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REVIEW

The caesarean section epidemic: a call for a reduction in the number of caesarean sections

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ABSTRACT

A caesarean section (CS) is one of the most important surgical interventions in modern obstetrics and has lead to a significant reduction of fetal and maternal mortality. However, it is important to take into consideration that CS can have risks and lead to unwanted short-term and long-term consequences. One of the main questions of modern obstetric is the ideal CS rate, ranging between 10 and 20%, but some countries have reached rates exceeding 50%, while in others, less developed countries, the issue of accessibility for CS still exists and consequently leads to a high mortality rate. Significant inequality exists in CS accessibility between developed and less developed areas of countries, and countries themselves. In some cases it is even desirable to increase CS rates in order to reduce negative patient outcome.
Key words: obstetrics, obstetric surgical procedures, prevalence

INTRODUCTION

A caesarean section (CS) is an obstetric surgical intervention and mode of delivery which aims to finish the pregnancy by surgically opening the uterus. CSs are among the most important interventions in modern obstetrics and have lead to a significant reduction of fetal and maternal mortality. They are the most common obstetric surgical interventions - abdominal surgical interventions performed with general or spinal anaesthesia (1, 2).

Obstetric dilemma

The term *obstetric dilemma* was coined by Washburn in 1960 as an explanation for the exceptionally difficult human childbirth in comparison to other primates. The original hypothesis explained the obstetric dilemma as an interaction between two conflicting evolutionary pressures: the narrowing of the human pelvis due to bipedalism and the increase in size of the fetal head due to a larger brain volume (3-5).
Modern human childbirth is a very complicated process in the comparison with other mammals. One of the main causes of maternal mortality in ancient as well as in modern humans is obstructed birth whose main cause is cephalopelvic disproportion that can be explained by the obstetric dilemma hypothesis (3). Inadequate CS access can lead to the development of perinatal asphyxia, uterine rupture, formation of obstetric fistulae, and stillbirth, which are the consequences of a long-lasting obstructed birth (6,7). Potentially superior explanation for the difficulty of human childbirth considers that the concept of an obstetric dilemma is intrinsically harmful as it exaggerates the risk of cephalopelvic disproportion and obstructed birth (8).
Predicting high CS rates will lead to greater cephalopelvic disproportion and to a potentially greater prevalence of obstructed birth due to the removal of selective evolutionary pressure caused by the limited size of the human birth canal (4). Some authors suggest that, in an evolutionary sense, the birth canal was not influenced only by CS and modern medicine, but also by early, primitive forms of birth assistance and obstetrics since the Stone Age (9).
The aim of this review was to show almost epidemic proportions of the frequency of caesarean section in the world, and here in Bosnia and Herzegovina, and to try to figure out a way to maintain the existing frequency or reduce it.

HISTORICAL ASPECTS OF CESAREAN SECTION

The term caesarean section is often associated with the Roman dictator Julius Caesar. However, historians are sceptical of the theory that Julius Caesar himself was born via CS, and consider that the intervention was not named after him. This is supported by the fact that Caesar's mother, Aurelia, survived childbirth and passed away when Caesar was 55 years

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old (10-12). Another theory suggests that CS was named after the Roman law *Lex Caesarea*, which prohibited the burial of a deceased pregnant woman with the child still in the uterus (11,12). Another etymological explanation states that the name comes from the Latin word *caedere* (cut) and the Latin term *caeso utero* (cut uterus) (11,12).

The first written record of a successful CS dates from 1500 when Jakob Nufer successfully performed the procedure on his wife. However, historians are still sceptical of the validity of the record (11,12). Although CSs have been documented since ancient times, the first verified records of successful CS without maternal or fetal mortality date from the late 18th and early 19th century (11). The main medical developments that enabled the reduction of maternal mortality were uterine closure techniques, the development of anaesthesia, aseptic and antiseptic techniques and the development of extraperitoneal surgical techniques. One of the foremost causes of maternal mortality in the early development of CS was peritonitis (11,13-15).

CSs can be divided into primary or elective CSs, secondary or emergency CSs and elective CSs on maternal request. Primary CS is performed before the onset of labour contractions and with an intact amnion, secondary CS is performed after the onset of labour contractions with a dilated cervix and ruptured amnion, and an elective CS on maternal request is performed without medical indications at the insistence of the patient or at the convenience of the physician (1,16). A medically justified CS can reduce maternal and neonatal mortality and morbidity, but CS is also associated with negative short-term and long-term consequences for maternal and fetal health, and thus the question of ideal CS rates and indications is raised (17).

