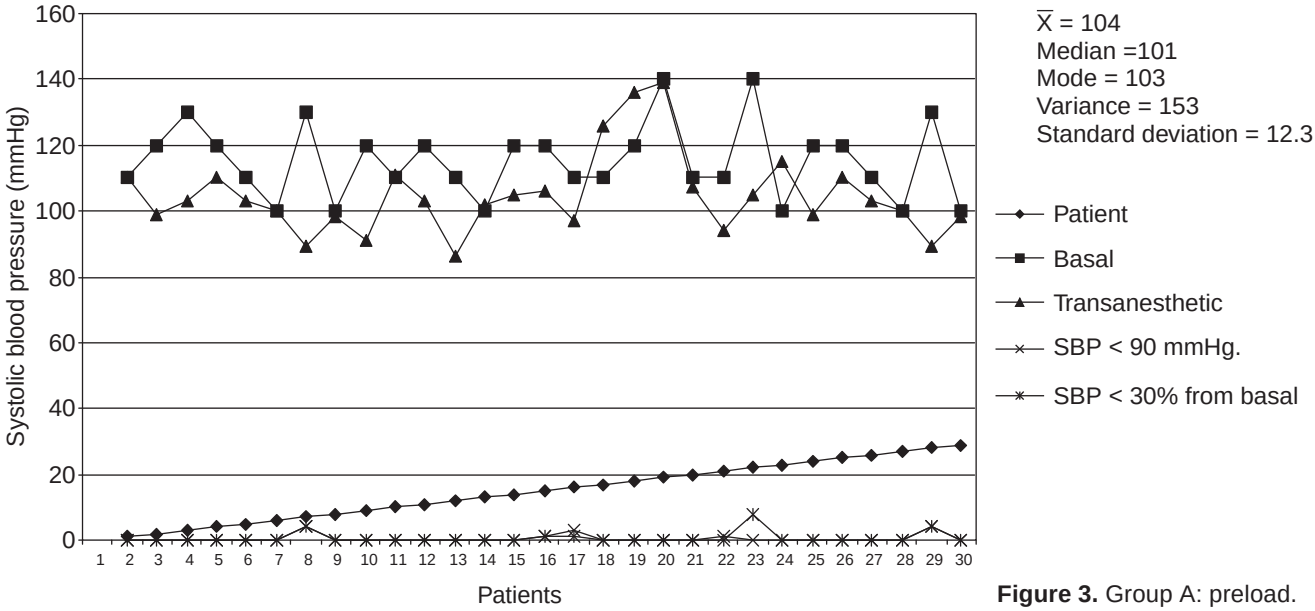

Figure 3. Group A: preload.

