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Original Article

Impact of establishment of a color code in emergency caesareans in secondary health care maternity

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ABSTRACT

In 2008, a tertiary health care maternity set up a colour code organization for emergency caesarean to reduce the delay between decision and birth to thirty minutes.

The aim of this study is to determine the feasibility of the implementation in secondary health care maternity.

Materials and methods: This retrospective study was conducted in secondary health care maternity and it was divided in two phases: phase I corresponding to the period before the implementation of colour code and phase II, to the period after the implementation of colour code. All patients who had an emergency caesarean were included. Then, we compared the decision to birth delay between the two phases and the neonatal state.

Results: Two hundred and twenty patients were included (one hundred and thirteen for the first phase and one hundred and seven for the second). The rate of caesarean sections realized within thirty minutes was no different between two groups. Decision to birth delay is variable and tends to decrease between two phases (-7 min for orange code, p = 0.91; and -15 min for red code, p = 0.0769).
The medium pH is the same in both groups (7.30, p = 0.22) and the rate of transfer in neonatology is 29% for the first group and 13% in the second (p = 0.004)

Conclusion: This protocol has resulted in better care for patients who had an emergency caesarean section. Two elements are to be noticed as follows: a reduction of decision to birth delay for extremely emergency caesarean (p = 0.0769) and less transfer in neonatology (p = 0.004).

1. Introduction

200 000 C-section occurring within a year in France, they are the most frequent form of intervention in this country. The caesarean rate keeps increasing up to 2003 by 20.2%, versus an increase of only 17.5% in 1998. Since 2003, the caesarean rate is stable [1]. Half the interventions are emergency caesareans. In France there is no recommended delay for an emergency caesarean. It is difficult to establish a perfect delay because of several parameters. It depends on the type of establishment, is the medical team is present or not in the maternity etc. The American and English governments recommend thirty minutes from decision to birth delay. The German government recommends twenty minutes. [2,3]. In 2003, Professor Olivier Dupuis set up a colour code system to distinguish caesareans depending on their emergency and then adapt to clinical situation [4,5,8]. According to this study published in 2008, this system increases the maternal and foetal prognostic. But these experiments happened in a tertiary maternity with an obstetrical and anaesthetic team being physically present in the delivery room. Unfortunately, all maternities are not organised like this. That is why we can wonder ourselves if this data can change anything in patients care. The aim of this study is to see if this protocol can be used in a secondary maternity care with a different organization.

2. Materials & method

This is retrospective observational study, took place in a secondary maternity care, in Compiègne, which delivers nearly

Abbreviation: BMI, body mass index; IUGR, intrauterine growth restriction; AFHR, anomaly of foetal heart rhythm; HELLP, hemolysis elevated liver enzymes low platelets.

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1460 births each year 5 (1471 en 2016 et 1458 en 2017). The medical team includes an obstetrician and his resident on-call in the delivery room, an anaesthetist on-call for operating theatre and his nurse, and two midwives. There is no operating room only for caesarean. If there is a caesarean during the day, it takes place in an operating theatre with other emergencies. At night, the anaesthetist and his team are present in the hospital but not in delivery room. He is available by phone 24 h a day. The obstetrician and his resident is in the delivery room 24 h a day.

Every patient who had an emergency caesarean between 1st august 2016 and 31 july 2017 was included. Patients who had a non-urgent caesarean, multiple pregnancies or medical termination of pregnancy were excluded. The study was separated into two phases. The first one, before any use of the previously mentioned colour-code system, was from 1st August 2016 to 31 January 2017. The second one, after the colour-code system, was from 1st February to 31 July 2017. Details of the colour-code and the role of all persons involved were diffused several times through meetings. The protocol was also available online and posted on delivery room walls.

The color code used is detailed in Table 1.

Collection of data was possible thanks to files of patients. Emergency c-section was selected from the birth register. The colour chosen by the obstetrician was referred to on partogram or foetal monitor. For each files we searched the term of the pregnancy, gestation and parity, previous c-section, weight, colour code used, time of decision, time of incision and time of birth. We also searched foetal repercussion through arterial pH and any necessary transfer in neonatology. We considered that arterial pH inferior to 7.13 was severe. This threshold correspond to -2 standard deviation. The arterial pH was achieved from the birth of the foetus, after clamping the cord by gasometry. It is then directly analyzed in birth room thanks to a pH meter [11–13].

