British Journal of Anaesthesia **107** (5): 757–61 (2011)
Advance Access publication 19 August 2011 · doi:10.1093/bja/aer262

BJA

OBSTETRICS

General anaesthesia is associated with increased risk of surgical site infection after Caesarean delivery compared with neuraxial anaesthesia: a population-based study

P.-S. Tsai[1,2,3], C.-S. Hsu[4,5], Y.-C. Fan[6] and C.-J. Huang[4,6,7]*

[1] Graduate Institute of Nursing, College of Nursing, Taipei Medical University, 250 Wu Shin St., Taipei 110, Taiwan
[2] Department of Nursing, Wan Fang Hospital, Taipei Medical University, 111, Section 3, Hsing-Long Rd., Taipei 116, Taiwan
[3] Sleep Science Centre, Taipei Medical University Hospital, 252 Wu-Hsing St., Taipei 110, Taiwan
[4] School of Medicine, Taipei Medical University, 250 Wu Shin St., Taipei 110, Taiwan
[5] Department of Obstetrics and Gynaecology, Wan Fang Hospital, Taipei Medical University, 111, Section 3, Hsing-Long Rd., Taipei 116, Taiwan
[6] Department of Anaesthesiology, Buddhist Tzu Chi General Hospital, Taipei Branch, 289, Jianguo Rd., Sindian District, New Taipei City 231, Taiwan
[7] School of Medicine, Tzu Chi University, 701, Zhongyang Rd., Sec. 3, Hualien 970, Taiwan

* Corresponding author. E-mail: huangcj1112@gmail.com

Editor's key points

- This is an important large study of the influence of anaesthetic technique on surgical site infection after Caesarean delivery.
- More than 300 000 notes were examined.
- Incidence of post-surgical infection within 30 days after surgery was 0.9%.
- The odds ratio of having infection was 3.7 when general anaesthesia was compared with neuraxial block.

Background. This study compared the odds ratio (OR) of surgical site infection (SSI) within 30 days after operation with general anaesthesia (GA) or neuraxial anaesthesia (NA) in Taiwanese women undergoing Caesarean delivery (CD).

Methods. An epidemiologic design was used. The study population was based on the records of all deliveries in hospitals or obstetric clinics between January 2002 and December 2006 in Taiwan. Anonymized claim data from the Taiwan National Health Insurance Research Database (NHIRD) were analysed. Women who received CD were identified from the NHIRD by Diagnosis-Related Group codes. The mode of anaesthesia was defined by order codes. Multivariate logistic regression was used to estimate the OR and associated 95% confidence interval (CI) of post-CD SSIs for GA when compared with NA. The outcome was whether a woman had been diagnosed as having an SSI during the hospitalization or was re-hospitalized within 30 days after CD for the treatment of SSIs using five or 81 International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes.

Results. Among the 303 834 Taiwanese women who underwent CD during the 5 yr observation period, the 30 day post-CD SSI rate was 0.3% or 0.9% based on five or 81 ICD-9-CM codes. The multivariate-adjusted OR of having post-CD SSIs in the GA group was 3.73 (95% CI, 3.07–4.53) compared with the NA group ($P<0.001$) using five ICD-9-CM codes for the definition of SSI.

Conclusions. GA for CD was associated with a higher risk of SSI when compared with neuraxial anaesthesia.

Keywords: anaesthesia; Caesarean section; general anaesthesia; neuraxial anaesthesia; surgical site infection

Accepted for publication: 2 June 2011

Despite a decline in birth rate, the rate of Caesarean delivery (CD) is increasing worldwide.[1] The rate of CD in Taiwan was 34.59% in 2009,[2] which is one of the highest in the world. CD is frequently complicated by surgical site infection (SSI),[3 4] which increases maternal morbidity, mortality,[5] and medical costs.[6] With the increase in CD rates, SSI associated with CD may become a significant health and economic burden. Factors frequently thought to be associated with SSI after CD include numbers of prenatal consultations, obesity, premature rupture of membranes, diabetes, hypertension, history of previous CD, duration of surgery, and the use of prophylactic antibiotics.[3 4 7–9] However, previous findings on predicting factors of SSI after CD have been inconsistent across studies.

General anaesthesia (GA) was reported to be associated with increased risk of SSI in individuals receiving total hip

or knee replacement, when compared with neuraxial anaesthesia (NA).[10] To the best of our knowledge, the effects of different modes of anaesthesia on SSI have never been taken into consideration when examining predicting factors of SSI after CD. Compared with GA, NA for CD decreased blood loss[11] and the duration of hospital stay,[12] which, in turn, may decrease the risk of SSI.

