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Guidelines

Guidelines for the management of urgent obstetric situations in emergency medicine, 2022☆,☆☆

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ABSTRACT

Objective: To provide recommendations on the management of urgent obstetrical emergencies outside the maternity ward.
Design: A group of 24 experts from the French Society of Emergency Medicine (SFMU), the French Society of Anaesthesia and Intensive Care Medicine (SFAR) and the French College of Gynaecologists and Obstetricians (CNGOF) was convened. Potential conflicts of interest were formally declared at the outset of the guideline development process, which was conducted independently of industry funding. The authors followed the GRADE (Grading of Recommendations Assessment, Development and Evaluation) method to assess the level of evidence in the literature. The potential drawbacks of strong recommendations in the presence of low-level evidence were highlighted. Some recommendations with an insufficient level of evidence were not graded.
Methods: Eight areas were defined: imminent delivery, postpartum haemorrhage (prevention and management), threat of premature delivery, hypertensive disorders in pregnancy, trauma, imaging, cardiopulmonary arrest, and emergency obstetric training. For each field, the expert panel formulated questions according to the PICO model (population, intervention, comparison, outcomes) and an extensive literature search was conducted. Analysis of the literature and formulation of recommendations were conducted according to the GRADE method.
Results: Fifteen recommendations on the management of obstetrical emergencies were issued by the SFMU/SFAR/CNGOF panel of experts, and 4 recommendations from formalised expert recommendations (RFE) established by the same societies were taken up to answer 4 PICO questions dealing with the pre-hospital context. After two rounds of voting and several amendments, strong agreement was reached for all the recommendations. For two questions (cardiopulmonary arrest and inter-hospital transfer), no recommendation could be made.
Conclusions: There was significant agreement among the experts on strong recommendations to improve practice in the management of urgent obstetric complications in emergency medicine.

1. Introduction

In 2010, The French Society of Anaesthesia and Intensive Care Medicine (SFAR) and the French Society of Emergency Medicine (SFMU) published a series of formalised expert recommendations on obstetric emergencies outside of hospitals [1]. Since that time, the modification of French territorial organisation has had a direct impact on pre-hospital management of medical emergencies, particularly as regards inter-hospital transfers [2]. For that reason, updated recommendations appeared called for.

Low incidence of obstetrical emergencies can be a source of difficulties, as is the need to manage two patients (the mother and the child) at the same time, especially in a pre-hospital setting [3]. According to the French National Institute for Statistics and Economic Studies (INSEE), 5,000 out of 784,000 births in 2016 (0.6%) took place outside of a hospital or a maternity ward. In nine cases out of ten, the mothers received assistance from a physician or a midwife [4].

Given the potential severity of some emergencies, which may be life-threatening for the mother and/or the child, and given the heterogeneity of specialised structures in France (type II and type III maternity wards), initial medical interventions may turn out to be crucial.

Through these recommendations, the experts have striven to define the main aspects of management of obstetrical complications in emergency structures, that is to say exterior to structures specialised in obstetrics (*i.e.*, prehospital or hospital management in an emergency unit). Questions pertaining to imagery in pregnant women have been included, the reason being that CT-scan in a traumatised pregnant woman or in cases of suspected pulmonary embolism may be required in situations involving emergency care practitioners.

The experts wish to stress that all relevant medical procedures must be thought out and clearly explained to the patient, the objective being to favour acceptance and implementation.

2. Methodology

These Recommendations for Professional Practices are the result of work by a group of experts brought together by the SFMU, SFAR and the CNGOF. Prior to participation in the analysis, each expert filled out a "conflict of interest" declaration. During the initial stage, the organising committee defined the objectives of the recommendations and the methodology to be applied. The different fields of applications of these Recommendations for Professional Practice (RPP) and the questions to be addressed were defined by the organising committee before being validated by the experts. The questions were formulated in accordance with the PICO (Patients, Intervention, Comparison, Outcome) format. The GRADE (Grade of Recommendation Assessment, Development and Evaluation) methodology was applied for analysis of the literature and elaboration of tables summarising the data in the literature. A level of evidence was defined for each bibliographic reference in accordance with type of study and could be re-evaluated by taking into account the methodological quality of the study, the coherence of the results from one study to another, the direct or indirect nature of the evidence, and analysis of the relative sizableness of costs and benefits. It bears mentioning that very few studies related to the context of emergency medicine were identified and more often than not, their methodological quality and overall power were low. As it was impossible to obtain a high level of evidence for the majority of the recommendations, it was decided prior to the drafting of the recommendations to adopt a "Recommendations for Professional Practice" (RPP) format rather

than a "Formalised Expert Recommendation" (FER) format, and to formulate recommendations using the RPP terminology of the SFMU and SFAR. That is why each recommendation is formulated as follows: "The experts suggest to do" or "The experts suggest not to do". Each recommendation was evaluated by each of the experts and given individual ratings on a scale ranging from 1 (complete disagreement) to 9 (complete agreement). Collective grading was established according to the GRADE grid methodology. To validate a recommendation, at least 50% of the experts had to express a generally concordant opinion, while fewer than 20% expressed a discordant opinion. In order for a recommendation to be strong, at least 70% of the participants had to express a generally concordant opinion. In the absence of strong agreement, the recommendations were reformulated and once again graded, the objective being to achieve a consensus.

3. Fields of recommendation

The formulated recommendations pertain to seven fields: imminent delivery, post-partum haemorrhage (prevention and management), hypertensive disorders in pregnancy, trauma, imagery, cardiopulmonary arrest and emergency obstetric training.

An extensive bibliographic search was carried out from PubMed™ and Cochrane™ databases and www.clinicaltrials.gov. In order to be considered for analysis, the publications had to be written in English or French. Analysis was focused on data reported over the last 20 years according to order of interest and ranging from meta-analyses to randomised trials and observational studies. Size of the population and relevance of the research were taken into consideration for each study.

