The contribution of anaesthesia modus on reducing blood loss during caesarean section

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Summary

The purpose of this study was to compare the effects of general anaesthesia (GA) and regional anaesthesia (RA) on the blood loss during caesarean section. We report on 161 patients undergoing both elective and emergency caesarean section at the Obstetrical Department of Democritus University of Thrace. In the majority (113 women, 70.2%) GA was used, while in 48 women (29.8%) RA was used. No significant differences were found in the demographic characteristics of the study women in the two groups. Although the preoperative Hgb and Hct levels did not differ significantly in the two groups RA vs GA, the postoperative Hgb and Hct levels were significantly lower in women who were subjected to GA compared to those who were subjected to RA ($p < 0.05$). The study showed that there is greater reduction in blood loss with RA compared to GA during caesarean section.

Key words: Regional anaesthesia; General anaesthesia; Caesarean section; Blood loss.

Introduction

The World Health Organisation estimates that the rate of caesarean section is between 10% and 15% of all births in developed countries compared to 22% (2003) in the United Kingdom, 23% in the United States and 21% in Canada [1, 2]. Anaesthetic practice for caesarean section has changed during the last decades. There is a world-wide shift in favour of regional anaesthesia (RA) [3]. A survey conducted in 2002 revealed that the rate of RA for elective caesarean section had increased to 73.5% from 39% six years previously [4]. General anaesthesia (GA) was considered the technique of choice because it was quick, not because it was thought to be particularly good. GA was the only real choice for emergency sections indicated by foetal distress, and most women undergoing elective caesarean section preferred the idea of being asleep [5]. Spina anaesthesia (SA) and epidural anaesthesia (EA) techniques have been found to provide effective anaesthesia for caesarean section. Both techniques allow the mother to be awake, minimise maternal aspiration problems and significantly prevent neonatal depression associated with GA [6]. However in contrast to the RA, GA has the advantage of less hypotension, less cardiovascular instability, and better control of the airway and ventilation [6]. Although both GA and neuraxial anaesthesia (SA or EA) are generally equally efficacious for intraoperative anaesthesia, some data have indicated that the use of neuraxial (SA or EA) might be of benefit in reducing intraoperative blood loss, which could theoretically lead to a reduction in blood transfusions and associated complications [7-10]. The purpose of this survey was to evaluate the possible consequences of different anaesthetic techniques in caesarean sections concerning intraoperative blood loss.

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Method

This study was conducted on 161 pregnant women who underwent elective or uncomplicated caesarean section between January 1, 2004 and December 31, 2007. All pregnant cases were uncomplicated singleton, cephalic, no breech, term pregnancies estimated to be equal to 37 weeks of gestation. Pregnancies with serious obstetric or medical complications or foetal malformations were excluded.

The majority of caesarean sections were elective, while the rest had indicative pathology such as prolonged labour, beginning of foetal distress, and placenta position anomalies. Information collected included the number of blood units crossmatched preoperatively, type of surgery (emergency or elective), type of anaesthesia, parity of the patient, estimated blood loss by both anaesthesists and obstetricians, intraoperative and postoperative transfusion within 48 hours and pre- and postoperative haemoglobin (Hgb) and haemocrit (Hct). Intraoperative or postoperative salvaged red blood cell (RBC) transfusion appropriateness was determined using the recommended guideline of transfusing RBCs if the hemoglobin is < 7 g/dl in a patient with continuous bleeding. Efforts should be made to reduce the blood transfusion without increasing maternal morbidity and mortality. Maternal request for GA and/or refusal of regional anaesthesia was the main reason for GA. GA was also performed when intraoperative haemorrhage and/or prolonged surgery was anticipated. The immediate foetal and neonatal effects were assessed by cord blood gas analysis and the infant's Apgar scores. Statistical analysis of the data was performed using the Statistical Package for the Social Sciences (SPSS), version 11.0 (SPSS, Inc., Chicago, IL, USA). The normality of quantitative variables was tested with the Kolmogorov-Smirnov test. Normally distributed quantitative variables were expressed as the mean ± standard deviation, while non-normally distributed variables were expressed as the median and range. Qualitative variables were expressed as frequencies and percentages. The Student's t-test and Mann-Whitney U-test were used to determine differences in demographic, clinical and laboratory characteristics between the two groups of women according to the type of anaesthesia. The chi-square test was used to evaluate any potential association between qualitative variables. To