INDICATIONS/ CONTRAINDICATIONS FOR CAESAREAN DELIVERY

A caesarean delivery is indicated when a vaginal delivery can potentially cause harmful maternal or fetal consequences, when contraindications for a vaginal delivery exist or if during the pregnancy such states develop that require the pregnancy to be urgently finished and a vaginal delivery is not possible (1).

According to a study from 2011 conducted in the United Stated of America (18), the most prevalent indications for elective CS were nonreassuring fetal status (32%), labour arrest disorders (18%), multiple gestation (16%), suspected macrosomia (10%), preeclampsia (10%), maternal request (8%), maternal-fetal conditions (5%), and other obstetric conditions (1%). The study from 2013 also conducted in the United States (19) determined that the most prevalent indications for elective CS were failure to progress (35.4%), nonreassuring fetal heart rate tracing (27.3%), and fetal malpresentation (18.5%).

Indications for CS can be divided into maternal, uterine/anatomical and fetal indications (2), and into absolute, relative and extended indications (1).

A Swedish study from 2010 (20) determined that the indication for CS has changed over time from 1992 to 2005. In 1992 the most common indications for CS were fetal malpresentation and uterine factors, while in 2005 the most common indications were of psychological nature including fear of childbirth and CS on maternal request without any coexisting medical indications. The authors came to the conclusion that there was a change in women's as well as obstetricians' attitudes towards the mode of delivery.

Absolute contraindications for CS are practically non-existent. Some of the relative contraindications include severe coagulopathy and history of abdominal surgery, which can complicate CS, intraamniotic infections, severe fetal anomalies and fetal death (1,2). CS is also ethically contraindicated in case of patient refusal despite informed consent and adequately provided information (2).

ROBSON CLASSIFICATION

The Robson classification, also known as the Ten Groups Classification System (TGCS) is a childbirth classification system according to the mode of delivery and indications. It presents a complete perinatal classification system that encompasses all women, not just women that had a caesarean delivery (21). One of the biggest advantages of the Robson classification is the ability to quickly and efficiently classify women into corresponding groups (22).

The Robson classification can help with audit standardisation after caesarean deliveries and with the identification of categories that chiefly contribute to the CS rate (23). The World Health Organisation (WHO) has identified the Robson classification as the most suitable for meeting global as well as local needs and recommends implementing the Robson classification as a global standard (17). The WHO also created the Robson platform, a global digital platform where health facilities can publish their data and compare it (24).

EPIDEMIOLOGY OF CAESAREAN SECTION

According to data from the WHO (25), the global median CS rate between countries in 2018 was 18.75%, with the lowest rate recorded in South Sudan (under 1%), and the highest rate recorded in the Dominican Republic (58.1%). It is important to emphasize that significant heterogeneity exists between the years of measurement and the measurement period between countries. The years of measurement range from 2006 to 2017, and in some countries the average of a multi-year period was taken into account, while in other countries only one year was taken into account.

The global CS rate in 2014 was 18.6%, with a range 1.4-56.4% between countries with the highest and lowest CS rates. The region with the highest CS rate was South America with 42.9% and the region with the lowest one was West Africa with 3.0% (26). According to a recent study (27), the global CS rate in 2018 was 23.4%; the region with the highest CS rate was East Asia with 46.3%, and the region with the lowest CS rate was Melanesia, Micronesia and Polynesia with 3.6%. The global CS rate in the period from 1990 to 2018 increased by 19.4%, with the most significant increase recorded in undeveloped countries. The countries with the most pronounced increase in the period from 1990 to 2018 were Turkey, Andorra, Egypt, China and the Dominican Republic (27).

It is estimated the global CS rate in 2030 will be 28.5%; the region with the highest CS rate will be East Asia with 63.4% and the region with the lowest CS rate will be Sub-Saharan Africa with 7.1%. The research also predicts that there will be a reduction in the discrepancy between developed and undeveloped countries (27). According to data from Euro-Peristat research conducted in 28 European countries in 2019 (28), the median CS rate was 26% and varied between 16% in Norway to 53% in Cyprus; the interquartile range was 20.7% - 32.1%. An outlier relative to other countries was Cyprus: significant heterogeneity exists between examined countries and a large range is observable between the countries with the highest

and lowest CS rates. The most significant increase in CS rates from 2015 to 2019 was observed in Croatia (+4.7%), Ireland (+3.5%), Hungary (+2.7%), Scotland (+3.1%), Northern Ireland (+2.5%) and Wales (+2.4%), while the most significant decrease was observed in Cyprus (-3.7%), Italy (-2.4%), Czechia (-2.4%) and Luxembourg (-2.2%) (9). Countries where CS rates increased exhibit a tendency of an increase in all categories of the Robson classification, while countries where the CS rates decreased exhibit a tendency of a decrease in all categories of the Robson classification (29,30). In countries with the most significant increase of CS rates, the absolute contribution of groups 1, 2a, 4a, 2b, 4b and 10 has exhibited a tendency of increase (29). Former communist countries in Europe exhibited lower CS rates than other European countries in the year 2000 and have experienced a much more significant rise in CS rates than other European countries until 2010 (31).