Data was compared between phase I and II. Statistical analysis was performed with Mann-Whitney test to compare quantitative variables between the two groups and Chi 2 test to compare qualitative variables. The threshold for statistical significance was set at the 5% level ($p < 0.05$). Analyses were performed using SAS software (version 9.4, SAS Institute Inc., Cary, NC, USA).

3. Results

All in all, 220 patients were included: 113 in phase I and 107 for the second phase. The demographic, organisational and neonatal characteristics of the phases I and II groups were similar. Anaesthesia methods were similar in both groups. (Table 2)

Table 2
patients' characteristics.

	Phase I	Phase II	p
Gestational age in weeks (SD)	38.5 +/- 1.94	39.3 +/-2.05	0.0110
Cervical dilatation (cm)	4.37 +/- 3.56	4.53 +/- 3.42	0.686
BMI	25.38 +/- 5.96	27.44 +/- 7.46	0.020
Epidural anesthesia	62.8%	69.1%	0.635
Spinal anesthesia	32.7%	28%	0.635
General anesthesia	4.4%	2.8%	0.635
Never had a c-section	75.21%	75.7%	0.744

Table 3
Duration of a caesarean according to colour code, in minutes.

	Phase I	Phase II	p
Green code	60.7	60.3	0.8382
Orange code	40.45	33.84	0.9138
Red code	31.57	16.375	0.0769

Between the two phases, there is no difference for the decision-to birth delay, regardless of the colour code. In median: 36.5 min for phase I and 34 min for phase II. ($p = 0.5637$). The average duration according to the code is variable. For a green colour it takes 60 min to make a caesarean. While for an orange code it takes 40 min for phase I and 33 min for phase II. And for red colour, it takes 31 min before colour code and 16 min after its introduction. (Table 3)

The most frequent cesarean indication, regardless of colour code, was similar in the two groups. First indication was anomaly of foetus heart rhythm, second was stagnation and third put in labour for patients who had a programmed caesarean. (Table 4)

Concerning foetuses, the average weight in phase I was 3111 g +/- 679 g, while in phase II it was 3304 g +/- 634 g.

After setting up the colour code, we noticed a significant decrease of neonatal transfer. Indeed, 29% of foetuses were transferred in phase I and 13% in phase II. ($p = 0.004$) (Table 5). There is no difference for the pH. Nearly 7% of foetus had a pH inferior to 7.13.

4. Discussion

The implementation of a colour code for emergency caesarean in secondary maternity health care allowed the understanding of several things. First of all, thanks to it, the rate of neonatal transfer decreased in a significant way. All of the studies agree that there is

Table 1
Colour code description according to indication.

Code	Indication
Red In case of major life-threatening, the birth will be in fifteen minutes after the decision to carry out a caesarean	• Foetal bradycardia during at least ten minutes • Failure of instrumental extraction associated with anomaly of foetal heart rhythm • Suspicion or diagnosis of haemorrhage from placenta praevia • Placental abruption • Umbilical cord prolapse • suspected uterine rupture • Eclampsia
Orange In case of moderate life threatening, the birth will be until thirty minutes after decision	• Anomaly of foetus heart rhythm (apart of bradycardia) • Failure of instrumental extraction without anomaly of foetus heart rhythm
Green It concerns emergency caesarean but without life threats.	• Failure of triggering • Failure of dilatation • Dystocia presentation (breech, forehead, transverse) • Put in labour for patients who had a programmed caesarean

Table 4
cesarean indication according to the colour code.

Code	Phase I	Phase II
Green	n = 18	n = 15
· Stagnation	n = 11	n = 12
· Put in labour before programed c-sec	n = 10	n = 9
· Failure of triggering	n = 11	n = 9
· No engagement	n = 4	n = 5
· Pre eclampsia	n = 3	n = 4
· IUGR	n = 3	n = 3
· Dystocic presentation		n = 9
· Others		
Orange	n = 3	n = 1
· HELLP	n = 45	n = 21
· Anomaly of foetus heart rhythm (AFHR)		n = 2
· Decrease of fetal movement		n = 5
· No engagement & AFHR		n = 3
· Stagnation & AFHR		n = 1
· Mother to child infection		
Rouge	n = 2	n = 1
· Abruptio placentae	n = 1	n = 0
· Cord prolapse	n = 3	n = 6
· Bradycardia	n = 1	n = 0
· Uterine rupture		n = 1
· Forhead presentation & AFHR		

Table 5
Comparison of neonatal state between two phases, in percent.