4. Synthesis of the results

Synthesis by the experts and application of the GRADE method led to the formulation of 15 recommendations and two absences of recommendation.

Due to the absence of trials and data specifically collected in a prehospital setting, the experts unanimously decided that the former recommendations issued by SFAR and the CNGOF for utilisation of oxytocic drugs in post-partum haemorrhage prevention and management of patients with severe pre-eclampsia in a hospital setting should also be applied in a non-hospital context. As a result, the recommendations on these issues issued by SFAR and the CGNOF in the preceding FER have been integrally reproduced in reply to questions 2.1, 4.1, 4.2 and 4.3.

Given the absence of steering committee consensus on analysis of the literature and congruence with recommendations issued by other learned societies, recommendations on the following question were not submitted to the experts for a vote: "In the event of delivery outside a maternity ward after more than 37 weeks of amenorrhea, does late umbilical cord clamping reduce neonatal morbi-mortality?". In addition, it was decided that the question on pulmonary embolism and the role of the spiral thoracic angio CT-scan would be considered in conjunction with the specific question on the CT-scan and injection in pregnant women.

Following two rounds of grading and several amendments, strong agreement was reached on all the recommendations. For questions on pre-hospital cardiac arrest in a pregnant woman and inter-hospital transfer of patients presenting with possibly severe post-partum haemorrhage, no recommendation could be formulated on the potential interest of foetal extraction.

The SFMU, SFAR and the CNGOF are encouraging hospital and non-hospital emergency physicians to comply with these RPP in view of ensuring high-quality patient care. When applying these recommendations, however, a practitioner is called upon to exercise his own judgment, taking into full account his expertise and the specificities of his establishment, the objective being to decide on the means of intervention best adapted to the state of the patient of whom he is in charge.

FIELD 1: IMMINENT DELIVERY

Question 1: In a patient in labour, which clinical signs are predictive of imminent delivery?

Experts: Philippe Le Conte (SFMU), Pierre-Yves Dewandre (SFAR), Julie Blanc (CNGOF)

R1.1.1 – In a pregnant patient in labour, the experts suggest questioning focused on the following elements: multiparity, previous rapid or non-hospital delivery, regular and painful uterine contractions and urge to push, the objective being to predict the imminence of delivery.

EXPERT OPINION (STRONG AGREEMENT)

R1.1.2 – In case of suspicion of imminent prehospital delivery and in the presence of qualified medical staff (physician or midwife), the experts suggest cervix examination before making contact with the host obstetric team, the objective being to optimally orient management of the patient (*i.e.*, transfer to a maternity ward or on-site delivery).

EXPERT OPINION (STRONG AGREEMENT)

Rationale

Unexpected delivery is considered as potentially problematic when there exists a risk that it occurs outside a specialised structure (*i.e.*, maternity ward) [5].

In the literature, there are scores assessing the risk of unexpected delivery outside a maternity ward [1]. For example, the Malinas score takes into account a number of characteristics and clinical signs: parity (*i.e.*, number of pregnancies to date), duration of labour, duration of contractions, interval between two contractions, preterm premature rupture of membranes (Malinas score A); cervical dilation according to parity (Malinas score B) [6]. With this in mind, cervix examination can be carried out, once patient consent has been obtained, by a qualified medical professional (physician, midwife). The information given by cervix examination on the state of the uterine cervix can help to predict imminence of delivery and effectively contribute to discussion on patient orientation (transfer to a maternity ward, or decision to deliver on the spot) with the referral hospital team.

The score predicting imminent delivery (SPID) can be calculated according to the following signs: reason for phone call after contact with the parturient woman, urge to push, and frequency of uterine contractions. This score also takes into account a number of aggravating factors: previous rapid delivery or home delivery, age, lack of pregnancy follow-up.

At this time, neither the Malinas score nor the SPID have been validated as means of accurately estimating the likelihood of imminent delivery, but in spite of not having been validated, in France the Malinas score is routinely utilised by emergency medical assistance services. In a multicentre prospective study, the SPID was compared to the Malinas score [5]. In this study, the clinical signs were evaluated by phone, and the primary endpoint was the time interval between call and delivery. The study reported an area under the ROC curve (AUC) score for the SPID superior to the corresponding Malinas score (0.78 *vs.* 0.89, delta AUC = 10%, $p < 0.001$).

Concerning clinical signs *per se*, to our knowledge no methodologically sound trial has specifically compared one clinical

sign to another in view of predicting imminent delivery in a pregnant woman in labour. That said, preterm premature rupture of membranes is a reliable predictive sign of imminent delivery outside a specialised structure. The elements to take into account would consequently seem to be: multiparity, associated with the risk of non-hospital delivery in a British case control study (OR 3.23 CI 95% [1.61–6.67]) [7], and the urge to push, considered in a single-centre retrospective study conducted in Guadeloupe as the only sign associated with imminent unexpected out-of-hospital delivery [8].

Question 2: In the event of delivery exterior to a specialised structure, does there exist a childbirth position of the pregnant woman reducing the risk of shoulder dystocia?

Experts: Sybille Goddet (SFMU), Estelle Morau (SFAR), Jeanne Sibiude (CNGOF)

R1.2.1 – Since no childbirth position is demonstrably superior to another, the experts suggest that in coordination with the patient, the caregiver selects the position in which both of them will be most at ease to achieve delivery.

