The Increasing Trend in Cesarean Sections in South Eastern Italy: Medical and Biopolitical Analysis of Causes and Possible Mechanisms for Its Reduction

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Abstract: Caesarean section (CS) rates are rising globally, though with considerable variation from country to country; in Italy the CS rate is about 38.2% and in Puglia, a region in the South-east (4 million inhabitants), the CS rate is about 47.7%, up 4.25% in the last two years.

Currently, the high rate of CS and operative delivery in developed countries may be attributed to larger foetuses, an increase in the frequency of diabetes mellitus and pelvic adiposity, advanced maternal age at first pregnancy and a decrease in tissue elasticity. Moreover patients have a very low acceptance of any maternal-foetal risk in labour, and there is a significant increase of CS "*on maternal request*". Studies of communities with low rates of caesarean delivery may help to identify factors that lower the CS rate, such as cultural attitudes toward childbirth, design of the perinatal system, and genetic and social aspects. Also needed are biopolitical projects for the rationalisation of human and technological resources, which may lead to a reduction in legal claims and a natural decrease in defensive practices or defensive obstetrics based on doubtful diagnoses. Furthermore, the number of caesarean deliveries performed *"on maternal demand"* should be reduced by making sure that women are adequately informed about the safety of vaginal versus caesarean delivery. National health programs should be insttituted and extended to large populations, showing the costs and benefits of vaginal versus CS delivery. This analysis reviews the current reasons for performing CS, analyzing limitations in labour management and focusing on dystocia, in order to identify possible socio-political and medical mechanisms that may reduce the CS rate in south-eastern Italy, including promising but under-used technologies.

Key Words: Caesarean section; dystocia; non-progressive labour; labour management; intrapartum ultrasonography; cervicometry; biopolitics; epidemiology.

INTRODUCTION

Caesarean section (CS) rates worldwide are currently on the rise. The latest national figures in the United States of America indicate a CS rate of 29.1% [1], a record that was 6% higher than the previous year [2]; in some communities and countries (e.g. Brazil and other South American states) CS rates of up to 80% have been seen for years now, while in Europe the rate was 23.7% in 2002 and in Canada was 21.2% in 2001 [3].

The Vaginal Birth After Caesarean Section (VBAC) rate in North America is declining, mainly in favour of CS: the VBAC rate declined yearly from a peak of 28% in 1996 to less than 10% in 2004 [1]. These increases in CS rates are now far in excess of the optimal CS rate of around 15% suggested in WHO guidelines [4].

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WORLD EPIDEMIOLOGY OF CESAREAN DELIVERY

There are probably a variety of different causes for the increasing rate of caesarean delivery: maternal obesity, for example, is a well-known risk factor and there is a significant linear association between pre-pregnancy maternal corpulence and frequency of caesarean deliveries at term [5].

A statistical and epidemiological evaluation found that this increased rate of CS was correlated with several different effects, which merit some considerations; first of all, larger foetuses, as shown in North America [6], an increase in the frequency of diabetes mellitus (types I and II) as well as gestational diabetes [7] and an increase in pelvic adiposity, probably resulting in an increased rate of unengaged foetal heads in primiparae, while a century ago most foetuses had engaged heads in late gestation.

Recent studies have shown that the frequency of unengaged foetal heads at the onset of labour is 43-78% [8-10]; this may also account for recent labour curves such as Zhang's [11] being longer than Friedman's original [12].

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The current increased frequency of advanced maternal age in industrialized countries may also be related to a decrease in tissue elasticity and an increased rate of caesarean delivery. In women over 35 or 40 years there is a significant increase in the CS rate, but this increase is probably more affected by the unwillingness of either patients or care givers to expose the fetus to any risk [13]. In a recent survey carried out in Canada, 42% of women surveyed were willing to undergo caesarean deliveries to prevent the baby from being injured [14].

The very low acceptance of any risk in labour, combined with other reasons such as concerns about pelvic damage, fear of pain and inconvenience, is leading a small but increasing number of women to ask for elective caesarean delivery with no specific clinical reason [15]; a survey performed in London showed that 38% of female obstetricians would have an elective CS for no clinical reason. However, postnatal mortality is 1.77 per 1000 deliveries for CS and 0.62 per 1000 for vaginal birth, while the risk of maternal death with CS is 3.6 times higher than with vaginal delivery [16, 17].