assess the independent effect of the type of anaesthesia on with the change of Hgb and Hct levels and the presence of high reductions of Hgb and Hct levels, multivariate stepwise linear and logistic regression models were constructed, respectively. Womens's age, smoking status, presence of diabetes, history of abdominal surgery, ASA, emergency, eating and the duration of surgery and anaesthesia were the major confounders in the multivariate models. Beta regression coefficients and adjusted odd ratios (aOR) were estimated as the measure of association of the type of anaesthesia with the change of Hgb and Hct levels and the presence of high reductions of Hgb and Hct levels, respectively. Two-way mixed ANOVA was performed to assess the interaction between the two types of anaesthesia and the change of Hgb and Hct levels over time. All tests were two-tailed and statistical significance was considered for p values less than 0.05.

Results

The study population was comprised of 161 women who underwent caesarean section (CS), with a mean age of 29.19 ± 5.24 years (range, 15-37 years); the majority (113 women, 70.2%) were subjected to GA while 48 women (29.8%) were subjected to RA. The demographic and clinical characteristics of women according to the kind of anaesthesia used are compared in Table 1. There were no significant differences in age, smoking status, incidence of diabetes, previous abdominal surgery, American Society of Anesthesiology (ASA) status, emergency status, and the duration of surgery and anaesthesia between the two groups of women. On the contrary, preoperative (4-6 hours before surgery) eating was more frequent in women who were subjected to GA ($p < 0.001$).

Both, Hgb and Hct levels were statistically significantly reduced after surgery for 12.2% and 10.0%, respectively, among women who were subjected to RA ($p < 0.001$), and for 17.2% and 15.2%, respectively, among those who were subjected to GA ($p < 0.001$) (Table 1). Women who were subjected to RA exhibited significantly lower blood loss compared to GA, since the two-way mixed analysis of variance showed a statistically significant interaction between the kind of anaesthesia and the change of Hgb and Hct levels over time ($F_{1,159} = 10.562$, $p < 0.001$ and $F_{1,159} = 10.380$, $p < 0.005$, respectively). While the preoperative Hgb and Hct levels did not differ significantly between women who were subjected to regional and general anaesthesia, the postoperative Hgb and Hct levels were significantly lower in women who underwent RA compared to those who underwent GA ($p < 0.05$) (Figure 1). To assess the effect of the kind of anaesthesia on blood loss, we also performed multivariate stepwise linear regression analysis on the change of Hgb and Hct levels, including all other women's characteristics as possible confounders. Our results suggested that the use of GA was a significantly independent determinant of greater postoperative reduction of Hgb and Hct levels (unstandardised beta coefficient = –0.70, $p < 0.001$ for Hgb; beta = –1.76, $p < 0.01$ for Hct), explaining a large proportion of their variance (6.2% and 6.1%, respectively). Furthermore, emergency status showed significant independent associations with increased blood loss (beta = –0.10, $p < 0.001$ for Hgb; beta = –3.41, $p < 0.001$ for Hct), explaining 7.0% and 6.6% of the variance of the Hgb and Hct changes, respectively. Women's age also showed significantly independent but clearly weaker associations with the change of Hgb and Hct levels (beta = –0.04, $p < 0.05$ for Hgb; beta = –0.10, $p < 0.05$ for Hct), explaining another 2.8% and 2.0% of their variance, respectively, while eating was also associated with greater postoperative reduction of Hct levels (beta = –1.23, $p < 0.05$), explaining a 2.2% of their variance.