R1.2.2 – Outside of a specialised structure, the experts suggest keeping open the option of rapidly placing the patient in a supine position compatible with the McRoberts manoeuvre: mother's legs hyper flexing tightly to her abdomen with the possibility of lowering the foetal head in the umbilical-coccygian axis.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

Literature on out-of-hospital management of the risk of shoulder dystocia according to position during childbirth is virtually non-existent. When delivery occurs in a maternity ward, the American and French guidelines have come to the conclusion that no single maternal or foetal posture is more advantageous than the others [9,10]. Moreover, according to the French guidelines on prevention of shoulder dystocia, in the event of foetal macrosomia, it is not recommended to carry out a prophylactic McRoberts manoeuvre [11]. These guidelines are based on two randomised trials comparing a prophylactic McRoberts manoeuvre to a classical gynaecological position [12,13]. In a recent trial, 1400 patients were randomised between a supine and a hands-and-knees delivery position [14]; in the two groups, the proportion of shoulder dystocia was similar. As a result, it is not possible to recommend one childbirth position rather than another as a means of preventing shoulder dystocia, and the experts suggest that caregivers liable to carry out delivery outside a specialised structure be able to choose, in agreement with the parturient woman, the position in which she would be most at ease.

On the other hand, in the event of proven shoulder dystocia, the McRoberts manoeuvre is recommended, whether associated or not with suprapubic pressure, as first-line intervention [15]. In the event of delivery outside a specialised structure, the experts also recommend keeping open the option of rapidly installing the patient in a supine position compatible with the McRoberts manoeuvre, mother's legs hyper flexing directly to her abdomen, with the possibility of lowering the foetal head in the umbilical-coccygian axis.

With that in mind, the experts advise that all caregivers liable to carry out delivery outside a specialised structure have access to initial and continuous medical training on maternal and neonatal management during delivery.

Question 3: In the event of delivery outside of a specialised structure, does episiotomy reduce the risk of obstetric and anal sphincter injury?

Experts: Sybille Goddet (SFMU), Estelle Morau (SFAR), Jeanne Sibiude (CNGOF)

R1.3 - The experts suggest not to systematically carry out episiotomy outside of specialised structures for the sole purpose of reducing the risk of anal sphincter injury.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

Outside of maternity wards, there is no literature concerning the question raised. In specialised obstetric settings, it is commonly admitted that episiotomy is not recommended, during delivery, as a means of reducing the risk of anal sphincter injury, even in the event of simple breech presentation, twin pregnancy or posterior delivery [16].

Since 2005, numerous publications have shown that during normal childbirth, episiotomy does not prevent severe perineal tear [17–19]. On the contrary, for other authors, restrictive episiotomy leads to a reduced number of severe perineal tears [20,21]. In 2017, the "HAS" (French National Authority for Health) concluded that no obstetric circumstance, including perineal fragility, justified systematic episiotomy [9]. Finally, it bears mentioning that episiotomy exposes the patient to haemorrhagic risk, which would further complicate hospital-based management.

To summarise, there exists no argument convincingly demonstrating that outside a maternity ward, episiotomy reduces the risk of obstetric injury of the anal sphincter. That is why, outside of specialised structures, the experts recommend application of the CNGOF guidelines on restrictive episiotomy. The experts also wish to recall that hands-on protection of the perineum, of which the objective is to prevent brutal expulsion of the foetus, is the preferred technique in France [22,23].

FIELD 2: POSTPARTUM haemorrhage (PREVENTION AND MANAGEMENT)

Question 1: Following delivery outside of a specialised maternity unit, does preventive oxytocin administration reduce the occurrence of postpartum haemorrhage?

Experts: Aurélie Gloaguen (SFMU), Agnès Le Gouez (SFAR), Alexandre Vivanti (CNGOF)

R2.1 – In the absence of any factor specific to a non-maternity ward setting, the experts suggest that during delivery outside of a specialised structure, the 2014 CNOGF/SFAR guidelines for clinical practice on postpartum haemorrhage prevention stipulating that "it is recommended to administer 5 to 10 IU of oxytocin, slow IV or intramuscular infusion, at the time of shoulder release or immediate postpartum so as to reduce incidence of postpartum haemorrhage" should be applied.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

We refer the reader to the 2014 CNOGF/SFAR guidelines for clinical practice on the prevention of postpartum haemorrhage [24].

Question 2: In the event of childbirth outside of a structured maternity unit, does manual removal of the placenta in the absence of spontaneous placental delivery 30 minutes after foetal expulsion reduce the risk of post-partum haemorrhage?

Experts: Bénédicte Douay (SFMU), Thibaut Rackelboom (SFAR), Hugo Madar (CNGOF)

R2.2 – In a woman giving birth outside a specialised structure, the experts suggest that manual removal of the placenta should not be carried out to reduce the risk of post-partum haemorrhage, except in the event of severe and uncontrollable post-partum haemorrhage.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

As regards means of reducing the risk of post-partum haemorrhage (PPH), there exists no literature on the recommended time interval between foetal expulsion and placental delivery following childbirth outside of a maternity ward. In this context, we have extrapolated from the existing data, which are limited, regarding in-hospital childbirths. Incidence of retained placenta, defined by the World Health Organizations as spontaneous placental delivery occurring more than 30 minutes after foetal expulsion [25], is low in the developed countries (3%) [26]. Two non-blinded single-centre randomised trials have been carried out to evaluate PPH risk according to the time elapsed prior to the third stage of labour [27,28], and neither of them showed an association of heightened PPH risk with time before placental delivery. A recent observational study on actively management of third stage of labour [29], which closely corresponds to current practices, suggests an increased risk of PPH > 500 mL when spontaneous placental delivery occurs more than 30 min subsequent to foetal expulsion (RR 5.94 CI 95% [3,12–11,3]). Similar results were reported in a prospective cohort in 1991 [30]. However, this observational study did not determine whether or not an intervention that would decrease placental delivery duration would likewise decrease PPH risk. In 2014 the CNGOF and the SFAR drew up common guidelines, which were adopted by the HAS (French National Authority for Health) in 2017; in the absence of bleeding 30 to 60 min after childbirth and in the absence of spontaneous placental delivery, they recommended manual removal of the placenta in a specialised structure [23,24,31]. Practices in Europe have remained highly heterogeneous, particularly in northern European countries, where it is necessary, in the absence of bleeding, to wait as long as 60 min before proceeding to manual removal of the placenta [32]. There are no data on manual removal of the placenta from 60 min after childbirth.