Even without such acute events, it is clear that in many different countries obstetricians are fully aware of the medico-legal consequences of poor outcomes in terms of protracted, costly and traumatic legal battles.

CESAREAN DELIVERY RATES IN THE SOUTH OF ITALY

The CS rate in Italy was 38.2% in 2005, which is significantly higher than the European average and is one of the highest in the world. All Italian regions exceed the reference rate of 20% (Fig. **1**) recommended by the National Health Plan (NHP) for 2003-2005 and confirmed in the following plan (2006-08). There is significant regional variability, with lower values in the northern regions. The highest percentages are seen in Campania (60.0%) and Sicily (52.3%), followed by Basilicata (50.4%), Molise (48.9%) and Puglia (47.7%). The lowest rates are seen in Friuli Venezia Giulia (23.9%), Trentino Alto Adige (25.2%) and Tuscany (26.1%) [18]. Until the late sixties, the rate of births with CS was about 5%. Since 1970 it has increased rapidly, leaping from 11.2% in 1980 to 38.2% in 2005. There is an evident north-south gradient, with rates reaching 52.4% in the south and 49.5% in the Islands (Fig. **2**). Analysis of the data in Puglia show a steady increase in all provinces until 2005, with the highest values in the provinces of Brindisi and Taranto, 58.07% and 56.39% respectively (Fig. **3**).

In 2005 the neonatal mortality rate (1-29 days) was 17.1 per 10,000 newborns. There are still differences between different geographical areas, with higher values in the islands (24.4), followed by the regions of the South (19.2),

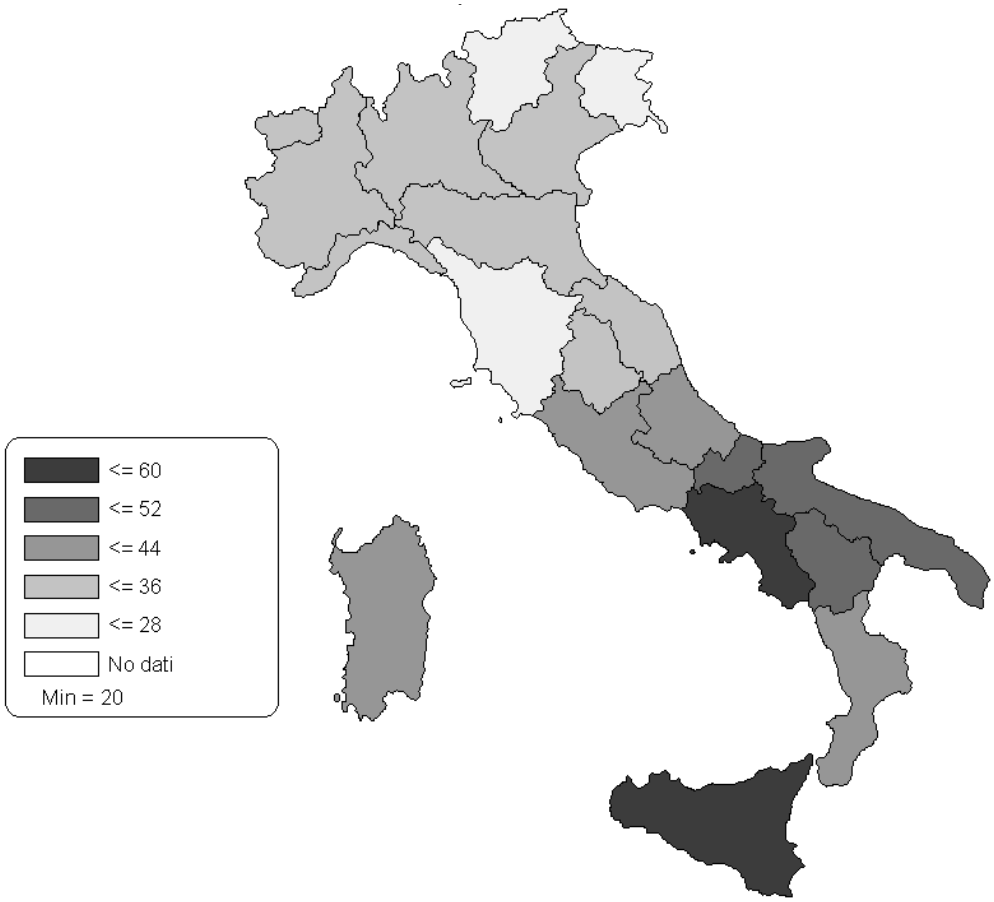

Fig. (1). Caesarean section deliveries in italian regions in 2005.

