INDUCTION OF LABOUR USING A CONCENTRATED OXYTOCIN INFUSION ADMINISTERED IN GEOMETRIC PROGRESSION IN A PERISTALTIC INFUSION PUMP

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ABSTRACT

A new regime for oxytocin titration was introduced into the Labour Ward, Alexandra Hospital, Singapore. It utilises an oxytocin infusion of 10, 20 or 40 mU/ml administered in geometric progression in a peristaltic infusion pump. A total of 91 patients classified according to parity and cervical score were studied. An overall vaginal delivery rate of 92.3% was obtained. The mean induction-delivery time for nulliparous and multiparous patients was 5.3 hrs (±2.6 hrs) and 3.6 hrs (±1.9 hrs) respectively. Almost 90% of patients who had a successful induction required only one pint of infusion. Of those babies who were delivered vaginally, all had an Apgar score of 7 or more at 5 minutes.

Keywords: Oxytocin titration, induction of labour, vaginal delivery rate, induction-delivery time, neonatal outcome.

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INTRODUCTION

In Singapore, artificial rupture of the membranes followed by oxytocin titration is the most popular method of induction of labour. Various oxytocin regimes are in use and the differences arise in terms of the interval between amniotomy and administration of oxytocin, the concentration of the oxytocin infusion, the increment dose, increment interval and the mode of delivery of the infusion.

In 1987, an improved regime was introduced into the Labour Ward, Alexandra Hospital, Singapore. This method utilises a concentrated oxytocin infusion of 10, 20 or 40 mU/ml administered in geometric progression through a peristaltic infusion pump for induction of labour after artificial rupture of membranes. This study was undertaken to evaluate the efficacy and safety of this regime.

Patients and methods

The patients were selected from those having induction of labour in the Department of Obstetrics and Gynaecology. Alexandra Hospital. The main indications for induction of labour were abnormal weight gain at term, prolonged pregnancy and hypertensive disease of pregnancy. The study was confined to singleton pregnancies presenting by the vertex with no history of previous Caesarean section and having a good prospect of vaginal delivery.

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All patients were examined before induction and the favourability of the cervix assessed by a modified Bishop score. A score of 0 – 2 was allocated for each of the following characteristics: dilatation, effacement, consistency and position of the cervix and station of the head. Induction was by artificial rupture of forewaters and simultaneous oxytocin infusion. The oxytocin infusion was administered by means of a peristaltic infusion pump (Terufusion Model STC-503) so that the oxytocin dose could be regulated with accuracy by altering the rate of infusion or the strength of the oxytocin solution in the reservoir. The infusion was started at 1 mU or 2 mU/min, the dose doubled every 20 minutes until optimum contractions lasting 40 – 50 seconds occurring every 2 to 3 minutes interval, as determined by clinical assessment or intrauterine pressure catheter, were obtained. The dose regime is shown in Table I. If contractions became too frequent or if the uterus became hypertonic, the infusion rate was decreased to a quarter of its rate or stopped. In all patients, continuous electronic foetal heart rate monitoring were commenced prior to and during the oxytocin infusion. If foetal distress was encountered, it was managed clinically including temporary reduction or cessation of the oxytocin infusion rate, foetal scalp blood sampling or delivery, if necessary. Epidural analgesia was not used; pethidine in a dosage of 50 – 75 mg and/or Entonox were prescribed for pain relief.

The maternal age, gestation, cervical score, induction - delivery time, dose of oxytocin, number of infusions, mode of delivery, birthweight and Apgar scores at 1 minute and 5 minute were recorded and analysed.

RESULTS

The 91 patients in the study comprised 40 nulliparae and 51 multiparae. Of the 40 nulliparae, 29 had a good cervical score (>5) and 11 had a poor cervical score (≤5). Among the 51 multiparae, 43 had a good score and 8 had a poor score.

The patient characteristics and outcome are summarised in Tables II and III.

Table I
OXYTOCIN REGIME FOR INDUCTION AND AUGMENTATION OF LABOUR

Units of Syntocinon in 500 ml D/S	pump rate in ml/hr 6	12	24	48	96	192
5 (10 mU/min)	1 mU/min	2	4	8	16	32
10 (20 mU/ml)	2	4	8	16	32	64
20 (40 mU/ml)	4	8	16	32	64	128

Dose escalated every 20 minutes until contractions lasting 40 – 50 seconds occurring at 2 to 3 minutes interval are obtained.

