A LOW DOSE OXYTOCIN REGIME FOR INDUCTION AND AUGMENTATION OF LABOUR

L Chan, K H Tan, D Vengadasalam

ABSTRACT

A low dose oxytocin regime was used in Labour Ward, Alexandra Hospital for the induction and augmentation of labour. It utilised an oxytocin infusion administered in an arithmetic progression from 1 to 16 mU in a peristaltic infusion pump. A total of 100 patients (67 for augmentation and 33 for induction of labour) classified according to parity were studied. An overall vaginal delivery rate of 87% was obtained. The overall mean durations of labour for nulliparous and multiparous patients were 6.6 hours (S.D. ± 2.9 hours) and 4.9 hours (S.D. ± 2.8 hours) respectively. The mean induction delivery time for nulliparous patients was 6.4 hours (S.D. ± 3.2 hours) and for multiparous patients it was 4.0 hours (S.D. ± 2.2 hours). About 69% of the nulliparae and 94% of the multiparae who were induced delivered within 9 hours. All the induced patients delivered within 12 hours. Neonatal outcome was good as assessed by Apgar score.

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

SINGAPORE MED J 1990; Vol 31: 321 - 326

INTRODUCTION

Intravenous oxytocin drip adminstration is extensively used in Singapore for the induction or augmentation of labour. In the case of labour it is usually used following forewater amniotomy.

The dose of oxytocin is given by titration to achieve optimum uterine contractions. One way is to use a concentrated oxytocin infusion administered rapidly by geometric progression to obtain regular and good uterine contractions simulating that of progressive labour [1]. More recent understanding of the pharmacokinetics of intravenously administered oxytocin for the purpose of induction of labour has shown that lower doses given by arithmetic progression and at intervals of between 40 to 60 minutes are effective [2].

Between March and June 1989, a low dose synthetic oxytocin (Syntocinon Sandoz) regime was tried out in the Labour Ward, Alexandra Hospital, Singapore. It utilised a low dose Syntocinon infusion administered in an arithmetic progression every 30 minutes through a peristaltic infusion pump delivering from 1 to 16 mU of Syntocinon per minute.

The aim of the study was to find out the efficacy of such a regime.

PATIENTS AND METHODS

This was a prospective study of 100 consecutive patients with low dose Syntocinon regime used for augmentation or induction of labour.

Augmentation of labour was performed when there were poor and inefficient uterine contractions in labour with a cervical dilatation rate of less than 1 cm/hr. An intravenous infusion was set up for the patient and the Syntocinon regime was then commenced. The 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. A 3-way tap was also used with one inlet for the Terufusion Infusion Pump and the other to a 500 ml. dextrose-saline (D/S). This D/S infusion was used either to maintain venula patency or for fluid replacement as prescribed. The Syntocinon infusion was commenced at

Gleneagles Medical Centre
6 Napier Road #05-02
Singapore 1025

L Chan, MBBS, FRCOG, AM(S'pore)
Obstetrician & Gynaecologist

Department of Gynaecological Oncology & Urology
Kandang Kerbau Hospital
Hampshire Road
Singapore 0821

K H Tan, MBBS
Trainee

Department of Maternal & Foetal Medicine
Kandang Kerbau Hospital

D Vengadasalam, MBBS, FRCOG, AM (S'pore)
Obstetrician & Gynaecologist

Correspondence to : Dr K H Tan

1 mU/min and the infusion rate was increased arithmetically by 1 mU/min every 30 minutes until contractions were one in 2-3 minutes lasting 40-60 seconds based on cardiotocograph (CTG) recording and clinical assessment. The rate of infusion was then maintained.

A convenient method of oxytocin titration is to place 5 units Syntocinon in 500 ml. 5% D/S solution when 2 drops/min rate will deliver 1 mU/min Syntocinon intravenously.

If the contractions became too frequent (more than 1 in every 2 minutes) or if the uterus became hypertonic, the infusion rate was decreased to a quarter of its rate or stopped. In all patients, continuous foetal heart rate (FHR) monitoring was 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.