Table 1. — *Demographic and clinical characteristics of the pregnant women.*

	Regional anaesthesia N = 48	General anaesthesia N = 113	*p* value
Age (years)	29.08 ± 5.18	29.24 ± 5.24	n.s.
Smoking status			n.s.
Non-smokers	26 (54.2)	69 (61.0)	
Occasional smokers	19 (39.6)	35 (31.0)	
Daily smokers	3 (6.2)	9 (8.0)	
Diabetes	3 (6.3)	3 (2.7)	n.s.
Previous abdominal surgery	9 (18.8)	34 (30.1)	n.s.
Preoperative eating	24 (50.0)	92 (81.4)	< 0.001
ASA status	1 (1-4)	1 (1-4)	n.s.
Emergency status	6 (12.5)	9 (8.0)	n.s.
Duration of surgery (min)	45 (30-80)	50 (30-130)	n.s.
Duration of anesthesia (min)	65 (40-100)	65 (35-150)	n.s.
Hgb (before)	12.30 ± 1.41	12.50 ± 1.23	n.s.
Hct (after)	10.80 ± 1.18	10.35 ± 1.43	< 0.05
Hgb (before)	36.93 ± 3.54	37.61 ± 3.48	n.s.
Hct (after)	33.22 ± 2.91	31.90 ± 3.27	< 0.05

Data are expressed as means ± standard deviation for normally distributed quantitative variables and as medians and range for non-normally distributed quantitative variables. Qualitative variables are expressed as frequencies and percentages; n.s.: non significant.

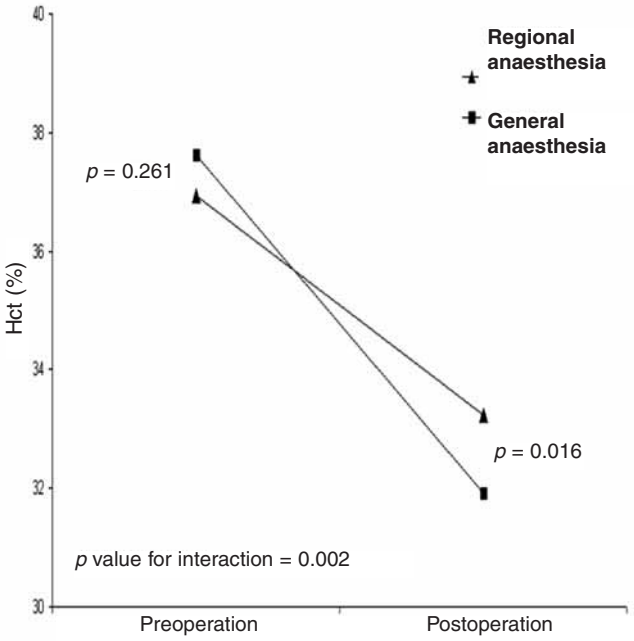

Figure 1. — Effect of the kind of anaesthesia on blood loss to.

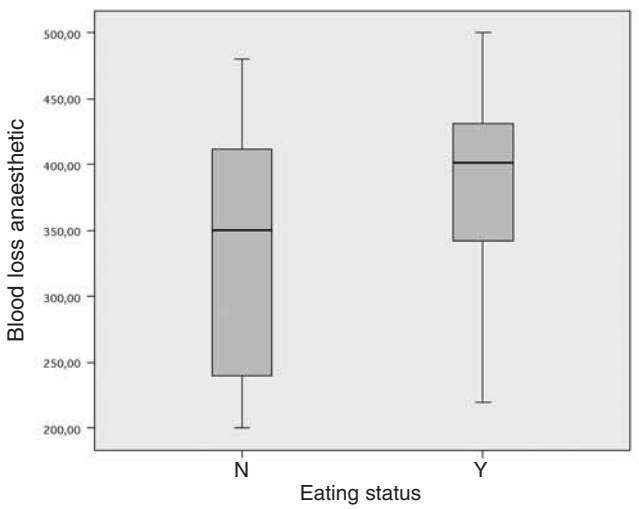

Figure 2. — Prior to operation effect of eating status on blood loss.

