INTRODUCTION

Caesarian section (C-section) rates have been rising worldwide, especially in the most developed countries. It seems that only now the rates have plateaued, but a steep increase happened from 1996 to 2011. The caesarian section is, in selected cases, the safest way to deliver, being the only way to save both mother and newborn. Regardless, when performed without clinical indication in low risk pregnancies, which represent the vast majority of pregnancies, it appears to pose a significantly greater risk when compared to vaginal delivery, in terms of maternal morbidity and mortality. In 1985, a panel of reproductive health experts at a meeting organized by the World Health Organization (WHO) about the C-section rates stated that “there's no justification for any region to have a rate higher than 10-15%”. This statement was reviewed since then, due to the steep increases in the C-section rates across countries.
Influence of maternal age on caesarean delivery – experience in a tertiary hospital

The rise in the C-section rates is multifactorial, but there is growing evidence suggesting that maternal age may have a significant contribution\(^2\). It is widely known that an advanced maternal age brings worst pregnancy outcomes, traditionally being the age of 35 years old the cut-off considering a higher risk. Nevertheless, the age associated risk factor is much more of a continuous variable than a threshold one. The increased risk of congenital abnormalities, gestational diabetes, placenta previa, macrosomia, other obstetric indications, preeclampsia and maternal request\(^1\).

The study conducted was observational and retrospective. Data were collected using the hospital electronic medical records, ICD-9-CM coding system and unit database software Obscare.

Ethics approval was obtained from the ethics committee of our hospital – reference number – 260-16; date of approval – October 18\(^{th}\) 2016.

We included every birth from January 1\(^{st}\) 2008 to December 31\(^{st}\) 2012 in a tertiary hospital and excluded cases without information on maternal age or mode of delivery, gestational age <37 or >42 weeks, multiple pregnancies, maternal diabetes mellitus, maternal hypertensive disease, placenta previa, intra-uterine growth restriction, fetal malformations, C-section conducted due to maternal or fetal disease that contraindicates vaginal delivery and C-section conducted due to pregnancy disorders.

Maternal age was categorized in 3 groups: under 20 years old (<20), from 20 to 34 (20-34) and 35 or older (35+). The maternal age reference group was 20-34. The delivery mode was assessed as spontaneous vaginal, instrumented vaginal or C-section. The outcome C-section vs vaginal delivery (spontaneous vaginal plus instrumented vaginal) was assessed. Labor induction (yes vs no), parity status (multiparous vs primiparous) and presentation (cephalic vs other) were also assessed. The variable C-section timing was coded as "elective" (before labor), "urgent" (during labor) and "emergent" (a condition that implies the birth must oc-
cur in under 20 minutes). C-section indications were coded as “abnormal situation/presentation”, “previous C-section”, “non-reassuring fetal tracing”, “suspected fetopelvic incompatibility”, “failed attempt of labor induction”, “labor arrest”, “maternal refusal for vaginal delivery”, “failed attempt of instrumented vaginal delivery” and “other”.

The primary outcome was the delivery mode; we also evaluated this outcome in subgroups concerning labor induction and parity. Secondary outcomes also assessed were: C-section indication and C-section timing.

The analysis was made using SPSS IBM Statistics 24. Continuous variables were described using mean ± standard deviation. Frequencies were described as absolute number (n) and percentage (%). Normality was checked using skewness and kurtosis. Independent samples t-test was used to assess differences among groups in normal continuous variables. Chi-square goodness of fit and X² test with Odds Ratio (OR) with a 95% confidence interval were used to compare categorical data. The level of statistical significance was set at p < 0.05.

**RESULTS**

There were 14,462 births from January 1st 2008 to December 31st 2012; we excluded 4051 cases. A total of 10,411 cases were assessed.

Mean maternal age was 29.79 ± 5.51 years old. Demographic and obstetric characteristics by maternal age group showed in Table I.

In the 35+ age group, when compared to the reference group, the odd of C-section was significantly higher, OR 1.527 [1.371-1.700].

The odd of C-section was higher in all women who had a labor induction, OR 1.367 [1.221 - 1.531]. When assessing the odd for induction, both 35+ and <20 age groups had lower probability of induction, OR .856 [0.753-0.974] and .619 [.468-.818], relative to the reference group. When we consider only the subgroup of labor induced women, the odd of C-section in the 35+ age group is not significantly different. When we consider only the subgroup of women without induction of labor, the 35+ age group still have higher probability of having a C-section, OR 1.620 [1.439- 1.825].

When dividing women for parity, the odd of C-section is significantly smaller in the multiparous group, OR .735 [.666-.811]. In the 35+ age group, both multiparous and nulliparous women still had a higher odd of C-section, OR 1.581 [1.356-1.843] and OR 2.098 [1.742-2.527], respectively, when compared to the reference age group.

Presentation and birth weight do not differ significantly between age groups.

The main indications for cesarean delivery are illustrated in Figure 1. When compared to the group reference, the 35+ age group had a higher odd of C-section due to “previous C-section”, OR 3.121 [2.519-3.865], and a lower odd for C-section due to “labor arrest” and “non-reassuring fetal heart tracing”, OR .559 [.457-.685] and .724 [.563-.931], respectively.