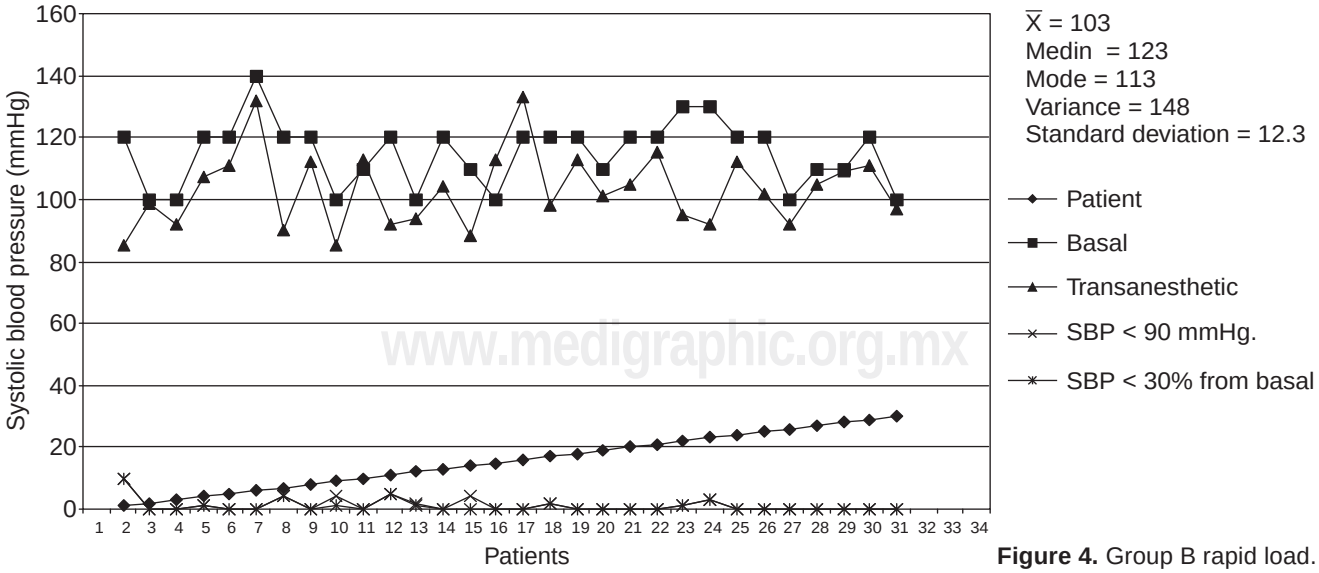

Figure 4. Group B rapid load.

vent hypotension after performing PDB. The results have demonstrated that this prophylaxis fails and has no beneficial effects. It is not recommended to administer preload in a routine way to decrease secondary hypotension.

Supine hypotension is secondary to several biophysical changes that happen in all pregnant women and is not necessarily due to the hemodynamic changes that PDB causes.

According to our results we can conclude that there was no statistical difference between the administrations of a preload of crystalloid solutions minutes before performing PDB *versus* a rapid load when performing PDB; however, from a clinical perspective there were minimal differences. This was demonstrated by the fact that in Group A, there were six events of supine hypotension < 90 mmHg while in Group B there were 10 events, although this was not statistically significant. It is worth considering that both groups had a total of 125 episodes of supine hypotension. These episodes were equally distributed in both. That should prompt the development of a preventive norm.

The lack of statistical significance can mean that the prevalence of supine hypotension is similar in both groups. That should open the possibility for carrying out prospective studies with larger sample size and for longer periods of time.

REFERENCES

1. Aldrete JA. Theoretical-Practical article on Anesthesiology. Volume II. Mexico, D.F. Salvat Ed. 1992. pp. 941-950.
2. Macarthur MDA. Solving the problem of spinal-induced hypotension in obstetric anesthesia. Can J Anesthesia 2002; 49:536-539.
3. Benumof JL. Obstetric Anesthesia. Anesthesiology Clinics of North America. Ed. Interamericana Vol. 1 México D.F. 1990. p. 77-93.
4. Birnbach GD. Obstetric Anesthesia. Ed. Mc Graw-Hill. México, D.F. 2002. pp. 34-51.
5. Corona FJ. Elements of statistics, applications of the experimental method. Ed. Trillas México. D.F. 1994. p. 22-47.
6. Norris MC. Obstetric Anesthesia. Ed. Mc Graw-Hill. México, D.F. 2001. pp. 3-31.
7. Dryer RA, Farina Z, Joubert IA, Du Toit P, Meyer M, Torr G, Wells K, James MF. Cristalloid preload *versus* rapid crystalloid administration after induction of spinal anaesthesia for elective caesarean section. Anaesth Intensive Care 2004;32:351-57.
8. Milsom I, Forssman L. Factor's influencing aortocaval compression in late pregnancy. Am J Obstet Gynecol 1984;148:764-71.
9. López CJL. Scientific method and hypothesis. Ed. Trillas México. D.F. 1979. pp. 69-85.
10. Méndez RI. The investigation protocol. Guidelines for its elaboration and analysis. Ed. Trillas. México. D.F. 1991. p. 1-62, 111-185.
11. Mendonca C, Griffiths J, Ateleanu B, Collis RE. Hypotension following combined spinal-epidural anaesthesia for caesarean section. Left lateral position *vs* tilted supine position. Anaesthesia 2003;58:428-431.
12. Miller RD. Anestesia. Doyma. Vol. II México. D.F. 1993. p. 1669-91.
13. Mondragón CH. Basic illustrated obstetrics. Ed. Trillas México. D.F. 1986. pp. 87-97.
14. Rama-Maceiras P, Aymerich H, Pensado A, Figueira A, Rodríguez VM, Cobian LlJM. Preloading with 500 mL of Hartmann's solution lessens the incidence and severity of hypotension and reduces the need for ephedrine after epidural anesthesia in ambulatory patients. Rev Esp Anestesiol Reanim 1999;46:14-18.
15. Kinsella SM, Lohmann G. Supine hypotensive syndrome. Obstetrics and Gynecology 1994;83:774-788.
16. Sthepen NJ. Clínicas de Anestesiología de Norteamérica. Vol. I. México. D.F. 1992. pp. 109-135.
17. Yun EM, Marx GF, Santos AC. The effects of maternal position during induction of combined spinal-epidural. Anesth Analg 1998;87:614-618.