In France, in the event of eutocic childbirth outside a specialised structure, in the overwhelming majority of cases the time needed to transfer the patient to a maternity ward is inferior to the 30-to-60-minute time lapse that would justify manual removal of the placenta in view of minimising the risk of PPH in the absence of spontaneous placental delivery. Since the time factor is essential to prognosis, the exact hour of childbirth and observation of any abnormal bleeding must be systematically recorded during medical regulation. Rapid transfer to a maternity ward and initial care for the neonate must be considered as soon as an emergency medical service team takes charge.

In conclusion, in childbirth occurring outside a specialised structure, given the potential technical difficulties of manual examination of the uterus by a non-expert practitioner, and given how difficult it might be to ensure satisfactory analgesic and aseptic conditions, it is recommended not to carry out manual removal of the placenta, except in the event of severe and uncontrolled haemorrhage, in which case the operator will be guided remotely by an obstetric professional. In all other cases, the patient should be transferred as rapidly as possible to a specialised structure, without performing manual removal of the placenta. When spontaneous placental delivery occurs prior to arrival in the specialised structure, it must be accompanied by maternal pushing if placental expulsion is followed by emission of blood.

Question 3: In the event of post-partum haemorrhage occurring during delivery outside of a specialised structure, does administration of tranexamic acid reduce maternal morbi-mortality?

Experts: Eric Cesareo (SFMU), Mathias Rossignol (SFAR), Emeline Maisonneuve (CNGOF)

R2.3 – In a patient presenting with post-partum haemorrhage outside of a specialised structure, the experts suggest intravenous administration of 1 g of tranexamic acid at most 1 to 3 hours after bleeding onset, the objective being to reduce maternal morbi-mortality.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

Included in a meta-analysis, two randomised studies demonstrate the effectiveness of tranexamic acid in treatment of post-partum haemorrhage (PPH) during vaginal delivery or caesarean section in a hospital setting. Due to randomisation bias and the absence of blinding, these studies are of moderate quality.

A first randomised study (EXADELI) involving 144 patients presenting with PPH after vaginal delivery highlighted a significant reduction in blood loss (173 mL IQR [50–370] *vs.* 221 mL [105–564]); $p < 0.05$) and a lower number of transfused red blood cell concentrates on D42 ($p < 0.05$) after administration of 4 g in bolus followed by 6 g in 6 h of tranexamic acid, as compared to the non-administration group [33].

The second international, placebo-controlled study (WOMAN) evaluated the effect of administration of 1 g slow IV of tranexamic acid, renewable one time only, in 15,000 patients presenting with PPH after vaginal delivery or caesarean section [34]. The study highlighted reduced bleeding-related mortality (1.5 *vs.* 1.9% - RR 0.81 – 95% CI [0.65–1.00] - $p < 0.05$) in the patients having received tranexamic acid 1 to 3 hours after the diagnosis, with number needed to treat set at 276. However, no diminution of overall mortality (2.3 *vs.* 2.6% - RR 0.88 - 95% CI [0.74–1.05]) or blood transfusion was found to have occurred. Interpretation of this study is limited by the extremely high mortality reported in the placebo group (1.9% for haemorrhage-related mortality and 2.6% for all-cause deaths, proportions that do not correspond to the situation in developed countries, where mortality due to PPH approximates 0.03%.

These two studies (EXADELI and WOMAN) were limited to delivery in healthcare structures, and management involved the usually recommended treatments (manual uterine exploration, uterotonics, wound suturing). There consequently exists no definitive proof of the effectiveness of tranexamic acid in the reduction of severe maternal morbidity or maternal mortality, particularly in the event of PPH occurring outside of a specialised structure. On the other hand, the results of these studies are highly reassuring with regard to the risk of thrombotic or epileptic side effects or the occurrence of acute renal insufficiency in connection with the administration of tranexamic acid. To conclude, the experts consider that in the event of PPH occurrence exterior to a specialised structure, given the inevitable delay in performance of the usually recommended treatments (manual uterine examination, sulprostone, intra-uterine tamponade balloon) [24], the risk/benefit ratio is favourable to the administration of tranexamic acid.

Question 4: Does inter-hospital transfer of a patient presenting with post-partum haemorrhage with signs of severity to a maternity referral centre ensuring a sufficient level of care reduce maternal morbi-mortality?

Experts: Eric Cesareo (SFMU), Mathias Rossignol (SFAR), Emeline Maisonneuve (CNGOF)

ABSENCE OF RECOMMENDATION. As of now, the experts cannot adjudicate on the modalities and timing of inter-hospital transfer of a patient presenting outside of a specialised structure with post-partum haemorrhage with signs of severity.

Rationale

Severe post-partum haemorrhage, defined by blood loss exceeding 1000 mL, occurs during 2% of deliveries in France [24]. Between 2013 and 2015, maternal mortality due to obstetrical haemorrhage represented 8.4% of peri-partum deaths [35]. The guidelines issued in 2014 by the CNGOF and SFAR indicated that transfers occasioned by massive PPH must imperatively be oriented to a multidisciplinary maternity referral centre possessing all the specialties necessary for the management of severe or worsening PPH: anaesthesia and intensive care, transfusion, surgery and, if possible, interventional radiology [36]. The 2012 HAS guidelines were similar [37].