Globally, CS rates are associated with the socioeconomic status of women (32). According to research from 2018 (33), global CS rates exhibited significant discrepancies between rich and poor social strata in undeveloped and developing countries, and the CS rates were higher in for-profit health institutions compared to public institutions. The most pronounced inequalities in CS rates between rich and poor social strata exist in Latin America. Meanwhile, the general CS rates are lower in Africa, but the inequality is also less pronounced (32). Inequality is not only pronounced between social strata, but also between countries and states themselves, which leads to disproportional distribution of global health resources, a large burden on the global economy and increased maternal and fetal mortality in countries with inadequate CS rates while other countries have unjustifiably high rates (34).

Ideal caesarean section rates

The WHO determined in 1985 that a caesarean section rate above 10-15% is unjustified for any region (17). By the definition (35), the ideal CS rate is a rate of 10-12% or lower. In 2015, a CS rate of 9-16% was identified as ideal, where higher rates are not correlated with lowered mortality rates (36). It was suggested in 2017 that an ideal CS rate should be 12-19% (37). The European Association of Perinatal Medicine and the European Midwives Association (38) stated in 2024 that country-level CS rates should range between 15 and 20%.

Nevertheless, the World Health Organisation emphasizes that CS should be available to every woman in need and whenever it is medically indicated, and that the focus should not be only on achieving certain CS rates (17).

Reducing caesarean section rates

A systematic review from 2018 (39) came to the conclusion that the following interventions are effective for the reduction of CS rates (weak, medium or strong evidence): childbirth training workshop, nurse-led applied relaxation training programme, psychosocial couple-based prevention programme, psychoeducation, implementation of clinical practice guidelines combined with mandatory second opinion for caesarean section indication, implementation of clinical practice guidelines combined with audit and feedback, physician education by local opinion leader and collaborative midwifery–labourist model of care. A meta analysis from 2007 (40) showed that CS rates can be reduced with interventions that imply analysis and change of practice of healthcare workers. According to a systematic review from 2019 (41), education of males and females, feedback, the presence of a midwife and a referral system for delivery are effective for the reduction of CS rates. Research from 2020 (42) about possible financial and regulatory interventions for the reduction of CS rates could not come to definitive conclusions due to weak and contradicting evidence.

CAESAREAN SECTION IN BOSNIA AND HERZEGOVINA

Data from the Agency for Statistics of Bosnia and Herzegovina (B&H) (43) show the CS rate in Bosnia and Herzegovina (B&H) demonstrated an increasing trend from 2009 to 2018. The percentage of CSs relative to the total number of births in 2009 was 17.50%, and 26.54% in 2018 (Table 1). The total number of livebirths in the period 2009-2018 was 313,008, while the total number of CSs was 70,662. The average percentage of CSs relative to the total number of livebirths during the studied period was 22.58%. The absolute number of CSs from 2009 to 2018 increased by 29.31%.

According to research conducted by Betrán et al. in 2016 (26), B&H was located in the South Europe region, which had a median CS rate of 30.7% in 2014, with a range 13.9%-38.1% between countries with the lowest and highest CS rates. Accord-

Table 1. Cesarean section (CS) prevalence according to data of the Agency for Statistics of Bosnia and Herzegovina

Year	Number of livebirths	Absolute CS number	CS percentage (%)	Percentage (%) change relative to previous year
2009	34 550	6045	17.50	–
2010	33 528	5355	15.97	–11.41
2011	31 811	6919	21.75	+29.21
2012	32 547	7361	22.62	+6.39
2013	30 684	7219	23.53%	–1.93
2014	30 268	7215	23.84	–0.06
2015	29 770	7256	24.37	+0.57
2016	30 183	7487	24.81	+3.18
2017	30 200	7988	26.45	+6.69
2018	29 467	7817	26.53	–2.14

Table 2. Review of cesarean section (CS) prevalence research in Bosnia and Herzegovina