Table II
PATIENT CHARACTERISTICS AND OUTCOME IN NULLIPAROUS PATIENTS

	n = 11	n = 29
	Cervical Score ≤ 5	**Cervical Score ≥ 6**
Age (years)	24.2 (2.5)	27.0 (4.9)
Gestation (weeks)	39.7 (1.1)	39.8 (1.4)
Cervical Score	4.8 (0.4)	6.4 (0.6)
No of Infusions	1.3 (0.7)	1.1 (0.3)
Mean Max Oxytocin Dosage	22.0 (12)	14.7 (8)[1]
Mean Induction-Delivery Time (h)	7.0 (3.7)	5.3 (2.6)
Instrumental Vaginal Delivery Rate	27%	24%
Caesarean Section Rate	18%	14%
Mean Apgar Score		
At 1 min	7.4 (0.8)	7.8 (0.6)
At 5 min	8.8 (0.6)	8.9 (0.4)
Birth Weight (g)	3041 (443)	3043 (433)

Results are mean (± SD) where appropriate.

Table III
PATIENT CHARACTERISTICS AND OUTCOME IN MULTIPAROUS PATIENTS

	n = 8	n = 43
	Cervical Score ≤ 5	**Cervical Score ≥ 6**
Age (years)	29.6 (3.6)	30.1 (4.9)
Gestation (weeks)	40.1 (1.4)	39.6 (1.5)
Cervical Score	4.9 (0.4)	6.3 (0.4)
No of Infusions	1.3 (0.5)	1.1 (0.4)
Mean Max Oxytocin Dosage	22.9 (11.7)	15.8 (11.1)
Mean Induction-Delivery Time (h)	4.1 (2)	3.6 (1.9)
Instrumental Vaginal Delivery Rate	0	4.6%
Caesarean Section Rate	2%	0
Mean Apgar Score		
At 1 min	7.6 (0.9)	8 (0.3)
At 5 min	8.8 (0.4)	9 (0)
Birth Weight (g)	3237 (612)	3162 (365)

Results are mean (± SD) where appropriate.

Mode of Delivery

Table IV shows the distribution of nulliparae and multiparae respectively by mode of delivery. 34 of 40 nulliparae (85%) and 50 of 51 multiparae (98%) achieved a vaginal delivery. This gave an overall vaginal delivery rate of 92.3%. 7 patients were delivered by Caesarean section, all but one were nulliparous. The indications for Caesarean section were failed induction in one, cephalopelvic disproportion in three and foetal distress in three. Three of the seven patients had a poor cervical score. The Caesarean section rate was 7.7% in all patients.

Table IV

DISTRIBUTION OF 40 NULLIPARAE AND MULTIPARAE BY MODE OF DELIVERY

(figures in percentage)

Mode of delivery	Nulliparae (n = 40 = 100%)	Multiparae (n = 51 = 100%)
Spontaneous Vaginal Delivery	60	94
Instrumental Vaginal Delivery	25	4
Caesarean Section	15	2

Induction-Delivery Interval

The induction-delivery time for patients who delivered vaginally is summarised in Table V. The mean induction-delivery time for the nulliparous group was 5.3 hours (SD ±2.6 hours) and for the multiparous group 3.6 hours (SD ±1.9 hours). The length of induced labour expressed as cumulative percentage is summarised in Table V. Almost all patients were delivered by 12 hours after commencement of induction of labour. If one assumes that induction was performed at 8 o'clock in the morning. 85% of nulliparae and 98% of multiparae who delivered vaginally would have been delivered by 5 o'clock in the evening.

Oxytocin Infusion

Almost 90% of patients who had a successful induction required only one pint of infusion. In other words, almost 90% of patients had less than 5 units total oxytocin dose infused. Nearly all patients who deliverd vaginally were delivered by the second pint of infusion.

Apgar Score

Of those babies delivered vaginally, all had an Apgar score of 7 or more at 5 minutes.