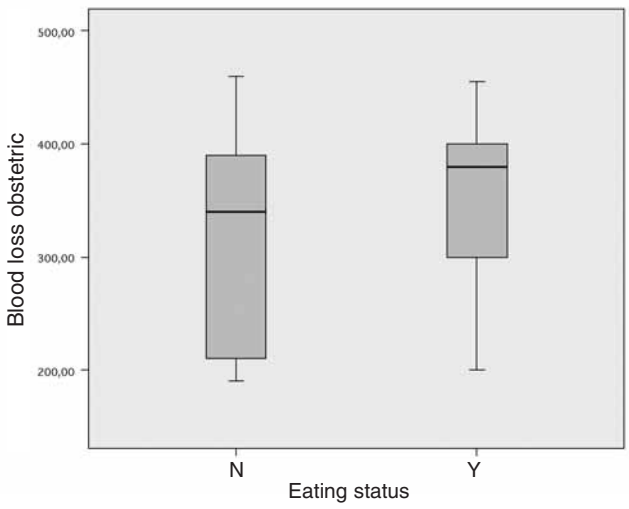

Figure 3. — Prior to operation effect of eating status on blood loss.

Among the entire cohort, the change in Hgb levels ranged from 0.00 to –6.70 with a median value of –1.80 and the change of Hct levels ranged from 0.40 to –23.00 with a median value of –4.10. In the sequence, the median value of the Hgb and Hct changes were selected as the cut-off points to subdivide women into groups with low reduction of Hgb or Hct levels and women with a high reduction of Hgb or Hct levels. High reduction levels were significantly more frequent among women who were subjected to GA compared to those who where subjected to RA (58.4% vs 27.1%, $p < 0.001$ for Hgb; 58.4% vs 31.3%, $p < 0.005$). Multivariate logistic regression analyses were performed separately to evaluate the role of potential confounders on the relationship observed between the type of anaesthesia and the reduction of Hgb or Hct levels. The use of GA remained a strong independent risk factor for high reduction of both levels (aOR = 3.93, 95% CI = 1.85 to 8.35, $p < 0.001$ for Hgb; aOR = 2.93, 95% CI = 1.33 to 6.41, $p < 0.01$ for Hct).

Blood loss at elective or emergency lower segment caesarean section was usually less than 500 ml and was estimated with reasonable accuracy. The mean blood loss was estimated to be more by anaesthetists compared to obstetricians. The mean measured blood loss estimated by obstetricians was 336.7764 ml (SE: 6.33186, range 270 min: 190, max: 460 ml) and by anaesthetists it was 366.9130 ml (SE: 6.38180, range 300 min: 200, max: 500 ml). A small number (6.5%) were transfused intraoperatively and 3.5% postoperatively. Our study shows that intraoperative blood loss was strongly related to whether patients had eaten or not prior to their surgery.

Women who ate prior to the caesarean section experienced larger amounts of blood loss (Figures 2 and 3).

Significant risk factors for blood transfusion were intraoperative during caesarean section and postopearative blood loss and some indications for caesarean section included: prolonged cephalic presentation, cephalic presentation anomalies, placenta position anomalies, previous caesarean section and foetal distress.