Fig. (2). Trend of caesarean section deliveries in the Italian geographical area from 1980 to 2005.

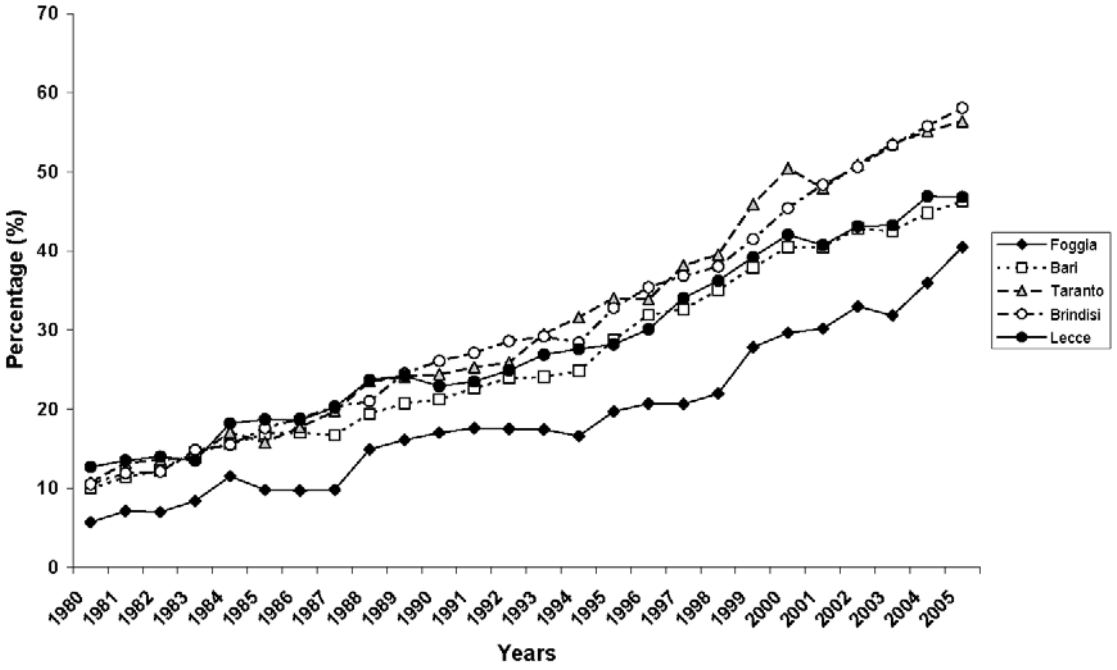

Fig. (3). Trend of caesarean section deliveries in the Puglia area from 1980 to 2005.

the Centre (16.8) and the North (14.1). The CS rate is higher for births in private nursing structures (59.9% in accredited nursing structures and 72.6% in non-accredited structures), while in public hospitals, CS is used in 34.2% of cases. The VBAC rate was 12.4%, with higher values in public facilities (12.7%) than private accredited structures (4.3%) or private non-accredited structures (4.9%). VBAC rates are lower in southern Italian regions, with the lowest (4.3%) in Puglia, where most of them are performed in public structures (4.5% compared to 1.6% in private structures) [19]. To best evaluate how to reverse this slowly increasing CS trend in south eastern Italy, this paper reviews the reasons given for CS and the limitations in labour management, focusing on non-progressive labour and trying to identify, on the basis of best available scientific evidence, under-used but promising technologies that may help in reducing the CS rate in south eastern Italy, especially in Puglia.