Table I

Indications for Induction of Labour (n = 33)

Indications	No. of patients
Static weight at term	9
Decreased weight at term	8
Post-dates or Post-term	8
Decreased foetal movements at term	4
Hypertensive disease of pregnancy	2
Gestation Diabetes	1
Social reasons	1
Total	33

As for induction of labour in this study, the leading indications were weight loss or static weight at term and prolonged pregnancy (Table I). All the patients were examined before induction and the favourability of the cervix assessed by a modified Bishop score. If the cervix was unfavourable (score of 3 or less), Prostaglandin E2 3mg (Prostin Upjohn) vaginal pessary was used to ripen the cervix prior to induction. The favourability of cervix for induction was usually reassessed 1 day after the insertion of the Prostin pessary. Induction of labour was carried out by artificial rupture of forewaters and Syntocinon infusion as previously described.

RESULTS

The 100 patients in the study comprised 47 nulliparae and 53 multiparae.

Table II

Overall Distribution by Mode of Delivery

	n = 100	%	
Spontaneous Vaginal Delivery	79	79	87%
Assisted Vaginal Delivery	8	8	
Caesarean Section	13	13	
Total	100	100	

Table III

Distribution of 47 Nulliparae by Mode of Delivery

	n = 47	%	
Spontaneous Vaginal Delivery	32	68.1	76.6%
Assisted Vaginal Delivery	4	8.5	
Caesarean Section	11	23.4	
Total	47	100.0	

Mode of Delivery

Tables II to IV show the overall distribution of nulliparae and multiparae respectively by mode of delivery. Eighty-seven patients (87%) of the total number achieved vaginal delivery. Among the 47 nulliparae, 36 (76.6%) delivered vaginally while 51 (96.2%) of the 53 multiparae achieved vaginal delivery.

Indications of Caesarean Section

Thirteen patients were delivered by Caesarean section, all but 2 were nulliparae (Table IV). The indications for Caesarean section were foetal distress in six, cephalopelvic disproportion in four, no progress of labour in two and twin pregnancy in one. The Caesarean section rate was 13% in all patients which was similar to that for the hospital.

Table IV

Distribution of 53 Multiparae By Mode of Delivery

	n = 53	%	
Spontaneous Vaginal Delivery	47	88.7	96.2%
Assisted Vaginal Delivery	4	7.5	
Caesarean Section	2	3.8	
Total	53	100.0	

Duration of Labour

The duration of labour for 36 nulliparae who delivered vaginally was 6.6 hrs (S.D. ± 2.9 hrs) and for the 51 multiparae was 4.9 hrs (S.D. ± 2.8 hrs). Mean maximum Syntocinon dosage was 8.2 mU/min (S.D. ± 4.6 mU/min) for the nulliparae and 5.1 mU/min (S.D. ± 4.1 mU/min) for the multiparae.

CTG Abnormalities during Syntocinon Infusion

There were 19 patients (19%) who developed FHR abnormalities in CTG during the Syntocinon infusion as shown in Table V. Three patients had tachycardia, 9 had early decelerations, 3 had late decelerations and 4 had variable decelerations. Syntocinon infusion was

Table V

CTG Abnormalities during Syntocinon Infusion

	n = 100	%	
Tachycardia	3	3	20%
Early decelerations	9	9	
Late decelerations	3	3	
Variable decelerations	4	4	
Hypertonus	1	1	
No abnormalities	80	80	
Total	100	100	

discontinued for 8 (8%) of these patients (1 for tachyardia, 3 for late decelerations and 4 for variable decelerations).

Abnormal Uterine Contractions

Only one patient (1%) had abnormal uterine contractions. She had a sustained prolonged contaction (hypertonus) about 20 minutes after Syntocinon was started at 1mU/min. Syntocinon was stopped for a while and she was observed and later restarted on Syntocinon infusion at 1mU/min.

Table VI

Apgar scores (n = 100 = 100%)

Score	1 min	5 min
> 7	94	100
5 - 6	6	0
< 5	0	0

Apgar Score

All babies had an Apgar score of 7 or more at 5 minutes (Table VI).