We did not observe any intra-or postoperative anaesthesia complications irregardless of anaesthesia mode. Especially in cases of RA no maternal hypotension was noted. Infants whose mothers received GA compared to RA had similar birthweights (median 3650, range 1950, min 2590, max 4500) but lower Apgar scores at one and five minutes (Table 2). By applying Spearman's correlation

Table 2. — *Correlations between kind of anaesthesia and neonatal results.*

			Birthweight	Apgar score	Kind of anaesthesia	Respiratory problems
Spearman's rho	Birthweight	Correlation Coefficient	1.000	–.034	.066	–.230(**)
		Sig. (2-tailed)		.666	.409	.003
		N	161	161	161	161
	Apgar score	Correlation Coefficient	–.034	1.000	–.820(**)	.021
		Sig. (2-tailed)	.666	–	.000	.789
		N	161	161	161	161
	Kind of anaesthesia	Correlation Coefficient	.066	–.820(**)	1.000	–.058
		Sig. (2-tailed)	.409	.000	–	.462
		N	161	161	161	161
	Respiratory problems	Correlation Coefficient	-.230(**)	.021	-.058	1.000
		Sig. (2-tailed)	.003	.789	.462	–
		N	161	161	161	161

** Correlation is significant at the 0.01 level (2-tailed).

coefficient test we can conclude that there was a statistically significant negative correlation between the kind of anaesthesia (RA vs GA) used and the Apgar score (r = –0.82 with $p < 0.001$) (Table 2). Mothers who received RA delivered newborns with higher Apgar scores. Statistical analysis was performed with SPSS 15. Variables were checked as to whether they were normally distributed. Quantitative variables (birthweight) were expressed with median value and range, while qualitative variables with frequency. The Mann-Whitney test was used to calculate whether there was a difference in birthweight in relation to the kind of anaesthesia and with the presentation of respiratory problems. Spearman's correlation coefficient test was used to prove the existence of correlations.

Discussion

The decision to proceed with general or regional anaesthesia depended on the underlying reason for caesarean section. While GA was administered in foetal distress and in cases where vaginal delivery was not feasible and turned into an emergency caesarean section, regional anaesthesia was preferred for elective or uncomplicated obstetric cases or when maternal disease existed. Neonatal outcome was assessed using Apgar scores and need for respiratory assistance at birth. Apgar score is a subjective measurement and its diagnostic value in foetal asphyxia is not significant [11]. Maternal outcome was assessed using the difference between pre- and postoperative packed cell volumes (PCV), need for blood transfusion and estimated blood loss [12]. Anaesthesia mode for caesarean section does not influence short-term outcomes in neonates although differences in the acid-base status of both the mother and especially the newborn recommend careful use of spinal anaesthesia [13]. Other authors have included GA as a risk factor for poorer immediate neonatal outcomes. Kolatat *et al.* reported that the Apgar scores of infants whose mothers received GA were lower than for infants whose mothers received RA [14, 15]. In contrast to these authors, Mueller *et al.* found that maternal arterial hypotension is by far the most common problem during RA and may be responsible for the higher incidence of foetal acidemia as hypotension has a deleterious effect on uteroplacental blood flow [16]. The complication of maternal hypotension occurs in 30% to 60% of cases, while significant foetal rate abnormalities and acidemia occur with a 15% to 20% reduction in maternal systolic blood pressure [17-19]. The results of our study do not confirm these findings although our cohort of women was not large enough to draw definite conclusions about neonatal respiratory morbidity. We reached the same conclusions with previous studies suggesting that the anaesthesia mode does not influence the short-term outcome [20]. To prevent maternal arterial hypotension during surgery, a 500 ml/IV infusion of Ringer's lactate solution was administered to all study women before the caesarean section and 1500-2000 ml during surgery. According to our results we found statistically significant differences in estimated intraoperative blood loss in correlation with the anaesthesia mode. The effect of RA is generally associated with a decrease in intraoperative EBL, which is clinically meaningful. The theoretical benefits of decreased intraoperative blood loss might include a lower incidence of blood transfusion, which is associated with possibly increased costs and many potential risks [21, 22]. However, RA introduced new problems, such as delays in inducing anaesthesia in emergency situations, postoperative immobility and urinary retention [23]. The increase in anaesthetic choices has led to inconsistencies in practice between individual anaesthetists, and between regions and nations [24-28]. Many hospitals surveyed were unable to provide basic data as they do not have these in retrievable form. An international consensus discussion and recommendations as well as comparable European instruments of quality control in obstetric anaesthesia are desirable. The trend from general to regional anaesthesia for caesarean section is continued, as is the trend from local infiltrative techniques to epidural anaesthesia for vaginal delivery. Switzerland was in the forefront for these developments [29]. Compared to our data from 1998, anaesthetic practice for caesarean section has changed with an increase in RA. This study confirms that the current practice of RA for caesarean section at Democritus University Hospital is good, but further studies need to be done to assess other outcome variables.