CURRENT REASONS FOR CHOOSING CS

There are also newer reasons given for CS and these include all breech presentations [20], high-order multiple pregnancies (more prevalent nowadays due to increased use of infertility therapy, in turn often linked to advanced maternal age) [21], uterine scars resulting from caesarians performed less than 18 months earlier, single-layer closure of a previous uterine scar, extreme obesity, high frequency of medical complications (e.g. diabetes or hypertension) and surgical complications (e.g. previous pelvic surgery, previous pelvic trauma).

Many of these are reasons for performing a caesarean delivery electively or early in labour. However, the frequency of CS at all stages of labour is increasing; Michael Robson's classification of the reasons for caesarean delivery includes 10 mutually exclusive groups - thus allowing all CS cases to be allocated to only one group. This classification has been adopted in many institutions [22].

Most caesarean deliveries involve primiparae at term with a vertex presentation in either spontaneous or induced labour; another large group that seems to be growing are women with a previous uterine scar (the large majority of whom acquired the scar as primiparae in labour).

It is also interesting to note that the frequency of induced labour is increasing; for example in the US the frequency of labour induction increased by 125% from 1989 (when it was first recorded) to 2001, when it accounted for 20.5 % of all births. The need for labour augmentation increased by 68% in the same period, and was 17.5% in 2001 [23]; Robson has shown that this group of women are generally more likely to have a caesarean delivery than women in spontaneous labour [23].

The most common reason for the higher rate of caesarean delivery in primiparae women is dystocia in non-progressive labour [2]; this accounts for about 80% of CS cases, while only about 1-2% are performed due to foetal distress [24]; furthermore, in a small percentage of cases, CS is performed due to a combination of failure to progress and foetal distress, and clinicians may find it hard to decide what the primary motive for the CS was.

In addition, some interesting data suggest that women suffering from distress may be destined to end up having a caesarean delivery [25].

CURRENT LIMITATIONS IN LABOUR MANAGEMENT

These limitations may be divided into two groups: limitations in our ability to measure the progress of labour (by digital examination) and incomplete algorithms for using the information acquired to manage labour.

Reliable data shows that the human fingers are far from optimal in terms of assessing the most important parameters for the progress of labour, namely foetal head station, foetal head position and cervical dilation.

Foetal Head Station

Foetal head station, during labour, is described as the level of the lowermost portion of the foetal head in relation to the ischial spines. In a model of a pelvis, the skill of clinicians in determining foetal head station was assessed and the results were quite poor: clinicians often failed (36-80%) to diagnose head station accurately. Experience was not correlated with ability to determine foetal head station accurately, or even with ability to label the foetal head [26]; the poor ability of clinicians to determine head station may be compounded by confusion as to the definition of head station itself.

A recent study found that 243 caregivers in four university obstetrics units used four different definitions of head station in labour. Whereas some clinicians used the American College of Obstetricians and Gynaecologists (ACOG) classification, measuring station in centimetres (from - 3 to + 5 cm), others used the old system which divides the pelvis into thirds (thus defining station on a 1-3 scale). Clinicians also disagreed on when the head enters the pelvis (station 0): some defined engagement as when the presenting part reached the spines, while others defined it as when the biparietal diameter reached that level. The result was that there were 4 different ways of defining station; the alarming aspect of this was that caregivers were not even aware of their disagreements in defining station [27].

Foetal Head Position

Very few studies have evaluated the accuracy of digital examination in the assessment of foetal head position in labour. The clinical assessment of foetal head position by digital examination during labour can easily be compared to the position as determined by ultrasonic imaging of the foetal head. Sherer *et al.* found that clinical assessment was correct (within a large margin of error of 45 degrees) only in 40% of cases [28]. Akmal *et al.* compared these two methods of determining foetal head position at a point that may be crucial - prior to application of forceps [29]; the clinician's diagnosis of occipital/transverse position of foetal head was correct in 54% of cases; in 25% of cases, the clinical diagnosis would have led to misapplication of forceps [29].

