Opinion paper

“Every case of asphyxia can be used as a learning example”. Conclusions from an analysis of substandard obstetrical care

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Abstract

Aim: To propose suggestions for improvements in care based on conclusions from studies on low Apgar scores and substandard care during labor.

Setting and patients: Studies on infants with low Apgar scores in a general obstetric population 2004–2006 and claims for financial compensation on the behalf of infants, based on the suspicion that substandard care in conjunction with childbirth has caused severe asphyxia or neonatal death in Sweden 1990–2005.

Results: The most common flaws were related to insufficient fetal surveillance, defective interpretation of cardiotocography (CTG) tracings, not acting in a timely fashion on abnormal CTG, and the incautious use of oxytocin. Besides, in half of the infants a suboptimal mode of delivery added further trauma to the already asphyxiated infant. Additionally, resuscitation was unsatisfactory in many of these infants. The most critical flaw was defective compliance with the guidelines concerning ventilation and the early paging of skilled personnel in cases of imminent asphyxia or known complications during labor. In many case reports, the documentation of the neonatal resuscitation was insufficient to enable accurate and reliable evaluation.

Conclusions: Examples of proposed improvements in care during labor are the introduction of a permanent educational atmosphere with aside time for daily educational rounds and discussion, cooperation around the use of standardized terminology in CTG interpretation, the cautious use of oxytocin, and the routine paging of a pediatrician before birth in cases of complicated delivery or imminent asphyxia. The proposed interventions need to be evaluated in clinical trials in the future.

Keywords: Asphyxia; CTG; fetal blood sampling; fetal surveillance; medical malpractice; substandard care.

Introduction

Global efforts are being made to improve patient safety in conjunction with childbirth, because neonatal asphyxia may cause irrevocable life-long impairment and immeasurable suffering to the afflicted patients and their families [35, 37, 39, 69, 77]. The group of patients claiming for financial compensation due to the suspicion that substandard care during labor has contributed to severe asphyxia, is notably small. Nevertheless, the insurance costs for this group of patients are substantial and amount to about 25% of all costs related to substandard care in Sweden [14]. Moreover, future risks for the infant must be taken into account. Recently published studies have shown that irrespective of whether the infants recover with or without sequelae after neonatal resuscitation, there is still an increased risk for low intelligence quotient (IQ) or cognitive dysfunctions later in life [55, 56, 66]. Attention must be drawn to these future risks and they must be further investigated. The aim of this paper is to propose suggestions for improvements in care based on conclusions from studies on substandard care during labor [14–17].

Method

The opinions presented in this paper are primarily based on four studies and published papers concerning the association between handling around labor, delivery and neonatal resuscitation and the risks for low Apgar scores, severe asphyxia or perinatal death [14–17]. In all four studies, all infants had a gestational age of ≥33 weeks, all births were planned as vaginal deliveries, and they had a normal cardiotocography (CTG) at admission for labor, indicating a well-oxygenated fetus at that time. Two studies were observational, and were carried out in a population of all 177 infants for whom financial compensation claims had been made on the grounds of severe asphyxia, presumably caused by medical malpractice during labor in Sweden 1990–2005 [14, 15]. In a third case-control study concerning risk factors for severe asphyxia associated with claims for medical malpractice, the same population was compared with all healthy infants (Apgar score 10 at 5 min of age) with the same inclusion criteria and born during the same time period in Sweden [16]. In the fourth study, also a case-control study, the frequency of substandard care was studied in a general obstetric population of 626 infants in Stockholm County 2004–2006. Here, cases were defined as infants with an Apgar score of <7 at a postnatal age of 5 min [17].

Data collection and statistical analyses are described in detail elsewhere [14–17]. All case records were similarly scrutinized and computerized by the author, a senior consultant in obstetrics and a graduate of the American Neonatal Resuscitation Provider Program [4]. She is also an instructor for team training instructors in obstetrical emergencies and neonatal resuscitation at the Centre for Education in Pediatric Simulator (CEPS) at Södersjukhuset in Stockholm. The reviewer had access to all information from each case record and was therefore

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not blinded to the outcome. Data were collected from the standardized obstetric records used throughout Sweden. These included CTG recordings, details and complications around labor including the time of paging of a physician, the date and time of birth, gestational age, gender, birth weight, Apgar scores at 1, 5 and 10 min, umbilical cord acid base status, acts of neonatal resuscitation, admission to and length of stay (LOS) in the neonatal intensive care unit (NICU), degree of hypoxic ischemic encephalopathy (HIE), and investigations during the first weeks of age. Diagnoses during pregnancy and delivery were registered at discharge from hospital. The information on the degree of HIE was retrieved from the neonatal case records.