Postpartum Maternal Complications

Out of the 89 patients who delivered vaginally, there were 2 cases of mild post-partum haemorrhage (one with 300ml loss and another with 350ml loss) and 2 cases of manual removal of placentae.

Table VII

Overall Distribution by Mode of delivery

	n = 33	%	
Spontaneous Vaginal Delivery	28	84.8	90.9%
Assisted Vaginal Delivery	2	6.1	
Caesarean Section	3	9.1	
Total	33	100.0	

Table VIII

Distribution of 16 Nulliparae by Mode of Delivery

	n = 16	%	
Spontaneous vaginal delivery	12	75.0	81.3%
Assisted vaginal delivery	1	6.3	
Caesarean Section	3	18.7	
Total	16	100.0	

Table IX

Distribution of 17 Multiparae by Mode of Delivery

	n = 17	%	
Spontaneous Vaginal Delivery	16	94.1	100%
Assisted Vaginal Delivery	1	5.9	
Caesarean Section	0	0	
Total	17	100.0	

Induction of Labour

Of the 100 patients, 67 patients (67%) had Syntocinon infusion for augmentation while 33 (33%) was for induction of labour.

Tables VII to IX show the overall distribution and the distribution of nulliparae and multiparae who had induction of labour respectively by mode of delivery. Thirty out of 33 patients (90.9%) achieved vaginal delivery. Among the 16 nulliparae, 13 (81.3%) delivered vaginally and all of the 17 multiparae delivered vaginally.

Table X

Induction-Delivery Time in Patients who delivered vaginally

	Time in hours				
	0 - 3	3.1 - 6	6.1 - 9	9.1 - 12	12 +
Nulliparae n = 13	3	3	3	4	0
Multiparae n = 17	6	9	1	1	0
All n = 30	9	12	4	5	0

Mean - induction - delivery interval for 13 nulliparous women who delivered vaginally was 6.4 hours (SD ± 3.2 hours)

Mean - induction - delivery interval for 17 multiparous women who delivered vaginally was 4.0 hours (SD ± 2.2 hours)

Table XI

Length of Induced Labour (Vaginal Deliveries)
Figures expressed as cumulative percentage (%)

	Time in hours				
	0 - 3	0 - 6	0 - 9	0 - 12	12 +
Nulliparae n = 13	23.1	46.2	69.2	100	-
Multiparae n = 17	35.3	88.2	94.1	100	-
All n = 30	30	70	83	100	-

The induction-delivery time for patients who delivered vaginally is summarised in Table X. The mean induction-delivery time for the nulliparous group was 6.4 hours (S.D. ± 3.2 hrs) and for the multiparous group 4.0 hours (S.D. ± 2.2 hrs). The length of induced labour expressed as cumulative percentages is summarised in Table XI. 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, all the patients who delivered vaginally would have been delivered by 5 o'clock in the evening.

PATIENT CHARACTERISTICS

The patient characteristics for nulliparae and multiparae who had induction of labour are summarised in Tables XII & XIII.

Table XII

Patient characteristics and outcome in Nulliparae

n = 16	Mean	(S.D.)
Age (Years)	25.5	(7.3)
Gestation (Weeks)	39.8	(1.0)
Cervical score	6.0	(1.4)
No. of infusion	1.2	(0.4)
Mean Max Syntocinon Dosage (mU/min)	8.2	(4.7)
Mean Induction-Delivery Interval (h)	6.4%	(3.3)
Assisted Vaginal Delivery	6.3%	–
Caesarean Section	18.7%	–
Apgar 1 min	7.9	(0.6)
5 min	9.0	(0)
Birth Weight (g)	3003	(521)

Table XIII

Patient Characteristics and outcome in Multiparae

n = 17	Mean	(S.D.)
Age (Years)	28.0	(4.8)
Gestation (Weeks)	39.7	(2.7)
Cervical score	6.6	(1.6)
No. of infusion	1.2	(0.4)
Mean Max Syntocinon Dosage (mU/min)	6.1	(4.3)
Mean Induction-Delivery Interval (h)	4.0	(2.2)
Assisted Vaginal Delivery	5.9%	-
Caesarean Section	0%	-
Apgar 1 min	7.9	(0.5)
5 min	9.0	(0.2)
Birth Weight (g)	3107	(517)