Cervical Dilatation

There is no gold standard for measuring cervical dilatation. Therefore studies assessing the ability of doctors to determine cervical dilatation have compared the digital examination of two examiners or the performance of an examiner on a cervical model. Studies comparing two analyses showed that there is usually a discrepancy of 1-2 cm between the results [30], although the difference may reach 6 centimetres. Research based on cervical models showed that clinicians were able to assess cervical dilatation to an accuracy of within 1 centimetre in only about 50% of cases [31, 32]. Tufnell showed that digital examination by single observers was consistent (with the same examiner consistently providing a good estimate, overestimating or underestimating cervical dilatation) in only 33% of cases, suggesting that even repeated examinations by a single clinician are of limited value. There are additional problems with digital examinations, including the following [30-32]:

- *Inaccuracy of the examination in relation to the speed of labour* - The human fingers have a limited capacity to determine differences of about 1-2 cm in dilatation; in the

active phase of labour a change of dilatation that exceeds this value takes on average 2 hours; more frequent examinations are likely to increase the inaccuracy of the digital examination.

- *Vaginal examinations and infections* - In the presence of ruptured membranes vaginal examinations are associated with an increased risk of chorioamnionitis [33]; therefore the clinician has to choose between gaining more information on dilatation and the progress of labour and reducing the risk of infection.
- *The cervix is a dynamic organ* - During the active phase of labour cervical dilatation is effected by contractions; during a contraction the cervix dilates and between contractions it recedes to almost the same dilatation as before; this effect is > 1cm in 50% of contractions and at times it may be up to 4 cm; therefore it may be important to record whether the vaginal examination was performed during or between contractions, which is rarely documented.
- *The elasticity of the cervix* - In order to assess dilatation the examining fingers have to try to spread the cervix; the dilatation is determined when the examining fingers meet counter pressure generated by the elasticity of the cervix; the cervix is thus further dilated by a few millimetres during vaginal examinations.
- *Dogmas in assessing dilatation* - There is a dogma that full dilatation is 10 centimetres, but this dogma is quite inaccurate in preterm labours when the cervix needs to dilate to a lesser extent to accommodate the foetal head; however, even at term full dilatation is dependent on head circumference, which may be variable.

INCOMPLETE ALGORITHMS FOR USING THE INFORMATION ACQUIRED TO MANAGE LABOUR

As mentioned above, caesarean deliveries in industrialized countries are mostly attributed to non-progressive labour (about 80% of cases), foetal distress (about 1-2% of cases), or a combination of failure to progress and foetal distress (a small group).

Unfortunately we lack effective and safe algorithms for using the information acquired during clinical evaluation to manage labour. This leads to the following problems for obstetricians:

Determining Key Events in Labour

Obstetricians have a very poor ability to accurately determine key events in labour and the only event that is invariably documented accurately is the time of birth; other key events are usually defined retrospectively and include:

- *Onset of labour* - often what seems to be either term or preterm labour is a false labour; furthermore patients often find it hard to say when the contractions they are feeling became painful.
- *Established labour* - Usually diagnosed after cervical changes have occurred, implying an incorrect diagnosis of onset of labour; just as the diagnosis of the onset of labour is difficult to pinpoint, the active phase of labour is usually determined retrospectively. The detection of full dilatation on digital examination implies that this event occurred prior to that examination.
- *Active phase of labour* - Can start at 3-5 cm dilatation and once again is usually determined in a subsequent examination.
- *Full dilatation* - This is invariably determined after it occurs; the detetction of full dilatation implies that it occurred at some point between the current examination and the previous one.
- *Onset of non-progressive labour* - This is invariably determined by poor progress in dilatation between two examinations, usually with an interval of 1-3 hours.

Determining the Speed of Labour

This determination is inaccurate, once again for a variety of reasons which include:

- *Inaccurate and subjective measurements* - Outlined above
- *Data generated infrequently and not acquired in real time* - Outlined above
- *Key events in poorly defined labour* - Outlined above

LABOUR MANAGEMENT BY LABOUR CURVES, CERVICOMETERS AND OXYTOCIN

There are no local labour curves; the most recent of Zhang [11] is quite different from that described by Freidman more than 60 years ago [12].

Letic [34] calculated that errors in assessing cervical dilatation by digital examination alone would result in a two-hour error in the assessment of the progress of labour in 33% of cases and a four-hour error in 11%.