A minimum of necessary fetal surveillance during labor and action in cases of threatening asphyxia and neonatal resuscitation was defined based on textbooks, papers and according to current guidelines in Sweden. This resulted in the definitions of substandard care as summarized in Figures 1–3. Threatening asphyxia was defined based on textbooks, papers and according to current clinical guidelines in obstetrics, the pediatrician should be paged before a birth in cases of complicated deliveries such as imminent asphyxia, in breech and instrumental deliveries, and immediately when deliveries are complicated by shoulder dystocia. In cases of unexpected asphyxia, the target time for the arrival of skilled assistance was set at being within 4 min after birth for a pediatrician and 15 min for a neonatologist [19, 20].

Summary of findings

We found that, in the general obstetric population, as many as two thirds of the infants with an Apgar score of <7 at a postnatal age of 5 min had been subjected to some kind of substandard care during labor [17]. The most common flaws in both study-groups were related to insufficient fetal surveillance, defective interpretation of CTG tracings, not acting in a timely fashion on abnormal CTG, and the incautious use of oxytocin. Moreover, in half of the infants a suboptimal mode of delivery added further trauma to the already asphyxiated infant; i.e., not the fastest or least injurious mode (Figure 4) [14, 17]. We also found that the resuscitation was unsatisfactory in many of these infants. The most critical flaw was defective compliance with the guidelines concerning ventilation and the early paging of skilled personnel in cases of imminent asphyxia or known complications during labor. Moreover, in many cases, the documentation of the neonatal resuscitation was insufficient to enable accurate and reliable evaluation (Figure 5) [15].

Discussion

Can fetal surveillance and neonatal outcome be improved?

Prerequisites and guidelines for fetal surveillance differ around the world. Despite its widespread use, there is also controversy about the interpretation of fetal heart rate (FHR) patterns, reproducibility and management algorithms for abnormal or non-reassuring patterns. The use of electro fetal monitoring (EFM) is controversial, and poor intra- and interobserver agreement in interpreting the tracings has led to its efficacy being questioned [21, 22, 67, 68]. Moreover, there is evidence that the use of EFM increases the rate of cesarean section (CS) and operative vaginal deliveries, with limited beneficial effects for the newborns, especially in low risk women [6]. Conventional FHR monitoring has also been criticized and questioned due to its low reliability in interpreting FHR patterns and high false positive rates of non-reassuring FHR patterns [1, 63]. Accurate interpretation of CTG is, however, essential and it is important to recognize a fetus that shows an abnormal CTG in labor, which may imply possible hypoxia and birth asphyxia. Usage of the standardized terminology developed by the National Institute of Child Health and Human Development (NICHD) to describe intrapartum CTG can help reduce miscommunication among providers caring for the patient in labor [71]. We found that the longer the CTG was abnormal during labor, the greater was the risk that the infant had a low Apgar score at a postnatal age of 5 min [17]. It is, however, uncertain to what extent improvements in CTG

<table>
<thead>
<tr>
<th>There was substandard care during labor if</th>
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<tr>
<td>• There were no CTG recordings done more than 2.5 hours after admission test</td>
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<td>• There were more than 2.5 hours between CTG recordings</td>
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<td>• CTG recordings were not interpretable or of too poor quality</td>
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<tr>
<td>• No FBS done despite continuous intermediary or abnormal CTG for more than 45 min</td>
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<td>• No follow-up of FBS despite abnormal CTG for more than 45 min with a normal FBS</td>
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<tr>
<td>• No follow-up of a pre-acidotic FBS (according to the stage of delivery)</td>
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<tr>
<td>• Untimely action on abnormal CTG (i.e., more than 45 min from onset of abnormal CTG to FBS or birth)</td>
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<tr>
<td>• Uterine tachysystole (&gt;6 contractions/10 min during &gt;20 min)</td>
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<td>• Increased dose of oxytocin despite abnormal CTG or tachysystole</td>
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*According to Swedish standards

