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CLINICAL ARTICLE

Economic implications of labor induction

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ABSTRACT

Objective: To assess health service costs associated with labor induction according to different clinical situations in a tertiary-level hospital. *Methods:* In a prospective study, individual patient cost data were assessed for women admitted for induction of labor at a tertiary hospital in Spain between November 1, 2012, and August 31, 2013. The costs of labor induction were estimated according to maternal and neonatal outcomes, method of delivery, cervical condition at admission, and obstetric indication. Direct costs including professional fees, epidural, maternal stay, consumables, and drugs were calculated. *Results:* Overall, 412 women were included in the final cost analysis. The mean total cost of labor induction was €3589.87 (95% confidence interval [CI] 3475.13–3704.61). Cesarean delivery after labor induction (€4830.45, 95% CI 4623.13–5037.58) was significantly more expensive than spontaneous delivery (€3037.45, 95% CI 2966.91–3179.99) and instrumental vaginal delivery (€3344.31, 95%CI 3151.69–3536.93). The total cost for patients with a very unfavorable cervix (Bishop score <2; €4283.47, 95% CI 4063.06–4503.88) was almost double that for women with a favorable cervix (€2605.09, 95% CI 2327.38–2837.58). Labor induction for hypertensive disorders of pregnancy was the most expensive obstetric indication for induction of labor (€4347.32, 95% CI 3890.45–4804.18). *Conclusion:* Following the induction of labor, a number of patient- and treatment-related factors influence costs associated with delivery.

1. Introduction

Induction of labor (IOL) is a common element of contemporary obstetric practice that accounts for approximately 20% of all deliveries [1,2]. As compared with expectant management, IOL is associated with better perinatal outcome when there are clear medical reasons at term for this approach [3]. However, IOL is thought to be associated with a longer hospital stay, increased rate of cesarean delivery, and neonatal intensive care unit admission [4], with the obvious consequence of increased costs as compared with spontaneous onset of labor [5].

Economic assessments of obstetric interventions are necessary to estimate the impact of obstetric practice on healthcare resources. Consequently, the impact of different delivery methods on adverse perinatal outcomes and healthcare costs is a topic of significant interest in the scientific literature [6–8]. Furthermore, most of the reports exclusively compared cesarean delivery with vaginal delivery, concluding that cesarean delivery is more expensive owing to increased maternal morbidity and hospital length of stay. However, the estimated expenditure did not take into account other specific costs of IOL (e.g. those of nursing and support staff, and neonatal, anesthesiologist, and obstetric physicians), other surrogate costs (e.g. those for equipment or supplies, including drugs and operating room packs, or instruments), or the costs associated with long-term health consequences [6–8]. Furthermore, available institutional information about the economic implications of labor and delivery is usually reported as diagnosis-related group or administrative data, which means that high-quality information about different clinical situations cannot be obtained [9]. For example, institutional data do not differentiate between elective IOL and spontaneous onset of labor—differences that fundamentally influence the cost of delivery [5].

Reliable estimates of the financial costs of IOL are needed. The aim of the present study was therefore to perform a cost analysis of prospectively collected individual patient data to assess health service costs associated with IOL according to different clinical situations in a tertiary-level hospital.

2. Materials and methods

In a prospective study, women scheduled for IOL were enrolled between November 1, 2012, and August 31, 2013, at the Obstetrics Department at Hospital Clínico Lozano Blesa (Zaragoza, Spain), a university tertiary-level center within the Spanish national health system. The exclusion criteria were premature rupture of membranes, placenta previa,

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breech presentation, or multiple pregnancies. The hospital ethics committee approved the study, and written informed consent was obtained from all of the participating women after they received a full explanation of the study.

Gestational age of the fetus was confirmed by the fetal crown–rump length during first trimester ultrasonography [10]. Indications for IOL were determined by a staff obstetrician and classified as follows: (1) small for gestational age (SGA); (2) gestational diabetes; (3) late-term pregnancy; (4) hypertensive disorders of pregnancy; and (5) miscellaneous (e.g. intrahepatic cholestasis, rhesus isoimmunization, or maternal pathology). Perinatal and IOL outcomes were analyzed separately for each of the five categories of IOL indications.

The cervix condition was assessed at admission via the Bishop score [11]. A very unfavorable cervix was defined as a Bishop score of less than 2 [12]. When the Bishop score was below 6 and the non-stress cardiotocography was reactive, a 10-mg dinoprostone vaginal insert (Propess; Ferring Pharmaceuticals, Madrid, Spain) was placed in the posterior fornix of the vagina to initiate cervical ripening. Membrane rupture and intravenous oxytocin were used if the non-stress cardiotocography was non-reactive, the Bishop score was above 6, regular spontaneous uterine contractions were present, or more than 24 hours had passed since cervical ripening had begun.

Cervical ripening was not performed in the labor and delivery room, and did not require one-to-one nursing care. Once in active labor, however, women had continuous one-to-one nursing care [1] and in-house consultant obstetric, anesthesiology, and pediatric coverage was available on a 24-hour basis. Fetal heart rate patterns were analyzed according to the guidelines of the National Institute for Health and Clinical Excellence [13]. Cesarean or assisted vaginal delivery was conducted according to clinical standards [14].