Oxytocin is used currently in about 50% of labours [35]. There is still major disagreement regarding the use of oxytocin, with a variety of regimes that use different dosages and different increments in the dose. There are also fundamental differences between protocols: most North American protocols call for a decrease in oxytocin administration once tachysystole (more than 5 contractions in 19 minutes) has occurred, while the Irish active management of labour does not have such limitations [35].

There is also a lack of clarity on when to reduce or stop oxytocin administration. For example, a recent study shows that once a dilatation of 5 cm has been achieved in labours augmented with oxytocin, the dose of this drug could be reduced [36].

The inherent problem for all these protocols and studies is that oxytocin has a half-life of 1-5 minutes; its administration should be titrated and adjusted at intervals of no more than a few minutes.

However, there is currently no good feedback mechanism to modulate its use and the feedback in terms of dilatation and/or descent is provided in intervals of hours and not minutes. Emanuel Friedman, a pioneer in the field of labour measurement who was the first to measure the speed of labour, was also the first to create a mechanical cervicometer that was based on sophisticated use of a calliper [37]; a

similar device was also developed in parallel by Krementsov [38]; the major disadvantage of mechanical cervicometers was their inability to measure dilatation continuously, but they had other disadvantages such as distorting the cervix.

The next step in the evolution of cervicometry was electromechanical cervicometers. These were introduced by several investigators, including Smyth [39], Siener [40], Friedman and Von Micsky [41] and Richardson [42]; unfortunately, these cervicometers were bulky, distorted the cervix, interfered with vaginal examination and occluded the birth canal at the time of birth. Kriewall and Work [43] were able to avoid some of the problems outlined above by developing an electromagnetic cervicometer which used the Hall effect, involving changes in magnetic field. However, at advanced dilatation above 6 cm, the earth's magnetic field interfered with the measurements.

Ultrasound cervicometry was described by an American group, Zador *et al*. [44], and the Dutch researchers Kok [45] and Eijskoot [46]; ultrasound transmitters were placed on the maternal abdomen, and receivers attached to the cervix: the electrodes were small, and there was a good agreement with clinical estimation of the cervix, but none of these cervicometers gained clinical acceptance and most were used on a relatively small number of patients (<100).

Reviews by van Dessel [47] and Lucidi [48] outline the design and use of all these devices; it is interesting that in the interval (1991-2000) between these two reviews there was not a single publication on cervicometry. Recently another paper on mechanical cervicometers was published by Letic [49], and there are two companies looking at new ultrasound-based cervicometry. One group has presented its concept but not presented or published any data on the device; other publications [50, 51] and presentations of data [52-54] on modern cervicometry stress the benefits of these instruments in continuous monitoring of cervical dilatation and foetal head station during labour, as part of a new outlook on labour monitoring.

BIOPOLITICAL ANALYSIS AND POSSIBLE WAYS TO REDUCE CS RATES

Biopolitical analysis supported by scientific evidence [55,56] has shown that the fundamental causes of the rising CS rate in south eastern Italy are socio-economic factors, rising maternal age at first pregnancy, infertility and *in vitro* fertilizations, and maternal diseases such as endometriosis, diabetes and neoplasm.

The upward trend of CS rates has been reported in many countries, and its relationship with social modifications is widely accepted in Italy, though poorly supported by published data.

The high CS rate observed in Italy is linked to clinical and social factors, especially the following:

- *Poor dystocia diagnosis*
- *High maternal age at first pregnancy*
- *The relative costs of vaginal birth and caesarean delivery*
- *The different organization of private and public clinics*

The first factor is poor dystocia diagnosis; foetal dystocia is the primary clinical cause of CS and is linked to the limited ability of obstetricians to measure the progress of labour and the paucity of automatic instruments for labour management.

Currently, assessment of the progress of labour and the diagnosis of dystocia are still performed inaccurately, dependant on the skill of the obstetrician and without precise instrumentation, apart from intrapartum ultrasound.

The medical and legal issues relating to obstetric difficulties in labour management have a high profile among pregnant women, the courts and the mass media, favouring the idea that CS is a better delivery option in terms of dealing with dystocia.

The second factor is the rise in reproductive age at first pregnancy, which means that women have an even higher stake in its success. This makes women unwilling to run the risks associated with labour and more likely to opt for CS on demand.