Figure 1  *Substandard care during labor: neglecting to supervise fetal well-being and signs of fetal asphyxia. CTG = Cardiotocography, FBS = Fetal blood sampling.
There was substandard care around delivery if

- Time from decision to deliver to birth exceeded 30 min in cases of threatening asphyxia
- There was a spontaneous vaginal delivery despite longstanding (at least 45 min) of abnormal or uninterpretable CTG recording
- There was a complex instrumental vaginal delivery, defined as an inappropriate trial of labor with a vacuum extractor or forceps in the following circumstances:
  a) incomplete cervical dilatation
  b) non-cephalic presentation
  c) nonengaged fetal head
  d) a clear indication of cephalopelvic disproportion
  e) extraction exceeding more than 20 min (thus more than the recommended 15 min)
  f) inadequate descent
  g) more than two cup detachments

*According to Swedish standards

Figure 2  Substandard care around delivery.  
CTG = Cardiotocography.

There was substandard care in neonatal resuscitation when

- Artificial ventilation not started within 1 min after birth in cases of apnea and fetal heart rate <100 bpm
- Endotracheal intubation not performed within 3 min after birth in cases of asystolia or in cases of persistent apnoea and bradycardia
- Thoracic compressions not performed despite asystolia
- Adrenaline not provided despite asystole or persistent bradycardia
- Correction of metabolic acidosis not performed in cases of asystole or persistent bradycardia
- Pediatrician or neonatologist not present before birth despite knowledge of delivery complication
- Pediatrician or neonatologist not arrived within 4 min after birth in cases of unexpected asphyxia
- Resuscitation not interrupted in spite of asystole for >15 min or total lack of spontaneous breathing or movements >30 min after birth

*According to Swedish standards during the study periods of 1990–2006

Figure 3  Substandard care in neonatal resuscitation.

interpretation can be achieved. In an online educational setting in CTG and acid-base interpretation in the UK, the mean scores in written tests after education were around 63% and 83% for midwives and obstetricians, respectively, which indicates that additional efforts are needed. This has raised the question of whether a certain number of people might suffer from cognitive dysfunction resulting in pattern dyslexia [13]. If so, besides training and education, maybe CTG interpretation should routinely be assessed by at least two persons in the future, or by additional computerized interpretation functions to enable improved accuracy in CTG interpretation [26, 73]. The introduction of system of automatic ST analysis (STAN) has also been intensely questioned since the appropriate interpretation of ST segment changes requires correct FHR pattern interpretation. Even with STAN guidelines, the intrareporter and interobserver agreement in interpreting the tracings is poor, since the interpretation of STAN data and management is dependent on the visual and subjective analysis of conventional CTG [34, 67, 83]. Another problem is that interpreting CTG tracings correctly is not enough. The additional challenge for the team is to decide how to act in cases of abnormalities, to communicate a plan clearly, and to perform it in a timely fashion [27].

So, the question is, can fetal surveillance and neonatal outcome be improved? Physicians and midwives working in labor units are already well educated, and labor units are well manned, modern, and well equipped. In the light of the importance of a prompt reaction to abnormal CTG, the introduction of routine inter-professional cooperation in combination with one-to-one care for all women during labor could be necessary to enable improvement in CTG interpretation and safety in the future. One of the hallmarks of professional midwifery is time-intensive supportive care, and this has been shown to be associated with lower rates of CS and fetal distress [25, 82]. An investment in capacity at the labor unit to enable such care could perhaps improve neonatal outcome and reduce insurance costs in the long run. Midwives in Sweden are independently responsible for uncomplicated deliveries and are thereby
expected to be skilled in interpreting CTG. A seemingly normal spontaneous vaginal labor can turn into a complicated situation at any time and this emphasizes the importance of the correct interpretation of CTG. This, needless to say, must be of interpretable quality. In a delivery with an intermediary or abnormal CTG tracing, the midwife is obliged to consult a physician and this was not always the case in deliveries resulting in a severely asphyxiated infant [14, 17].