According to protocols at the study center, IOL for women with previous cesarean delivery was performed directly by oxytocin, resulting in the need for direct admission to the delivery unit and one-to-one nursing care. The surgical assistant was a resident in obstetrics and gynecology. A midwife or a resident in obstetrics and gynecology and a resident in pediatrics, always under staff supervision, were present at uncomplicated vaginal deliveries. Hours in the labor and delivery unit were calculated from the time and date of admission to the unit until the time and date of delivery. According to hospital policy, discharge to home occurred 2 days after uncomplicated spontaneous and assisted vaginal deliveries, and 3–4 days after uncomplicated cesarean deliveries.

The economic evaluation was performed using the method of Allen et al. [5]. Delivery costs were expressed in euros. Only economic costs were considered; intangible or psychosocial costs were not included [15]. The analysis focused on costs that were directly attributable to the care of the mother and neonate. The costs assessed included those related to: the duration of hospital admission and stay in the intensive care unit; obstetric and anesthesiology fees; nursing and other personnel support hours in the labor and delivery unit, operating room, postpartum area, and neonatal intensive care unit; anesthesia technician hours; epidural use; IOL agents; and consumables. Three secondary cost analyses were conducted that included the method of delivery, cervical condition at admission, and obstetric indication for IOL as variables.

Direct costs were related to medical supplies, such as infusion pumps, intravenous solutions, anesthesia supplies, and medications. Consumable costs were those related to vaginal and cesarean delivery packs containing instruments, catheters, needles, syringes, sponges, drapes, and gowns. Hospital equipment prices were obtained from the Purchasing and Supplies Center of the study center.

In terms of staff salaries, the fees were the same for each type of attending consultant and for all types of delivery. The fee for anesthesiology care incorporated epidural placement and maintenance of epidural analgesia during labor and delivery, in the operating room, and during immediate postoperative monitoring. Midwife, nursing, support staff, and resident salaries were also calculated. The average attendance time per patient was calculated for each professional group. Wages were estimated using information from the Department of Management Control of the study center, accounting for the base fee with employer costs plus supplements for delivery during nights, weekends, or holidays.

The study assessed maternal and neonatal morbidity as a measure of the costs associated with short-term maternal and neonatal adverse outcomes. Maternal and neonatal intensive care unit admission costs were included in the analysis according to their diagnosis-related groups [9]; however, the costs of readmission were not taken into account. Four principal adverse maternal outcomes were considered: postpartum hysterectomy, 3rd and 4th grade perineal tears, blood transfusion, and postpartum curettage.

Statistical analyses were performed with SPSS version 20.0 (IBM, Armonk, NY, USA). Maternal social and demographic characteristics and perinatal outcomes were recorded in a database as hardcopies at the time of the study. Patient data were reported as mean ± SD, median (range), or number (percentage). Cost data were reported as mean with 95% confidence interval (CI). χ^2 and Fisher exact tests were used to compare categoric data where appropriate. A Bonferroni correction was performed to correct the cost analysis for the presence of the four IOL indications. $P < 0.05$ was considered significant.

3. Results

During the study period, 430 women were scheduled for IOL and eligible for inclusion in the study. Eighteen refused to participate, resulting in an acceptance rate of 95.8%. Thus, data from 412 women were included in the final cost analysis. Table 1 lists the demographic characteristics and perinatal outcomes for the total study sample.

As expected, when compared with neonates who were not SGA, SGA neonates had a significantly lower birth weight (mean 2486.50 g vs 3385.10 g; $P < 0.001$) and had a higher frequency of neonatal intensive care unit admission (32.5% [13/40] vs 10.4% [43/412]; $P < 0.001$). Patients who underwent IOL as a result of hypertensive disorders exhibited the worst perinatal outcomes: when compared with patients with other indications, they had a higher incidence of cesarean delivery (38.3% [18/47] vs 27.2% [112/412]; $P = 0.042$) and neonatal acidosis (9.1% [4/44] vs 2.3% [8/348]; $P = 0.022$), and the longest duration of IOL (mean 1629.7 ± 879.7 min vs 1294.63 ± 734.38 min; $P = 0.021$) and hospital stay (4.2 ± 1.5 days vs 3.5 ± 1.1 days; $P < 0.001$).

Among all 412 patients, the mean total cost was €3589.87 (95% CI 3475.13–3704.61). Table 2 summarizes the costs of personnel, admission, procedures, consumables, and adverse maternal outcomes.

Table 1
Demographic characteristics and perinatal outcomes of all study women (n = 412).[a]

Maternal characteristic or perinatal outcome	Value
Maternal age at delivery, y	32.46 ± 5.27
White ethnic origin	348 (84.5)
Smoker	61 (15.9)
Previous cesarean delivery	27 (6.6)
Length of pregnancy at labor induction, d	284.05 ± 20.18
Cervical ripening with dinoprostone	323 (78.6)
Epidural anesthesia	350 (78.6)
Bishop score at admission	2 (0–8)
Cervical length at admission, mm	27.36 ± 10.19
Duration of labor induction, min	1294.63 ± 734.38
Hospital stay, d	3.50 ± 1.11
Neonatal weight at delivery, g	3385.10 ± 521.20
Female neonate	203 (49.3)
Cesarean delivery	112 (27.2)
Cesarean delivery for fetal distress	34 (8.3)
Cesarean delivery for failure to progress	78 (18.9)
Neonatal admission	43 (10.4)
Umbilical artery pH <7.10	8 (1.94)
Adverse maternal outcome[b]	31 (7.5)

[a] Values are given as mean ± SD, number (percentage), or median (range).
[b] Adverse maternal outcomes included third- or fourth-grade perineal tears, postpartum curettage, postpartum hysterectomy, intrapartum cesarean scar rupture, blood transfusion, or admission to the intensive care unit.