The 35+ age group had a higher odd of an elective C-section, OR 1.844 [1.509-2.254] and a lower odd of an urgent C-section, OR .644 [.537-.774], when compared to the group reference (Figure 2).
Our total C-section rate was 23.6%, which is higher than recommended by the WHO, especially considering we are only assessing low risk pregnancies. We chose to assess only pregnant women with no labeled risk factors or comorbidities that could be related to aging, trying to exclude possible reasons behind higher C-section rates in older women. However, even when assessing these healthy women with otherwise low risk pregnancies, we found a higher risk for C-section in older women. This supports the hypothesis that there is either a different approach from physicians towards older women, due to the “high risk labeling” and/or a biological factor associated with aging that impairs the ability of older women to have a vaginal delivery. Supporting the “high risk labeling” hypothesis, we also found that being older was a risk factor for having an elective C-section and a protective factor for having an urgent C-section. Although literature suggests that older women have a higher risk of emergency C-section, most studies included women with the comorbidities knowingly associated with aging and that pose a higher risk for emergency procedures. The fact that we did not found this association reinforces that maternal age alone is not a risk factor. Additionally, we found no differences in birth weight or presentation among age groups.

Indication for C-section due to “labor arrest” or “non-reassuring fetal heart rate” is lower in older women, being only higher the indication due to “previous C-section”, which is indicative of the need to reduce rates of primary C-section and once again it supports that clinicians may be mistakenly labeling older women as high risk patients due only to their age. The importance of vaginal birth after cesarean section (VBAC) cannot be underestimated and it has a major impact in C-section rates – for each 1% increase in VBAC, an estimated 0.58% decrease in C-section occurs. Regarding maternal outcomes, the risk of a trial of labor...
after C-section is lower than the risk of repetitive elective C-section and may, thus, be attempted in women with 1 or even 2 prior C-sections, with prior individualized risk assessment, especially concerning uterine rupture — there is no clear evidence that maternal age poses a greater risk of uterine rupture. There is conflicting evidence concerning the influence of maternal age on labor progression. Smith et al reported that older maternal age was associated with a reduced degree of spontaneous contraction of human myometrium and an increased likelihood of multiphasic spontaneous contractions, which is associated with prolonged labor. However, ArrowSmith et al have reported that, although the lack of contractility does happen in older non-pregnant uterus, in pregnant myometrial tissue, there is an hormonal response of myocytes with hyperplasia and hypertrophy, compensating any age-related differences and Crankshaw et al demonstrated that there was no evidence that the contractility of human myometrium obtained during pregnancy had any variation with advancing maternal age. Response to oxytocin appears to be decreased in older women, leading to increased needs of oxytocin-augmentation — the reason behind this can be the high content of cholesterol in myometrium cells of older women, influencing the oxytocin-receptor function — both serum LDL cholesterol and body mass index could, therefore, be important factors concerning the evolution of labor. Our results show that older women had fewer C-sections due to labor arrest, when compared to the reference age group, supporting that there is no direct effect of age on labor progression. Further research is needed to clarify the physiology of the aging pregnant myometrium and possibly provide targets to intervene and reduce the need for C-section. We found rates of C-section significantly higher in labor induced women. It is still not clear whether there is or is not an increased risk associated with induction — traditionally it was considered a risk factor for C-section, but there are some recent studies suggesting induction might have no effect on the C-section rates or even be a protective measure for it. Further investigation is needed to establish the true contribution of induction in the delivery mode, since an elective C-section has lower risks than an urgent one, the latter possibly potentiated by induction. When analyzing only the subgroup of labor induced women, older age stops being a risk factor for C-section. A possible explanation is that the augmented risk due to the induction itself supplants the risk of maternal age, since there is a higher risk of induction in the reference group. Adding to it, the option of inducing denotes a preference of the physician for a vaginal labor, instead of an elective C-section, which can further decrease the risk of C-section in older women due to the “high risk labeling” itself. The subgroup of non-induced women statistically behaves the same way as the total group — with an even higher risk for C-section in older women, possibly related to the higher odd of elective C-sections.

Regarding women’s parity, significant differences were found — multiparous had, as expected, lower risk of C-section. However, older women when compared to the reference age group still had a higher risk of C-section in both parity groups. The higher risk in the multiparous group may to some extent be due to previous C-section accounting for the multiparous status, which was in fact the major indication for C-section in the older group.

We had some limitations in this study, regarding missing information on whether there had been a previous C-section in multiparous women, medically assisted reproduction, increased body mass index and smoking status, all of them likely to have a higher prevalence in older women and possibly affecting the outcome “delivery mode”.

In conclusion, our study supports that advanced maternal age contributes to the elevated C-section rates in singleton low risk pregnancies at term. Physicians’ sensitization to this concerning matter may help to lower the C-section rates, by removing the high risk labeling associated with this age group and increasing the threshold for decision making regarding cesarean delivery. Focus should also be given on lowering the primary C-section rates, given the fact that “previous C-section” was the most frequent reason leading to C-section in older women. Another important concern that as to be addressed is that it seems the risk of having a C-section in older women is being overestimated due to elective C-sections, and an effort to figure the reason behind this is pivotal. Further studies are needed to evaluate the biology of the aging myometrium to establish new targets for intervention.

REFERENCES


Influence of maternal age on caesarean delivery – experience in a tertiary hospital

3. OECD - Social Policy Division - Directorate of Employment L and SA. Age of Mothers at Childbirth and Age-Specific Fertility. 2015.


13. PORDATA - Idade média da mãe ao nascimento do primeiro filho [online] Available at: http://www.pordata.pt/Portugal/Idade+m%C3%A9dia+da+m%C3%A3e+a+ao+nascimento+do+primeiro+n%C3%B3+filho-805 [Accessed at May 7th 2017]. (624):2-5.


ENDEREÇO PARA CORRESPONDÊNCIA
Joana Oliveira
E-mail: joanaoliveira.fmu@gmail.com

RECEBIDO EM: 20/03/2017
ACEITE PARA PUBLICAÇÃO: 18/07/2017