Fetal blood sampling (FBS)

We found that FBS was performed only in every fifth delivery when CTG had been abnormal in a general obstetrical population [17]. This also speaks in favor of the initiation of an educational effort towards the handling of cases of abnormal or intermediate CTG. There is an indication for FBS when CTG is abnormal for more than 40–60 min and delivery is not imminent [7, 27, 65]. In cases of continuous intermediary or abnormal CTG but a normal FBS, and in cases with pre-acidocis in FBS, there is an indication for a follow-up of FBS every 20–30 min, although this is dependent on the stage of delivery [23]. Unfortunately, FBS has come into disrepute as being a complicated, uncomfortable, and time-consuming procedure. Furthermore, in cases of acidemia, it is maintained that far more time than foreseen is spent from decision to perform a FBS to when the infant is delivered [2, 9]. The introduction of lactate analysis in scalp blood has, however, simplified the method, since only 5 µL of blood is required for lactate determination [64]. Interpretation value for normal lactate is (<4.2 mmol/L), pre-acidosis (4.2–4.8 mmol/L) and acidosis (>4.8 mmol/L) [62, 84]. A source of error that may give a false high lactate concentration is if the blood sample is mixed with amnion fluid that has high concentrations of lactate. This has to be taken into account before delivering urgently [7].

Risk factors for asphyxia

The prerequisites and guidelines for safe delivery vary in different countries and parts of the world, but the staff at any labor unit need to have good knowledge of the risk factors for asphyxia. High-risk patients can be recognized on admission and during labor, and several obstetrical complications can thereby be foreseen and catastrophes prevented. Risk factors such as maternal age, previous CS delivery, women with a noted history of infertility or infertility-treatment, diabetes, presentation, twin pregnancies, pre- and post-term pregnancies, and the estimated size of the fetus must be taken into account when a woman is admitted for labor [16, 50, 62]. The risk factors associated with severe asphyxia due to substandard care during labor and a claim for financial compensation [16] were, principally, the same risk factors that were associated with a low Apgar score at 5 min of age among infants born in Stockholm County in 2004–2006 [17] as in a general Swedish urban population [62]. Women with advanced maternal age run increased risks of pregnancy complications such as pre-eclampsia, gestational diabetes, and uterine inertia during labor. These conditions are also associated with increased risk of birth complications and asphyxia [50]. Moreover, there is a risk of rupture of the uterus and severe perinatal asphyxia in women with a history of CS, especially in cases of induction or augmentation. In particular, this risk is further increased in mothers of short stature with a large fetus [14, 17, 59, 75].

Risk factors relating to care, and risk of severe asphyxia or low Apgar score

In a Cochrane review from 2005, Anim-Somuah et al. found an increased risk for instrumental deliveries but no effects on Apgar scores or CS when epidural analgesia was used during labor [8]. This is in contrast to the finding of a more than 10-fold risk for severe asphyxia associated with substandard care during labor in deliveries in which there was a combination of epidural and dystocia of labor [16]. The risk of dystocia of labor is increased in older mothers, mothers of short stature, and mothers with high body mass index (BMI), but the use of epidural analgesia is the risk factor that is the most strongly associated with dystocia [53]. The frequent and improper use of oxytocin in deliveries resulting in asphyxiated infants is an alarming finding. Hyperstimulation of uterine contractions may cause asphyxia and is defined as ≥26 contractions/10 min (tachysystole) for at least 20 min [30, 36]. Jonsson et al. [51, 52] have shown that the incautious use of oxytocin in deliveries may result in severely asphyxiated infants. This is in line with the finding relating to the incautious use of oxytocin in deliveries and leading to a filed claim on the grounds of substandard care during labor [14]. Oxytocin is only required in cases of uterine inertia diagnosis, which is defined as no progress of labor for 2 h after an initially normal progress, or in cases of induction of labor. Augmentation causing hyperstimulation is associated with the risk of perinatal asphyxia and a low Apgar score at 5 min of age [45, 47, 51, 52, 62, 74]. The partogram is a useful tool in the assessment of the progress of labor. The action line in the partogram provides guidance in the detection of delayed progress and it is a helpful resource in diagnosing uterine inertia. The partogram is used in most deliveries in Sweden, albeit without always applying