In this study, we used a population-based, epidemiologic approach to examine the association of different modes of anaesthesia on the risk of SSI after CD. In particular, we compared the odds ratio (OR) of SSI within 30 days after operation between GA and NA [i.e. epidural anaesthesia (EA) or spinal anaesthesia (SA)] in Taiwanese women who underwent CD during a 5 yr period. We hypothesized that GA is associated with a higher odds of acquiring an SSI in women after CD when compared with NA.

Methods

Data source

The study used 2002–7 publicly available, anonymized data from the Taiwan National Health Insurance Research Database (NHIRD) provided by the National Health Research Institutes. The National Health Insurance programme provides a comprehensive benefit package covering preventive, dental, and medical services to all citizens in Taiwan. From the NHIRD, we obtained registries of medical institutions that contract with the Bureau of the National Health Insurance in Taiwan and monthly collect summaries for all claims with a principal International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and up to four secondary diagnoses being listed for each patient.

The study population was based on the records of all deliveries in hospitals or obstetric clinics between January 2002 and December 2006. Women who received CDs were identified from the database by Diagnosis-Related Group (DRG) codes 0371A (CD) and 0373B (maternally requested CD). For those women with multiple CDs during the observation period, only the first CD was counted. There were a total of 305 330 women who received CD during the observation period. The case notes were carefully inspected to screen for outliers. Subjects with an extremely short (<1 day, $n=180$) or long (>1000 days, $n=2$) hospital stay for the CD were identified and subsequently excluded. Women with extreme values of maternal age (i.e. younger than 16 yr or older than 50 yr, $n=151$) and women with missing data ($n=1163$) were further excluded, resulting in a total of 303 834 case notes.

Definition of variables

The independent variable of interest was the mode of anaesthesia, which was defined by the order codes for GA and for SA and EA. The primary outcome under investigation in this study was whether a woman had been diagnosed as having an SSI during the surgical hospitalization (i.e. CD) or re-hospitalized within 30 days after operation for the treatment of SSIs using five or 81 ICD-9-CM codes according to previous studies. One group of investigators defined post-CD SSI using five ICD-9-CM codes.[7] Another group showed that identification of SSI could be enhanced by the use of 81 diagnosis codes.[13]

We also extracted variables frequently associated with post-CD SSIs and variables that might influence an anaesthesiologist's choice of mode of anaesthesia for women undergoing CD. These included the woman's age in years, length of stay (LOS) in days, diabetes mellitus, chronic hypertension, pregnancy-related hypertension, premature rupture of membranes, fetal distress, previous CD, antepartum haemorrhage, preeclampsia/eclampsia, and CD by maternal request.

Statistical analysis

The SPSS statistics software, version 16.0 (SPSS Statistics, IBM Corporation, Somers, NY, USA), was used to perform the statistical analyses in this study. Continuous data were presented as mean (SD). Categorical data were presented as numbers and percentage. The Mann–Whitney *U*-tests, χ^2 tests, and the Kruskal–Wallis *H* tests were used to examine the differences among modes of anaesthesia. Univariable logistic regression was performed to estimate the OR and 95% confidence interval (CI) of SSI for GA when compared with NA in women undergoing CD with SSI as a binary variable. Multivariable logistic regression was used to estimate the OR and associated 95% CI of post-CD SSIs for GA when compared with NA in women undergoing CD after adjusting for various potential confounding variables. The analyses were performed with SSI defined by five ICD-9-CM codes and with SSI defined by 81 ICD-9-CM codes, respectively. As aforementioned, variables were selected for inclusion in the model based on the clinical plausibility that they would have an effect on an anaesthesiologist's choice of the mode of anaesthesia for women undergoing CD or variables frequently associated with post-CD SSIs and therefore may explain the differences in the incidence of SSI between modes of anaesthesia. These variables included age, diabetes mellitus, chronic hypertension, pregnancy-related hypertension, premature rupture of membranes, fetal distress, previous CD, CD by maternal request, antepartum haemorrhage, and preeclampsia/eclampsia. As all variables are of clinical relevance and were significantly different between modes of anaesthesia, they were forced into the first multivariable logistic regression model. Because LOS was found to be significantly different between modes of anaesthesia, in the second model, we adjusted all the above-mentioned variables and LOS as well.

Results

Among the 303 834 women who underwent CD during the 5 yr observation period, 12 531 (4.1%) women received GA whereas 95.9% of the parturients under study received SA or EA. The GA group was slightly older, had longer LOS, had more parturients with a history of diabetes or hypertension, had more parturients with fetal distress, antepartum