	Phase I	Phase II	p
Transfert néonatal	29.20%	13.21%	0.004
pH	6.66%	7.84%	0.793
• < 7.13	90.47%	92.15%	
• > 7.13			

an improvement of emergency caesarean care thanks to this colour code. Our study goes in this direction too. This protocol permits to decrease the morbidity and mortality which is essential in medical care.

Moreover, the delay announced by Huissoud and al. is not optimal in secondary health care maternity. Indeed, even if we reduced decision to birth delay to seven minutes for an orange code, we are above the threshold of thirty minutes. For red colour we considerably reduced the time from thirty one to sixteen minutes which is not negligible. But it is respectable, because according to a study carried out in a primary health care maternity, [6] the decision to birth delay for a green code is of 62 min, for an orange code of 42 min and for a red code of 22 min. In a tertiary health care maternity, the average delay was of 24 min for the orange code and 10.8 min in red code [10]. So our results are consistent with other study. The values found during our analysis are to be improved but and confronted with several parameters bound to organization of the operating theatre. As a reminder, delivery rooms do not have an obstetric block. Which are in the operating theatre. This means that in the case of a green colour caesarean, sometimes we have to wait for the end of an intervention to proceed.

Furthermore, thanks to this protocol, the role of each participant was clearly defined according to degree of emergency, and so time was saved particularly between the delivery room and operating theatre. [7] Indeed, many studies conclude that the delay between the decision and entry in the operating room represents nearly 50% of birth delay to delivery delay [8,9]. Team in general is satisfied with this protocol because it enables to speak the same language which is precious in an emergency case. Each person, thanks to this given code has a specific role, which is essential given the number of people involved. And this especially in our study because we do not have an operating room strictly dedicated for cesareans. The goal is not to go as fast as possible but to have a proper care in connection with the indication of cesarean section. Reasons for the color codes were respected concerning the green codes.The majority For the red codes concerned fetal bradycardias. One of the patient had a red code labeled caesarean section for a presentation of the forehead with abnormal rhythm and stagnation of dilatation. However, many cesarean sections were classified orange code by default only because it did not correspond to a green code or a red code, such as in a case of a suspicion of chorioamnionitis. The orange code is indeed sometimes incorrectly set because the factor justifying a cesarean section does not strictly correspond to the protocol. Colour announced by the obstetrician was related to the indication of the caesarean, but also sometimes according to the cervical dilatation and the overall clinical context. A presentation of the forehead is a green code, however when it is related to abnormal fetal heart rate and stagnation of dilatation the degree of emergency becomes more important in order to avoid the risk of uterine rupture for example. In 2010 the Anglo-Saxon recommendations were modified and gave another approach to this protocol. Caesareans are now divided into four categories each represented by a different color according to a color spectrum, related to the presence or absence of maternal-fetal risk. The concept is that there is a specific risk to each situation and that, depending on the risks involved, caesarean section becomes more or less urgent and falls in line with our words [14].

Also in case of cesarean section red code, it is recommended to perform a general anesthesia, faster than the establishment of an epidural or spinal anesthesia. In our study, we did not systematically comply with this recommendation in cases of extremely urgent caesarean because the epidural was already performed before the indication of the gesture for most patients. Very often in view of the organization of the establishment the anesthetist comes to make a reinjection into the epidural while the team of the operating room prepares the intervention room and equipment. This saves time between the passage of the birth room and the operating room. In the case of a patient without analgesia, general anesthesia was recommended, but only one patient out of eight. General anesthesia is not easy in the pregnant patient who presents a physiological modification of the upper airways. It therefore requires experimentation and a quick gesture that is not without risk [15,16].

5. Conclusion

The implementation of a colour code in an emergency caesarean enables to reduce neonatology transfer significantly. This is a sign of a better medical care. This protocol is not optimal because the delay is above what is recommended. It showed a better coordination of the team which made it save some time.

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