**Figure 4** The most common flaws in conjunction with labor associated with substandard care. CTG = Cardiotocography.

**Figure 5** The most common flaws in conjunction with resuscitation associated with substandard care.
an action line, and thereby risking that the diagnosis of labor dystocia may be based on individual subjective assessment [78]. The reason for unstructured management may be the lack of clear directives for oxytocin use and it is clear that the use of oxytocin must, as in all interventions, be steered by evidence-based decisions. In August 2007, oxytocin, which is the most common medication administered in labor and delivery settings, was labeled a high-alert medication by the Institute for Safe Medication Practices (ISMP). The use of oxytocin during labor can cause substantial harm, and it is listed among the top five litigation risks for malpractice in obstetrics in the US [48]. To improve neonatal outcome, oxytocin should only be used after serious considerations and only in accordance with strict directives. After initiating infusion of oxytocin, continuous CTG tracing with simultaneous registration of contractions should be registered at least as long as oxytocin is augmented, with the required number of contractions 4–5/10 min. If oxytocin is causing tachysystole, it should be discontinued, or the rate of infusion decreased at least temporarily, to avoid uterine hyperstimulation and secondarily causing asphyxia. Likewise, the oxytocin infusion should be discontinued while assessing fetal well-being in cases of abnormal CTG [36].

**Instrumental delivery**

Instrumental delivery may be an easy way to assist and deliver quickly, but it may be harmful both to the mother and to the infant when used incautiously [14, 61]. Minutes must be regarded as precious capital in cases of instrumental deliveries and should be prudently consumed and considered when experienced assistance is paged in the event of difficulties. When assisting women in instrumental deliveries, the maximum time or number of tractions with retained safety for the infant has not been agreed. Some authors claim a maximum of 15 min; others maintain a maximum of 20 min [40, 61]. Compared with spontaneous vaginal deliveries, we found a more than seven-fold risk for an Apgar score <7 at a postnatal age of 5 min in instrumental deliveries. The risk was increased almost 18-fold when the traction time exceeded 20 min, or after two cup detachments [17]. For the safest neonatal outcome, it is important to continuously evaluate the expected time of traction for the infant to be born, to page for a pediatrician before birth, and to quickly convert to CS in cases of inadequate descent, even after the first one to two pulls.

**Infant characteristics with increased risk for asphyxia**

**Gestational age and intrauterine growth** There was a three-fold increased risk of severe asphyxia associated with substandard care or a low Apgar score in post-term pregnancies [14]. This is in accordance with previously described findings on asphyxia, including risks of low Apgar scores, neonatal encephalopathy, and post-natal mortality [12, 46, 47].

If intrauterine growth restriction is diagnosed prenatally, the timing and mode of delivery has to be planned carefully together with the neonatologist [19]. Extremely small infants for their gestational age (size 25% less than expected) had a five- to six-fold increased risk of severe asphyxia, and a filed claim due to substandard care. There was a more than three-fold increased risk of severe asphyxia among extremely large infants (size 25% greater than expected) [16]. Efforts to recognize small and large-for-gestational-age fetuses during pregnancy may reduce risk of stillbirth, and asphyxia-related neonatal morbidity [11, 28, 46]. In growth-restricted infants, stored glycogens are diminished and there is, to some degree chronic hypoxia. A vaginal delivery may therefore be too stressful and the risk of developing acute asphyxia increases [58]. The vulnerability of the fetus depends on the degree of intrauterine growth restriction, the blood flow class in the umbilical cord, and the gestational age. In cases when a vaginal trial of birth of a growth-restricted fetus is planned, readiness for CS is required. Likewise, the vaginal delivery of a macrosomic infant also requires attention by an experienced obstetrician and preparedness for operative delivery in the event of shoulder dystocia or asphyxia. However, there is little evidence that elective delivery (induction or CS) should be routinely advocated on the grounds of suspected macrosomia alone [43].

**Breech presentation** The careful exclusion of patients with known risk factors, informing the patient in detail about the risks and possible complications, and not routinely refraining from vaginal delivery, is advocated in cases of breech presentation [38, 42]. Nevertheless, the number of obstetricians with sufficient clinical experience of assisting a vaginal delivery in breech presentation is decreasing and this is likely to influence the rate of primary CS for this indication.

Among breech presentations, the risk of asphyxia and neurological morbidity is substantially higher after a vaginal breech delivery than after a planned CS delivery [44, 54]. Compared with infants born in cephalic presentation, we found that infants delivered vaginally in breech presentation had a more than six-fold increased risk of severe asphyxia associated with substandard care [16]. In another Swedish investigation on an urban population, Milsom et al. found as much as a 20-fold increased risk of asphyxia in deliveries with breech presentation [62].