Author	Year	City/ Municipality	Health facility	Number of births	No (%) of CS	Reference
Mišeljić et al.	2007	Sarajevo	General hospital „Prim. dr. Abdulah Nakaš“	1424	221 (15.52)	[45]
Abou El-Ardat et al.	2012	Sarajevo	Clinical Centre University of Sarajevo	3216	1115 (34.67)	[46]
Abou El-Ardat et al.	2012	Travnik	Hospital of Travnik	927	115 (12.41)	[49]
Fatušić et al.	2015	Tuzla	University Clinical Centre Tuzla	3672	936 (25.49)	[47]
Mišeljić et al.	2017	Sarajevo	General Hospital „Prim. dr. Abdulah Nakaš“	1514	347 (22.92)	[45]

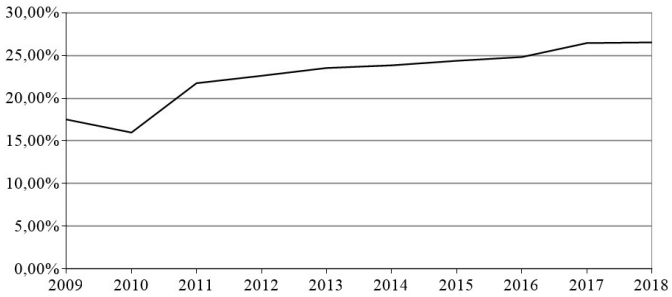

Figure1. Cesarean section (CS) rate in Bosnia and Herzegovina during the period from 2009 to 2018

ing to the same study, the global median CS rate was 18.6% in 2014, with a range of 1.4% - 56.4%.

In the South Europe region a median CS rate of 30.1% in 2018 was noticed, with a range 21.2%-34.1% between countries with the lowest and highest CS rates. Additionally, the global median CS rate was 21.1% in 2018, with a range 1.4%-58.1% (37). According to projections by Betrán et al. from 2021 (27), the CS rate in the South Europe region will be 47% in 2030.

The study conducted at the General Hospital "Prim. dr. Abdulah Nakaš" in Sarajevo (44), the CS rate increased from 15.5% to 22.9% in the period 2007-2017. During 2012 the CS rate at the Clinical Centre of the University of Sarajevo was 34.7%, and of the total number of livebirths, 1.50% were vaginal deliveries after a previous CS (45).The CS rate at the University Clinical Centre Tuzla in 2015 was 25.49%, of which 54.70% were emergency CSs and 45.30% were elective CSs (46,47). During the five-year period between 2012 and 2016, 41.63% of preterm neonates were delivered by CS at the University Clinical Centre Tuzla (48). At the Hospital of Travnik during 2012, the CS rate was 12.41% (49) (Table 2, Figure 1).

CS rates in B&H have demonstrated an upward trend in the period between 2008 and 2018, which corresponds to the increase in the wider region, but it is difficult to precisely follow CS rates due to the limited amount of data available. Local research has also demonstrated an upward trend, but the observation is limited and available research on this topic in B&H is sparse. CS, especially CS rates present fertile ground for future research in B&H.

Although there is no clear consensus on the prevalence and prominence of the negative consequences of CS, especially neonatal consequences, unnecessarily high CS rates are not associated with better maternal and neonatal outcomes. Global epidemiological data demonstrated that, in most countries, there is a tendency of an increase for CS rates and some countries reach staggering rates of over 50%. Still, not all countries should focus on the reduction of CS rates, and in some poorer countries it is desirable to increase CS rates and enable adequate and timely access to CS. Such observations are indicative of global inequality, in particular with the distribution of medical and health resources. There is no clear consensus on the ideal CS rate in which higher rates are not associated with better patient outcomes. However, the ideal CS rate, according to newer research, is higher relative to older research and guidelines.

High CS rates, notably elective CS and CS on maternal request, are caused by a variety of factors which is indicative of the multidisciplinarity of the problem and the requirement for a multidisciplinary solution. Taking into consideration that existing guidelines are relatively sparse and primarily based on weak and medium evidence, it is necessary to further analyze the factors that lead to an increased CS rate and create unified guidelines. The opinions of pregnant women should also be taken into consideration when selecting the mode of delivery.

In conclusion, taking into consideration that CS rates are generally associated with the development of country and society, and the fact that there are certain exceptions to this association, it is necessary to analyze high-income (developed) countries with regard to low CS rates and determine the factors that enabled such rates. Bosnia and Herzegovina could also benefit from such an approach as the CS rates, although high, have not yet reached critical values seen in other developing countries.

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