There exist practically no solid bibliographic references on the means of inter-hospital transfer in the event of severe PPH. In the developed countries, the data in the literature do not suffice to precisely estimate its effect on maternal mortality [36,38–41]. However, studies published by maternity centres have compared patients having given birth in their facilities to transferees. That said, when evaluating the interest and modalities of inter-hospital transfer, the most relevant control group would consist in the patients having remained in their first-line maternity unit. It also bears mentioning that one of the priorities of inter-hospital transfer is to facilitate arterial embolisation as opposed laparotomy in a stable patient, without aggravating her haemodynamic status due to the time necessitated by the transfer. In this respect, the few available studies suggest that the inter-hospital transfer required for arterio-embolisation would have no impact on a possible need for haemostasis hysterectomy or on the risk of failed embolisation [39,42]. So it is that in the developed countries, inter-hospital transfer is realisable without major risk for the patient, even though timing of the transfer is a pronouncedly complex question; occurring too early, it may not be necessary (the bleeding is under control); occurring too late, it may entail a risk of severe haemodynamic deterioration during transport. Once the transfer has been decided on, and the newly arrived medical team in charge has detected haemodynamic instability, it would seem urgent to establish lines of communication between the physician from the emergency medical assistance service present on site, the obstetric and anaesthetic-intensivist teams in charge of the patient in the referring centre, the regulating doctor from the emergency medical assistance service, and the obstetric and anaesthetic-intensivist teams in the receiving centre, the objectives being: (1) to ensure observation of the algorithm for therapeutic PPH management and (2) to conduct a collegial discussion to decide whether more benefit will be derived from management in the referral centre or from transport to a receiving centre, possibly subsequent to reinforcement by means of labile blood products. Once management in the referral centre has been decided on, the SMUR team can remain present to provide medical and paramedical back up for the on-site team.

FIELD 3: THREATENED PREMATURE LABOUR

Question 1: Does medicalisation of the inter-hospital transfer of a pregnant woman presenting with a threatened premature labour occurring outside a specialised structure reduce maternal and foetal morbi-mortality?

Experts: Julien Vaux (SFMU), Max Gonzales (SFAR), Paul Berveiller (CNGOF)

R3.1 – The experts suggest not to systematically medicalise the inter-hospital transfers of pregnant women presenting with threatened premature labour occurring outside a specialised structure, the reason being a lack of demonstrated impact on maternal and foetal prognosis.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

To our knowledge, no study has directly compared the different means of transport (medicalised, paramedicalised or neither medicalised nor paramedicalised) in the context of inter-hospital transfer of a pregnant woman presenting with threatened premature labour (TPL). The existing data do not authorise a direct response to the question put forward.

A few studies have evaluated the occurrence of complications during the transport of pregnant women. An observational study involving 1101 women having received a non-medicalised inter-hospital transfer, whatever the indication, showed a rate of adverse events approximating 6% [43]. These events consisted mainly in aggravated hypertension (4.5%) and the occurrence of hypotension (1.3%); even though 41.2% of the patients were in labour when the transfer got underway, none of them gave birth while it was proceeding. This result is consistent with those of several other studies, in which rate of delivery during the transfer of pregnant women presenting with TPL ranged from 0 to 2% [44–46]. As a result, it seems reasonable to consider that inter-hospital transfers in the event of TPL are not justified. It should be remembered that risk factors for imminent delivery must be systematically explored prior to any transfer (*cf.* R1.1.1 and R1.1.2), and that risk of delivery during transport constitutes a contraindication to *in utero* transfer and an indication for on-site delivery [1]. In this case, the presence of a neonatal back-up team should be considered. In other instances, indications for medical transfer should be considered on a case-by-case basis by the patient's initial and final reception teams and the regulating doctor from the emergency medical assistance service, taking into account its feasibility (*i.e.*, emergency medical service mobile team availability) and the time factor (*i.e.*, time necessary for medicalised management compared to nearby non-medicalised management, the objective being to get the patient "on time" to the specialised reception structure).

FIELD 4: HYPERTENSIVE DISORDERS IN PREGNANCY

Question 1: In management outside a specialised structure of a patient presenting with severe pre-eclampsia, does administration of an antihypertensive drug reduce maternal and foetal morbi-mortality?

Experts: Julien Vaux (SFMU), Max Gonzales (SFAR), Paul Berveiller (CNGOF)

R4.1 – In the absence of any specific factor associated with the non-hospital setting, during non-hospital management of a pre-eclampsia patient, the experts suggest application of the 2020 SFAR/CNGOF formalised expert recommendations on management of patients with severe pre-eclampsia, recommendations that stipulated:

"**R2.1** – It is recommended to give antihypertensive treatment to patients presenting with severe pre-eclampsia and SBP $\geq$ 160 mmHg and/or DBP $\geq$ 110 mmHg at rest and persisting for more than 15 minutes, and to maintain blood pressure levels below these thresholds, to reduce the occurrence of severe maternal, fetal and neonatal complications. GRADE 1+ (STRONG AGREEMENT)"

EXPERT OPINION (STRONG AGREEMENT)

Rationale

We refer the reader to R2.1 and R2.2 in the 2020 RFE SFAR-CNGOF formalised expert recommendations entitled "Guidelines for the management of women with severe pre-eclampsia" [47].

The experts nonetheless wish to emphasise that ideally, the decision to initiate and the determination of the modalities of antihypertensive treatment will be discussed during a phone call involving the obstetric and anaesthetic-intensivist teams of the specialised structure receiving the patient. Due to these therapeutic considerations, an indication for medicalised transport of patients with severe pre-eclampsia should be systematically considered in coordination with the regulating doctor from the emergency medical assistance service.

Question 2: In management outside a specialised structure of a patient presenting with severe pre-eclampsia with severe clinical signs, does the administration of magnesium sulphate reduce maternal and foetal morbi-mortality?

Experts: Bénédicte Douay (SFMU), Thibaut Rackelboom (SFAR), Hugo Madar (CNGOF)

R4.2 - In the absence of any specific factor associated with the non-hospital setting, during non-hospital management of a severe pre-eclampsia patient, the experts suggest application of the 2020 SFAR/CNGOF formalised expert recommendations on management of patients with severe pre-eclampsia, recommendations that stipulated:

"**R2.8** - It is recommended to administer magnesium sulfate antenatally to women with severe pre-eclampsia and at least one clinical sign of seriousness to reduce the risk of eclampsia. GRADE 1+ (STRONG AGREEMENT)"

EXPERT OPINION (STRONG AGREEMENT)

Rationale

We refer the reader to R2.8 and R2.9 of the 2020 RFE SFAR-CNGOF formalised expert recommendations entitled "Guidelines for the management of women with severe eclampsia" [47].