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References

[1] Sigalas J., Galazios G., Tsikrikoni I., Scordala M., Vogiatjaki T., Spanopoulou P.I., Tsikouras P.: "The influence of the mode of anaesthesia in the incidence of neonatal morbidity after an elective caesarean section". *Clin. Exp. Obstet. Gynecol.*, 2006, *33,* 10.

[2] Ouzounian J.G., Masaki D.I., Abboud T.K., Greenspoon J.S.: "Systemic vascular resistance index determined by thoracic electrical bioimpedance predicts the risk for maternal hypotension during regional anesthesia for cesarean delivery". *Am. J. Obstet. Gynecol.*, 1996, *174,* 1019.

[3] Stamer U.M., Messerschmidt A., Wulf H.: "Anaesthesia for caesarean section-a German survey". *Acta Anaesthesiol. Scand.,* 1998, *42*, 678.

[4] Stamer U.M., Wiese R., Stüber F., Wulf H., Meuser T.: "Change in anaesthetic practice for caesarean section in Germany". *Acta Anaesthesiol. Scand.,* 2005, *49*, 170.

[5] Dresner M.R., Freeman J.M.: "Anaesthesia for caesarean section". *Best Prac. Res. Clin. Obstet. Gynaecol.,* 2001, *15*, 127.

[6] Chan Y.K., Ng K.P.: "A survey of regional analgesia and anaesthesia for obstetrics in selected countries in the Far East". *Int. J. Obstet. Anesth.*, 2000, *9,* 225.

[7] Rodgers A., Walker N., Schug S., McKee A., Kehlet H., van Zundert A. *et al.*: "Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials" (review). *Br. Med. J.*, 2000, *321,* 1493.

[8] Richman J.M., Rowlingson A.J., Maine D.N., Courpas G.E., Weller J.F., Wu C.L.: "Does neuraxial anesthesia reduce intraoperative blood loss? A meta-analysis". *J. Clin. Anaesth.,* 2006, *18,* 427.