Table V

INDUCTION-DELIVERY TIME IN PATIENTS WHO DELIVERED VAGINALLY

	0 – 3	3.1 – 6	6.1 – 9	9.1 – 12	12+
Nulliparae n = 34	4 (12%)	15 (56%)	10 (85%)	4 (97%)	1 (100%)
Multiparae n = 50	21 (42%)	25 (92%)	3 (98%)	1 (100%)	—
All n = 84	25 (30%)	40 (79%)	13 (93%)	5 (99%)	1 (100%)

— the length of induced labour (vaginal deliveries) expressed as cumulative percentage are within parentheses

— mean induction-delivery time for 34 nulliparous women who delivered vaginally was 5.3 hrs (SD ± 2.6 hrs)

— mean induction-delivery time for 50 multiparous women who delivered vaginally was 3.6 hrs (SD ± 1.9 hrs)

DISCUSSION

The study of methods of induction of labour is aimed at maximising the vaginal delivery rate and minimising the duration of labour with minimal risks of foetal hypoxia. The ideal oxytocin dose should produce the required

amount of uterine activity to effect vaginal delivery in optimal time without compromising the condition of the foetus. It is well known that the sensitivity of the uterus varies enormously from patient to patient (1, 2) and thus, if the oxytocin dose is kept within a narrow range a considerable number of induction failures will occur. Therefore, for oxytocin to be really effective, it must be varied to suit the individual. Turnbull and Anderson (3) considered that an ideal regime for oxytocin administration would be to start with a low dose and increase the amount at short intervals until effective uterine contractions were induced. In other words, oxytocin should be given in the form of a "titration" the "end-point" being optimal uterine activity. The main concern of increasing the oxytocin dose at short intervals and using high concentrations until optimal uterine activity is produced is uterine hyperstimulation and an increased risk of foetal hypoxia. Reassuringly, Toaff et al found no significant difference in the incidence of hyperstimulation whilst using physiological (2.6 – 13.2 mU/min) or pharmacological doses (2.6 – 422.4 mU/min) of oxytocin (4). In our study, although hyperstimulation was not included in the design protocol, the neonatal outcome was uniformly good as assessed by the 1-minute and 5-minute Apgar scores.

Efforts have been made to improve this popular method of induction of labour. These include reduction of maximum oxytocin dose to maintain adequate uterine activity after 5 cm cervical dilatation (2), and the use of pulsed oxytocin infusion (5) to reduce the mean maximum or total dose of oxytocin; automation of oxytocin titration (6), and oxytocin titration to achieve present active contraction area values (7,8). These efforts hope to optimise the induction-delivery interval without compromising the chances of vaginal delivery or the condition of the fetus.

The "end-point" of oxytocin titration is optimal uterine activity. The use of uterine activity measurements has been recommended to guide oxytocin titration for induction of labour (7,9). However, the studies of Arulkumaran et al (8) and Gibb et al (10) suggest that oxytocin titration to achieve preset uterine activity values based on spontaneous labour may not give any advantage over the traditional method of oxytocin titration to achieve a preset frequency of uterine contractions. Furthermore, in a busy clinical setting it is easier and simpler to assess clinically adequate uterine contractions by frequency than by maximal uterine activity.

The automatic infusion system when compared to the manual infusion system for induction of labour used less oxytocin but suffered from a significantly longer duration of labour to achieve a similar proportion of vaginal deliveries and had no statistically significant effect on neonatal outcome. Furthermore, in half of the nulliparae with poor cervical scores the automatic infusion system proved inadequate to effect vaginal delivery (10). The automatic infusion system thus confers no advantage to the foetus over the traditional method of manual oxytocin administration.

We conclude that despite efforts to improve the methods of induction, our method of manual oxytocin titration using a concentration oxytocin infusion administered in geometric progression in a peristaltic infusion pump has its place in modern obstetric practice as it is easy to use and effective in achieving a high vaginal delivery rate. Its safety is attested by the good 1-minute and 5-minute Apgar scores. The risks of fluid overload such as water intoxication and electrolyte disturbances are minimal as most patients required only one pint of infusion to achieve vaginal delivery.

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