We wish to emphasise that in these recommendations, the clinical signs of severe pre-eclampsia were (R1.3): systolic arterial pressure $\geq$ 180 mmHg and/or diastolic arterial pressure $\geq$ 120 mmHg; persistent or intense epigastric abdominal and/or oppressive right hypochondrial pain; severe headaches not responding to treatment; persistent visual or auditory disorders; a neurological deficit; altered consciousness; hyperactive, diffused and polykinetic osteotendinous reflexes; respiratory distress and/or acute pulmonary oedema; and biologic signs: HELLP syndrome, acute renal insufficiency.

The experts also wish to underline that given the above-mentioned therapeutic considerations; an indication for medicalised transport of patients with severe pre-eclampsia must systematically be discussed with the regulating doctor from the emergency medical assistance service.

Question 3: In management outside a specialised structure of a patient presenting with eclampsia, does the administration of magnesium sulphate reduce maternal and foetal morbi-mortality?

Experts: Bénédicte Douay (SFMU), Thibaut Rackelboom (SFAR), Hugo Madar (CNGOF)

R4.3 – In the absence of any specific factors associated with a non-hospital setting, during management of a patient presenting with eclampsia outside a specialised structure, the experts suggest application of the 2020 SFAR/CNGOF formalised expert recommendations on the management of patients with severe pre-eclampsia, recommendations that stipulated:

"**R2.12** – It is recommended to administer magnesium sulphate as a first-line treatment in women having had an episode of eclampsia to reduce the risk of recurrence of eclampsia. GRADE 1+ (STRONG AGREEMENT)"

EXPERT OPINION (STRONG AGREEMENT)

Rationale

We refer the reader to recommendation R2.12 of the 2020 RFE SFAR-CNGOF "Guidelines for the management of women with severe pre-eclampsia" [47].

FIELD 5: Trauma

Question 1: Following a fall or non-severe thoracic and abdominal trauma in a pregnant woman, does an obstetrical examination within 24 hours reduce foetal morbi-mortality?

Experts: Sybille Goddet (SFMU), Estelle Morau (SFAR), Jeanne Sibiude (CNGOF)

R5.1 – The experts suggest systematic performance of an obstetrical examination by an obstetrician or a midwife in the immediate aftermath of even minor thoracic and/or abdominal trauma in a woman more than 20 weeks of gestation, the objective being to look for signs predictive of foetal morbi-mortality.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

There has been no study directly evaluating the obstetrical evolution of a patient or a foetus according to performance or non-performance of a systematic obstetrical examination subsequent to thoracic and abdominal trauma. That said, the cohort studies carried out on large-scale insurance and hospital databases have shown a moderately heightened risk of obstetrical and foetal morbidity subsequent to minor trauma. American cohort studies of pregnant patients having undergone trauma between 1991 and 1998 have been published. The first cohort involved 2,494 patients hospitalised due to trauma and having given birth during their hospitalisation, while the second cohort involved 7,822 patients hospitalised due to trauma and having given birth after their hospitalisation [48]. In the cohort of patients having given birth during their stay in trauma management, the authors found a heightened risk of premature birth (OR 2.07 95% CI [1.84–2.34]), of birth by caesarean section (OR 2.18 [1.98–2.40]), of foetal distress (OR 1.84 [1.62–2.10]) and of foetal death (OR 4.67 [3.42–6.37]). Stratification in terms of trauma severity (ISS score) found that patients having undergone the most severe trauma (ISS $\geq$ 9) were even more exposed to these risks than patients having undergone less severe trauma (ISS $<$ 9). When childbirth occurred subsequent to the initial stay for trauma management, the authors found a heightened risk of premature birth (OR 1.20 [1.11–1.31]), of birth by caesarean section (OR 1.20 [1.13–1.28]) and of foetal distress (OR 1,20 [1,09–1,31]). By the same token, Chen et al. [49] reported a heightened risk of premature birth among 8,762 patients exposed to minor trauma. Other cohort studies involving a lower population likewise found the above-mentioned morbidity factors [50–54].

As regards an association between the occurrence of morbid events and the obstetrical examination, in a cohort of 75 patients with over 20 weeks of gestation, Pearlman et al. [50] observed that all of the 4 patients having presented with obstetrical morbidity had uterine contractions when foetal heart rate was recorded in the course of the obstetrical examination. Having compiled their data as well as those of three previous studies [50,55,56], Dahmus et al. [51] reported that among 605 patients with over 20 weeks of gestation who had undergone trauma, during the 4 h of observation after the traumatic event, those who had developed an obstetrical complication presented with at least one of the following obstetrical signs: uterine contractions, vaginal bleeding, abdominal or uterine tenderness, abnormal foetal heart rate or orthostatic hypotension. That is why obstetrical examination with recording of foetal heart rate seems justified as a means of screening for potential foetal morbidity resulting from the trauma. In the absence of risk factors for morbidity (gestational age $>$ 35 weeks of amenorrhea, road accidents, assaults) or an associated

obstetrical event (sustained contractions, abnormal foetal heart rate, vaginal bleeding, placental abruption, abdominal or uterine tenderness, tachycardia or maternal hypotension), four to six hours of monitoring seems sufficient (moderate level of evidence) [57–60].

FIELD 6: IMAGING

Question 1: Does thoracic, abdominal and pelvic CT-scan of a pregnant woman, with or without injection, have any impact on the morbi-mortality of the unborn child?