The third factor in the high CS rate observed in private clinics in the South east of Italy compared to public Hospitals is related to the different costs of vaginal birth and caesarean delivery.

The current cost of a vaginal delivery is, on average, 1700 Euro and the cost of a CS is, on average, 2400 Euro; it is thus financially more remunerative to perform a CS than a vaginal delivery, whether the government or the individual pays.

Last but not least is the different organization of private and public clinics: in the former, there is frequently a lack of human resources, so the delivery needs to be well-organized, avoiding urgent CS in labour or emergencies in delivery rooms (with their increased risk of legal issues), as well as the higher price paid for CS than for vaginal delivery.

These evaluations, based on literature and personal experience, show that many factors are involved in the choice of a caesarean section and most of these are not strictly medical; furthermore, the rapidly mounting number of legal claims may indeed be leading to the adoption of defensive practices, called "Defensive Medicine" by hospital-based obstetricians.

In a recent survey, Defensive Medicine was shown to encompass all categories of doctors [56].

Given these data, a reduction in CS rates seems unlikely at present. However, the authors analyzed various approaches to the issue and came up with the following criteria.

First of all, vaginal delivery and CS need to be priced at the same level, so as to prevent CS from being a more profitable alternative, whether it is the government or the individual who pays; secondly, the technological resources for labour management, such as cervicometry, need to be developed rapidly, so that they automatically assist the diagnosis of dystocia by providing a description in the form of a printed report (helping to resolve legal issues), as occurred with cardiotocography at the last century.

Cervicometry may help control and decrease the number of caesareans by replacing the unreliable finger cervical examination with the graphic representation (e.g. on a monitor) of foetal head rotation and descent and cervical dilatation. [53, 54].

Assuming an objective instrumental diagnosis of labour dystocia, CS should be performed only after a sterile instrumental evaluation; thus, legal claims may indeed be reduced, with a consequent reduction in defensive practices and defensive obstetrics linked to doubtful diagnoses.

Finally, CS on maternal request can be reduced by raising the awareness of women and giving them adequate information regarding the safety of vaginal versus caesarean delivery. Thus a national health education program should be instituted and extended to a large population, showing the benefits of vaginal delivery and the risks of CS.

We believe that residential programs should be modified in order to improve specialists' understanding of malpractice problems and that the patient-doctor relationship should be ameliorated in private and public hospitals.

CONCLUSIONS

Currently the high number of caesareans and operative deliveries is linked to larger foetuses and an increase in the frequency of diabetes mellitus and pelvic adiposity. Also contributing to the rising CS rate is a greater frequency of advanced maternal age at first pregnancy, possibly related to a decrease in tissue elasticity, and a very low acceptance of any risk in labour combined with other psychological and social factors, such as concerns about pelvic damage, fear of pain and foetal distress.

In essence, the two basic issues to be resolved in relation to high CS rates are: CS *"on maternal request"* and dystocic or non-progressive labour. In the first case, it needs to be made clear that the maternal and neonatal risk of death is 3 times higher with CS than with vaginal delivery, while in the second case, early detection of dysfunctional contractions could assist the detection of slow dilatation or descent, enabling earlier intervention and reducing the need for CS. In the near future, it may become possible to base the use of oxytocin on short-term changes in cervical dilatation and head station, as well as the pattern of changes induced by individual contractions. Moreover the arrival of new instrumental resources such as cervicometers, which should reduce the number of unhelpful vaginal examinations, will help the automatic diagnosis of dystocia by depicting foetal head rotation and descent and cervical dilatation. This should reduce the number of legal claims, with a natural decrease in defensive practices and defensive obstetrics linked to doubtful diagnosis of dystocia. Finally, the rate of caesarean deliveries granted *"on demand"* should be reduced both by better education of women and provision of adequate information regarding the safety of vaginal versus caesarean delivery, and by biopolitical health programs aimed at the general population. This entails modification of cultural attitudes towards childbirth, improvement of the perinatal system, consideration of genetic and social factors, and a more rational use of human and technological resources. In fact, by employing currently under-used but promising technologies, it should soon become much easier to identify non-progressive labour and to convince pregnant women to avoid CS *"on demand"*, thus leading to an effective reduction of the CS rate, especially in south eastern Italy.

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