**Multiple births** Twin deliveries must be supervised carefully during labor. Special attention should be given to the second twin who is more difficult to supervise and who has to be delivered safely after the first twin. The risk of intrapartum hypoxia is further increased when the second twin is delivered abdominally after a vaginal delivery of the first twin [47, 49, 76]. Among twin pregnancies, we found a five-fold increased risk of severe asphyxia combined with a claim for financial compensation due to substandard care. The risk was further increased if the twin was born in breech presentation compared with infants in simplex cephalic presentation [14].

However, although several risk factors associated with severe asphyxia due to substandard care during labor were found to be associated with substantially increased odds ratios, it should be emphasized that the corresponding absolute risk for substandard care causing severe asphyxia, or neonatal death, is small.
Does quality of care differ with respect to the time of delivery?

Neuropsychological tests show impaired performance during work at night [5]. Obstetric and neonatal care at night-time may require additional skilled and experienced staff to ensure safe deliveries around the clock [33, 79, 80]. There was a doubled risk for severe asphyxia associated with a financial claim for suspected medical malpractice among infants born during the night compared with infants born during the day (Figure 6) [14]. This finding merits special attention and may reflect the view that concentration levels and the ability to react promptly are not optimal during night shifts. However, the underlying causes of increased risk of severe asphyxia are not clear. This may be due to excess workloads or inadequate or less experienced staff on night shifts, but it needs to be analyzed further. In another Swedish study, based on deliveries between 1973 and 1995 (2.1 million infants without major malformations), it was reported that infants born during the night, especially pre-term born infants, ran a greater risk related to asphyxia and early neonatal mortality (death during the first 6 days of life) than those born during the day. Shift changes and the hours immediately after such changes were the high-risk periods [57]. Similarly, in a nationwide cohort study of 700,000 singleton births in Sweden during 1991–1997 (elective CS excluded), Stephansson et al. found that the risk of early neonatal death was higher for nighttime births compared to daytime births, and the risk increased when women with high-risk deliveries were excluded. In one in eight of the infants that died in the early neonatal period, the cause was attributed to being born during the night [79].

Educational efforts

Mandatory skills training in obstetrical emergencies, CTG interpretation, and neonatal resuscitation significantly reduce the number of infants with low Apgar scores at 5 min of age. Improvements can thus be achieved by introducing training programs [13, 21, 27, 35].

When immediate delivery is requested due to imminent asphyxia, both obstetricians and midwives must be confident in their choice of the fastest and least injurious mode of delivery. They must take both maternal and infant health into account [29, 72], but they must also be well prepared to start extensive neonatal resuscitation while awaiting the arrival of skilled personnel. It is necessary to create a continual educational atmosphere in each delivery unit where all staff attending childbirths repetitively practice how to anticipate and handle complications in conjunction with labor [18]. Nobody accepts that a footballer comes directly to a match without previous training with the team or that a vocalist has not rehearsed before a concert. Consequently, one must also rehearse, practice obstetrical skills, and update knowledge.

Organizational efforts to make care safer

We should learn from and adopt procedures from the world of aviation where team members routinely monitor and check each other to optimize safety. Aviation used to be a high-risk industry, but it has been transformed by the widespread utilization of information technology (IT), in particular autopilots, and several mistakes must be made before an accident happens [24, 41, 81]. Moreover, labor units need to identify situations that could cause misunderstandings or steal time in emergency situations. Checking up on the effectiveness of call and alarm systems on the labor ward, and how many locked doors and lifts you need to negotiate before arriving at the emergency operating theatre are examples of such measures. Additionally, the response to an error must be to examine the system for delivery and care rather than to blame an individual. The root causes of adverse clinical events may lie in factors such as communication and supervision problems, excessive workload, educational and training deficiencies.

Every case of asphyxia can be used as a learning example

In order to prevent mistakes we must first accept that we all make them and use every case of asphyxia as a learning example. Perinatal audits may be useful when investigating shortcomings in conjunction with childbirth both locally at the clinic and nationally. The aim is to initiate adjustments for perinatal care, optimize the quality of care, and inter-professional collaboration. For example, perinatal audits have been used in the Netherlands where perinatal mortality was assessed to be the highest in the 25 countries of the European Union in 1999 (11.4/1000) [32, 60]. In one rural region in the Netherlands, it was found that 31% of perinatal deaths could have been prevented [31]. In another recently published nationwide Dutch study, it was found that 9% of the 228 cases of perinatal deaths during 1 year in the Netherlands were related to substandard care and were assessed to be potentially avoidable [32].