Experts: Philippe Le Conte (SFMU), Pierre-Yves Dewandre (SFAR), Julie Blanc (CNGOF)

R6.1 – The experts suggest to perform thoracic, abdominal and/or pelvic CT-scan of the pregnant woman (with or without injection of contrast product) as soon as indicated; the risk/benefit balance of this examination should prevail to the decision to carry it out.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

Foetal radiation risks [61–69]

While ultrasound and magnetic resonance imaging are the usual imaging techniques recommended for pregnant women, if thoracic, abdominal and pelvic computed tomography (TAP CT) is necessary and more rapidly accessible and appropriate for diagnostic and/or therapeutic management, it should not be avoided due to the patient's pregnancy. Indeed, TAP CT imagery is of major importance in diagnostic evaluation of a polytrauma and of numerous acute and chronic pathologies in a pregnant woman. The radiation generated by this technique remains pronouncedly below the thresholds associated with foetal damage.

Any healthcare professional whose management of a pregnant woman requires imagery for diagnostic purposes is called upon to take into consideration the risk-benefit balance of exposure to radiation *vs.* abstention, which might possibly lead to aggravation of the pathology. Close coordination with a radiologist will customise the imaging technique, reducing radiation to a minimum. The potential biological effects of *in utero* exposure of an embryo or foetus to ionising radiation have for the most part been estimated from the results of animal studies and reports on human exposure. The most important data on humans come from studies conducted on survivors exposed to radiations from the bombs dropped on Hiroshima and Nagasaki in 1945. In this group, which included approximately 2,800 pregnant women exposed to radiation, an estimated 500 foetuses were exposed to a dose $>$ 10 mGy.

Degree of foetal risk associated with exposure to ionising radiation depends on gestational age at the moment of exposure and on the dose received. The volume of the radiation doses emitted during TDM (CT-scan) depends on the number of slices and their spacing. The theoretical risks of foetal exposure to ionising radiation include the risk of spontaneous abortion, teratogenic risk and carcinogenic risk. As regards teratogenic or lethal effects, the terms commonly used are deterministic effect or "threshold" effect. There exists in the literature a consensus according to which, when the dose of foetal exposure is inferior to 50 mGy, non-carcinogenic risk, that is to say risk of abortion or malformation, is negligible. This "threshold" dose is greater than the dose generated by a majority of TDM examinations, provided that they not be repeated. As examples, TAP CT and pulmonary angiography are associated with foetal exposure ranging from 13 à 25 mGy and from 0.01 to 0.66 mGy, respectively. A dose of foetal exposure inferior to 100 mGy should not enter into consideration as a potential reason for medically induced termination of pregnancy. Moreover, a dose of 100 mGy is considered by the American College of Radiology as probably too weak to generate clinically detectable effects. Some authors have proposed to consider the 100-mGy threshold as the threshold for absence of adverse effects, whatever the gestational age.

On the other hand, exposure $>$ 100 mGy is likely to be associated with an increased risk of mental retardation, which is estimated at a loss of 0.025 IQ points by 1 mGy of exposure exceeding 100 mGy. Risk of malformation further increases with doses of fetal exposure superior to 150 mGy. A threshold of 200 mGy, not to mention 500 mGy, is suggested as a possible reason for medically induced termination of pregnancy.

As regards carcinogenic risk, potential damage to foetal DNA is theoretically possible at any dose, without a "threshold effect"; on this subject, the term used is "stochastic effect". It is generally recognised that foetal radiation $>$ 50 mGy is associated with a doubled relative risk of death by cancer during childhood. While this risk may appear considerable, it should be put into perspective with overall risk of death by cancer during childhood, which is extremely low (1 to 2.5 by 1000). The estimated increase of cancer incidence following foetal exposure to 50 mGy is 1.1 to 3 by 1000, which leads us to conclude that the risk of developing cancer subsequent to application of an imagery technique is minimal. In any event, discussion concerning a TAP CT examination during pregnancy should involve senior physicians, the objective being to avoid any delay in patient management.

Risks associated with injection of a contrast product [70,71]

Iodinated contrast media, which enhance visualisation of the soft tissues and vessels, can cross the placental barrier and go directly into the amniotic fluid. Animal studies have found no teratogenic or mutagenic effect following their utilisation. Theoretical considerations pertaining to the potential impact of an iodinated contrast product on a foetus's thyroid gland have not been confirmed in studies involving humans. That is why it is important to reassure the patient on the safety for the foetus of this radiological procedure. At birth, any use of imagery using a contrast agent must be mentioned to the paediatrician.

It bears mentioning that thoracic, abdominal and pelvic disease is the main aetiology leading to discussion of pulmonary angiography in a pregnant woman. Even though spiral CT angiography seems safe for the patient and her foetus, a progressive diagnostic strategy according to the means of diagnostic imagery at the disposal of the practitioner is open to discussion (*i.e.*, D-dimers, compression ultrasonography of the lower extremities, perfusion scintigraphy).

FIELD 7: CARDIOPULMONARY ARREST

Question 1: In the event of non-traumatic cardiac arrest in a pregnant woman, does pre-hospital foetal extraction reduce maternal and foetal mortality?

Experts: Eric Cesareo (SFMU), Mathias Rossignol (SFAR), Emeline Maisonneuve (CNGOF)

ABSENCE OF RECOMMENDATION – As of now, subsequent to out-of-hospital maternal cardiac arrest the experts cannot adjudicate on the interest of foetal extraction outside of a specialised structure in view of enhancing the chances of maternal and foetal survival.

Rationale

Cardiac arrest (CA) occurs in approximately one out of 20,000 pregnancies and one out of 10,000 to 15,000 childbirths. Its extremely low incidence explains the highly limited experience by centre and by practitioner in management of cardiac arrest in a pregnant woman; what is more, few cases have been reported in an out-of-hospital setting.

The most robust data on CA in pregnant women concern intrahospital management. In order to improve vital prognosis for the mother and the foetus (after more than 20 weeks of gestation),

emergency caesarean section must imperatively be considered if, four minutes after the outset of extensive resuscitation, no effective cardio-circulatory activity has been observed. The objective will be to extract the neonate during the 5 min following the outset of resuscitation [72]. As regards maternal and foetal survival, there exists a correlation between CA onset and extraction time lapse [73,74]. No maternal survival has been reported after 15 min of resuscitation, and no foetal survival after 30 min [75]. Due to the constraining time frame, it is not recommended to transport the patient to an operating theatre, and it also bears mentioning that aseptic conditions may be rudimentary [76].