[9] Delis K.T., Knaggs A.L., Mason P., Macleod K.G.: "Effects of epidural-and-general anesthesia combined versus general anesthesia alone on the venous hemodynamics of the lower limb". *Thromb. Haemost.*, 2004, *92*, 1003.
[10] Zwetsch-Rast G., Schneider M.C., Siegemund M.: "Obstetric analgesia and anesthesia in Switzerland in 1999". *Anaesthesist.,* 2002, *51,* 103,
[11] Martin M., Paes B.: "Birth asphyxia. Does the Apgar score have diagnostic value?". *Obstet. Gynecol.*, 1988, *72,* 120.
[12] Afolabi B.B., Kaka A.A., Abudu O.O.: "Spinal and general anaesthesia for emergency caesarean section: effects on neonatal Apgar score and maternal haematocrit". *Niger. Postgrad. Med. J.,* 2003, *10,* 51.
[13] Petropoulos G., Siristatidis C., Salamalekis E., Creatsas G.: "Spinal and epidural versus general anesthesia for elective cesarean section at term: effect on the acid-base status of the mother and newborn". *J. Matern. Fetal Neonatal. Med.,* 2003, *13*, 260.
[14] Kolatat T., Somboonnanonda A., Lertakyamanee J., Chinachot T., Tritrakarn T., Muangkasem J.: "Effects of general and regional anesthesia on the neonate (a prospective, randomized trial)". *J. Med. Assoc. Thai.,* 1999, *82,* 40.
[15] Levy B.T., Dawson J.D., Toth P.P., Bowdler N.: "Predictors of neonatal resuscitation, low Apgar scores, and umbilical artery pH among growth-restricted neonates". *Obstet. Gynecol.,* 1998, *91,* 909.
[16] Mueller M.D., Brühwiler H., Schüpfer G.K., Lüscher K.P.: "Higher rate of fetal acidemia after regional anesthesia for elective cesarean delivery". *Obstet. Gynecol.*, 1997, *90*, 131.
[17] Shnider S., Levinson G.: "Anesthesia for caesarean section". In: Shnider S., Levinson G. (eds.). Anesthesia for obstetrics. Baltimore, Williams & Wilkins, 1993, 211.
[18] Vincent R.D. Jr., Chestnut D.H., McGrath J.M., Chatterjee P., Poduska D.J., Atkins B.L.: "The effects of epidural anesthesia on uterine vascular resistance, plasma arginine vasopressin concentrations, and plasma renin activity during hemorrhage in gravid ewes". Anesth. Analg., 1994, *78,* 293.
[19] Wright P.M.C., Iftikhar M., Fitzpatrick K.T., Moore J., Thompson W.: "Vasopressor therapy for hypotension during epidural anaesthesia for caesarean section: effects on maternal and fetal flow velocity ratios". *Anesth. Analg.,* 1992, *75,* 56.
[20] Kavak Z.N., Başgül A., Ceyhan N.: "Short-term outcome of newborn infants: spinal versus general anesthesia for elective cesarean section. A prospective randomized study". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2001, *100*, 50.
[21] Wong R.P., Carter H.B., Wolfson A.., Faustin C., Cohen S.R., Wu C.L.: "Use of spinal anesthesia does not reduce intraoperative blood loss". *Urology,* 2007, *70,* 523.
[22] Exadaktylos A.K., Buggy D.J., Moriarty D.C. *et al.*: "Can anesthetic technique for primary breast cancer surgery affect recurrence or metastasis?". *Anesthesiology*, 2006, *105,* 660.
[23] Dresner M.R., Freeman J.M.: "Anaesthesia for caesarean section". *Best Pract. Res. Clin. Obstet. Gynaecol.,* 2001, *15* 127.
[24] Hawkins J.L., Gibbs C.P., Orleans M. *et al.*: "Obstetric anesthesia work force survey, 1981 versus 1992". *Anesthesiology,* 1997, *87,* 135.
[25] Thomas T.A., Cooper G.M.: "Editorial Board of the Confidential Enquiries into Maternal Deaths in the United Kingdom. Maternal deaths from anaesthesia. An extract from Why mothers die 1997-99, the Confidential Enquiries into Maternal Deaths in the United Kingdom". *Br. J. Anaesth.,* 2002, *89*, 499.
[26] Department of Health and Social Security: "Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1988-90, 1991-93, 1994-96, 1997-99". London, HSMO, 1994, 1996, 1999, 2001.
[27] Shibli K.U., Russell I.F.: "A survey of anaesthetic techniques used for caesarean section in the UK in 1997". *Int. J. Obstet. Anesth.,* 2000, *9,* 160.
[28] Stamer U.M., Schneck H., Grond S., Wulf H.: "Surveys on the use of regional anaesthesia in obstetrics". *Curr. Opin. Anaesth.,* 1999, *12,* 565.
[29] Bartusseck E., Fatehi S., Motsch J., Grau T.: "Survey on practice of regional anaesthesia in Germany, Austria, and Switzerland. Part 3: Methods in obstetric anaesthesia". *Anaesthesist.*, 2004, *53*, 993.

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