The use of clinical dashboards in monitoring and presenting regular healthcare performance is gaining in popularity and it may be a useful tool in predicting trends on a monthly basis in various clinical governance parameters. This could

Figure 6  Time of birth and risk of severe asphyxia associated with substandard care in Sweden 1990–2005.
enable immediate action to be taken and could rectify patient safety issues. Standards, as well as local agreements for “clinical activity”, “work force”, and “clinical outcome”, are used as indicators. These tools, such as maternity dashboards, present a summary of performance in a color-coded fashion. Green indicates (good performance), amber (warning of deteriorating performance), and red (deteriorated performance requiring action). By using green, amber and red, it enables the users to determine whether safety goals are met. Action is taken for amber and red parameters to improve patient care. For example, when the system was introduced at St George’s Hospital in London in 2007, there was an “amber-red” trend of increased emergency CS after failed instrumental deliveries. Immediate action was taken and educational efforts in hands-on ventouse-training and daily review of emergency CS were instituted, after which there was a decrease in the CS rate from about 26% to about 20% in 2009 [10, 26, 70].

Conclusion

Every case of asphyxia can be used as a learning example. Suggestions for improvements are summarized in Figures 7 and 8. Educational and organizational efforts may reduce the number of depressed infants at birth. Many circumstances causing severe asphyxia are predictable and may be preventable. The challenge is to improve interprofessional collaboration, knowledge and awareness of risk factors, potentially dangerous procedures, and warning signs without interfering with the normality of childbirth. One example of proposed improvements in care during labor, is the creation of a permanent educational atmosphere with aside time for daily educational rounds and discussion. Furthermore, CTG interpretation could be carried out by two persons using standardized terminology to reduce the risk of miscommunication and could include assessment for risk factors for asphyxia at admission and repetitively during labor. Oxytocin must be used with caution, following strict indication and maintaining awareness of the risk of hyperstimulation of uterine contractions. Finally, the routine of timely paging of a pediatrician in cases of complicated delivery or imminent asphyxia is also recommendable, as is the early conversion to CS if birth is not expected to occur within 15–20 min in cases of instrumental delivery. The proposed interventions should be evaluated in clinical trials in the future.

1. CTG interpretation routinely assessed by at least two persons or by additional computerized interpretation functions including usage of standardized terminology to reduce the risk of miscommunication
2. Increased awareness of risk factors for asphyxia at admission and repetitively during labor
3. Clear and strict directives for oxytocin use during labor
4. CTG with simultaneous registration of contractions mandatory in all deliveries when oxytocin is provided, and never exceeding 4–5 contractions/10 min
5. Timely conversion to cesarean section if expected birth is not within 15–20 min in cases of instrumental delivery
6. Routines for early paging of pediatrician in cases of complicated delivery or imminent asphyxia
7. Careful exclusion for vaginal trial of labor in patients with known risk factors in cases of breech presentation and multiple births

Figure 7  Suggestions for improvements in care based on conclusions from studies on substandard care during labor. CTG = Cardiotocography.

1. Create a permanent educational atmosphere with aside time for daily educational rounds and discussion
2. Mandatory skills training in obstetrical emergencies, and CTG interpretation
3. Team training in neonatal resuscitation with special focus on ventilation communication and documentation
4. Repetitively practice how to anticipate and handle complications in conjunction with labor for all staff at the unit
5. Capacity at the labor unit to enable one to one supportive care, which has been shown to be associated with lower rates of cesarean section and fetal distress
6. Check on the effectiveness of call and alarm systems on the labor ward and how many locked doors and lifts you need to negotiate before arriving at emergency operating theatre

Figure 8  Suggestions for educational and organizational efforts to make care safer. CTG = Cardiotocography.
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The authors stated that there are no conflicts of interest regarding the publication of this article.

Received June 20, 2011. Revised August 15, 2011. Accepted August 17, 2011. Previously published online December 13, 2011.