DISCUSSION

The study of methods of induction of labour is aimed at maximising the vaginal delivery rate and at the same time minimising the duration of labour with minimal risks of foetal hypoxia and hyperstimulation leading to uterine rupture. 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. However it is well known that the sensitivity of the uterus varies considerably from patient to patient [3,4] 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 considered that an ideal regime for oxytocin administration would be to start with a low dose and increasing the amount at regular short intervals until effective uterine contractions were induced [5]. 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 was uterine hyperstimulation and an increased risk of foetal hypoxia. Although there are wide variations in foetal reserve, excessive uterine tone and frequency of contractions may lead to acidosis and foetal distress [6]. As many of the risks associated with the use of oxytocin are dose related [7-9], the minimum effective oxytocin dose is preferable.

Protocols for the induction and augmentation of labour which allowed for relatively high doses and short intervals of increase of oxytocin have been in use in the recent past [7-10]. Such protocols for induction and augmentation of labour which called for a starting dose of 2 to 6 mU/min and an increase every 15 to 20 minutes were based on in vitro pharmacologic studies of oxytocin and indirect methods of determining its half-life [7, 11 - 13].

Seitchik et al have commented that these methods promoted the misconception of short oxytocin half-life in the range of 3 to 4 minutes [11]. The time to reach steady state is generally accepted as approximately four half lives of the drug. The misconception of short oxytocin half-life, and therefore, shorter time to reach steady state, led to the recommendation to increase the infusion rate every 15 to 20 minutes. Also the recommendation of a geometric increase of oxytocin was an attempt to save time in reaching the effective dose. However, geometric increase in oxytocin reduces the safety margin, with a high potential of overdosing and has no pharmacologic basis.

In recent in vivo studies, which employed sensitive radioimmunoassay and computer simulations, it has been determined that the interval to reach a steady state concentration of oxytocin in plasma and maximal response is 40 to 60 minutes after initiating or altering the infusion [12, 14 - 16].

The in vivo half life of oxytocin is also longer than previously thought and is 10 to 15 minutes. These studies of plasma oxytocin levels during continuous intravenous infusion have also shown first order saturation kinetics, with a progressive, linear, stepwise increase with each increase in the infusion [17].

Based on these information, it can be concluded that the pharmacologic data now suggest that the infusion rate should increased arithmetically every 40 to 60 minutes. However, because of varied response range in individuals, this rate of increase is inefficient in a significant portion of patients [12, 16]. Seitchik and Castillo proposed, as a compromise, an increase in the infusion rate every 30 minutes with cautious observation for hyperstimulation [12].

The "end point" of oxytocin titration is optimal uterine activity. The use of uterine activity measurements has been recommended to guide oxytocin titration for the induction of labour [18]. However the studies of Arulkumaran et al [19] and Gibb et al [20] 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 an optimum 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.

Our study incorporates a low starting dose of 1mU/min with an arithmetic progression every 30 minutes for augmentation and induction of labour. The results have shown that this method is easy to use and is effective in achieving a high vaginal delivery rate. Its safety is attested

by the good neonatal outcome and minimal risk of uterine hypertonus.

For the purpose of induction or augmentation of labour the use of intravenous oxytocin is to bring about regular uterine contractions that will result in normal progressive labour. The duration of such labours should not be precipitate which may lead to uterine rupture or amniotic fluid embolism and disseminated intravascular coagulation. Nor should such stimulated labours be so prolonged as to increase the chance of intrauterine infection. It should result in a labour of normal duration for the parity of the patient and a spontaneous vertex delivery. Although there are individual variations of response to intravenous oxytocin administration, most patients will respond to an oxytocin rate of 1mU to 9mU per minute, the pharmacologic dose of Seitchik et al. (1984). Others may require between 10mU to 20mU per minute oxytocin infusion. Rarely would an infusion of 40mU per minute oxytocin or more be required. When the infusion rate of oxytocin is more than 20mU per minute, hypertonus and fluid retention may occur.