Given that time lapses between CA and foetal extraction in a non-hospital setting or outside a structure containing a maternity unit are always greater than in specialised structures, maternal survival and, especially, foetal survival without neurological sequelae under these circumstances are highly exceptional [77,78]. That is why the benefit of pre-hospital caesarean delivery appears highly uncertain, all the more so in that in a majority of cases, the technique is not mastered; moreover, the situation may be traumatising for caregivers. In the absence of more precise delineation of the risk-benefit balance, experts cannot currently adjudicate on the interest of the procedure.

The experts wish to emphasise that CA in a pregnant woman imposes a number of specificities in the organisation of cardio-pulmonary resuscitation. Medical and paramedical teams liable to be called upon to manage this type of vital distress need to be informed of the fact that a uterus palpated at the level of or above the umbilicus translates a term equal or superior to 20 weeks of gestation, and that the aortocaval compression provoked by a gravid uterus must imperatively be taken into consideration. Usually recommended for a pregnant woman, in this case the left lateral position is responsible for reduced efficacy of external cardiac massage [8]. That is why, during resuscitation manoeuvres, a team member must be designated for continuous leftward shifting of the gravid uterus, by two-handed traction, while taking care not to push it toward the pubis or the patient's back [79]. If the uterus is not shifted toward the left, external cardiac massage yields cardiac output estimated at only 10% of the cardiac output recorded during pregnancy.

FIELD 8: EMERGENCY OBSTETRIC TRAINING

Question 1: Does simulation training on obstetrical emergencies occurring outside maternity units of emergency medicine teams reduce maternal and foetal morbi-mortality?

Experts: Aurélie Gloaguen (SFMU), Agnès Le Gouez (SFAR), Alexandre Vivanti (CNGOF)

R8.1 – The experts suggest training for emergency medicine teams by means of simulation on obstetrical emergencies, including difficult situations such as mechanical and dynamic dystocia, the objectives being to facilitate acquisition and conservation of the professionals' technical skills, and subsequently to analyse the impact of such training on maternal and foetal morbi-mortality.

EXPERT OPINION (STRONG AGREEMENT)

Rationale

There exists practically no literature on simulation training for emergency medicine teams on obstetrical emergencies. The rare studies found assessed only Kirkpatrick's levels 1 and 2 in American emergency medicine students [80,81]. Kirkpatrick's level 1 evaluates learner satisfaction, level 2 apprises learner acquisition of knowledge and/or skills [82].

As of now, there exists much more evidence of the positive impact of simulation training for obstetrical teams in obstetrical emergencies in terms of participant confidence, knowledge and skills, than in terms of outcome (*i.e.*, lessened maternal and foetal mortality). Indeed, literature on the effectiveness of simulation training for obstetrical teams with regard to Kirkpatrick's level 4 (impact on patient management and, consequently, on maternal and neonatal mortality) is relatively scarce. In a 2019 review of the literature on the effectiveness of obstetrical team training in emergency obstetrical care, only 17 out of the 118 included articles assessed its impact on perinatal or maternal health [83]. In this review of the literature, some of the studies pertained to general public health programs (simulation training associated with prevention programs), and it was consequently difficult to measure the impact of simulation alone. To our knowledge, only 13 studies, of which 7 were found in the review of the literature, contributed to analysis of the repercussions of simulation on maternal and foetal morbi-mortality. It bears mentioning that these studies are heterogeneous, and that 6 of them concerned developing countries, where the rate of morbi-mortality often largely exceeds the world average, rendering problematic the interpretation of expected improvement in these countries; what is more, only 3 of these studies were randomised and controlled [84–86]. That said, one study detected an impact on neonatal injuries after shoulder dystocia (OR 0.50 [0.25–0.99]) [86], and some non-randomised studies found an impact on maternal mortality (RR 0.71 [0.65–0 .77] [87] and RR 0.25 [0.08–0.80] [88]), Apgar < 7 at 5 min (RR 0.51 [0.35–0.74] [89] and RR 0.70 [0.53–0.92] [90]), post-partum haemorrhage > 500 mL (RR 0.55 [0.44–0.69] [90] and RR 0.65 [0.43–0.98] [91]), and less injury at birth of the brachial plexus following shoulder dystocia (RR 0.31 [0.13–0.72] [92] and RR 0.27 [0.12–0.66] [93]). However, other non-randomised studies were not in agreement with the above results [88,94,95]. In order to draw conclusions on the impact of simulation in maternal and neonatal mortality, particularly in developed countries and in out-of-hospital setting, studies of higher quality are called for.

A survey by Allain et al. on the initial training in France of emergency physicians showed that in 2018, techniques concerning gynaecologic and obstetrical pathologies were seldom taught by simulation [96]. In accordance with the 2019 SRLF-SFAR-SFMU-SOFRASIMS guidelines underlining the interest of learning by simulation in critical care [97], and while awaiting complementary results of future studies with a higher level of evidence, in pre-hospital obstetric emergencies the experts suggest simulation for the acquisition, conservation and development of technical professional skills. In an initial stage, it appears particularly important to elaborate simulation-based training programs on difficult obstetrical situations (breech delivery, twin pregnancies), mechanical dystocia (shoulder dystocia) and dynamic dystocia (ineffective uterine contractions), the objective being to analyse their impact on maternal and foetal morbi-mortality.

Organising societies:

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Société française d'anesthésie et de réanimation (SFAR)/French Society of Anaesthesia and Intensive Care Medicine

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Conflicts of interest of the SFMU experts over the five years preceding the date of validation by the SFMU Board of Directors:

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Conflicts of interest of the SFAR experts over the five years preceding the date of validation by the SFAR board of directors:

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