The American College of Obstretricians and Gynaecologists in 1987 recommended that intravenously administered oxytocin should start with a dose of 0.5mU/minute to 1mU/minute and then be increased by 1mU/min to 2mU/minute every 30 - 60 minutes until optimum contractions are obtained. It also agreed that oxytocin given by any other method than by a dilute intravenous solution is not advisable. In the case of a nullipara with slow response to oxytocin, an increment by 2mU/minute every 30 minutes may be given. However, in cases of multiparae and for augmentation of labour an increment of 1mU/minute every 30 minutes is more appropiate.

Intravenously administered oxytocin is a powerful drug. It has been of real value in the induction and augmentation of labour when indications are present. However, it can result in complications of asphyxia to the foetus and uterine rupture, amniotic fluid embolism and disseminated intravascular coagulation to the mother. A plea is therefore made for the more careful use of intravenous oxytocin. Genuine indications must be present and a low dose regime utilised as this is both effective and safer.

ACKNOWLEDGEMENTS

We wish to thank Dr Ng Yook Kim, Medical Director, Alexandra Hospital Singapore for his kind permission to publish our findings in this study. Grateful thanks are also due to the medical and nursing staff of the labour ward for their patience and attentive care of the patients during this study.

REFERENCES

1. Ho HK, Yeo SL, Vengadasalam D: Induction of Labour using a concentrated oxytocin infusion administered in geometric progression in a peristaltic infusion pump. Singapore Med J 1989; 30: 542-5.
2. Brindley BA, Sokol RJ: Induction and Augmentation of Labour: Basis and Methods for Current Practice. Obstet Gynecol Surv 1988; 43: 730-43.
3. Embrey MP: Effects of Intravenous Oxytocin on Uterine Contractility Part I - General Characters of Uterine Response. Dose : Response Relationships in Late Pregnancy. J Obstet Gynaecol Br Cwlth 1962; 69: 910-7.
4. Beazley JM, Banovic I, Feld MS: Maintenance of labour. Br Med J 1975; 2: 248-50.
5. Turnbull AC, Anderson ABM: Induction of Labour Part II: Intravenous Oxytocin Infusion. Part III: Results with Amniotomy & Oxytocin "Titration". J Obstet Gynaecol Br Cwlth 1968; 75: 24-41.
6. Liston WA, Campbell AJ: Dangers of oxytocin-induced labour to fetuses. Br Med J 1974; 3: 606-7.
7. Barber HRK, Graber EA, Orlando A: Augmented labor. Obstet Gynecol 1972; 39: 933-40.
8. Knutzen VK, Tanneberger U, Darvey DA: Complications and outcome of induced labour. S Afr Med J 1977; 52: 482-5.
9. Steer PJ, Carter MC, Choong K: A multicentre prospective randomized controlled trial of induction of labour with an automatic closed-loop feedback controlled oxytocin infusion system. Br J Obstet Gynaecol 1985; 92:1127-33.
10. Steer PJ, Carter MC, Beard RW: The effect of oxytocin infusion on uterine activity levels in slow labour. Br J Obstet Gynaecol 1985; 92: 1120-6.
11. Saameli K: An indirect method for the estimation of oxytocin blood concentration and half-life in pregnant women near term. Am J Obstet Gynecol 1963; 85: 186-92.
12. Seitchik J, Castillo M: Oxytocin augmentation of dysfunctional labor. Clinical Data. I. Am J Obstet Gynecol 1982; 144:899-905.
13. Seitchik J, Castillo M: Oxytocin augmentation of dysfunctional labor. III. Multiparous patients. Am J Obstet Gynecol 1983; 145: 777-80.
14. Seitchik J, Amico JA, Castillo M: Oxytocin augmentation of dysfunctional labor. V. An alternative oxytocin regimen. Am J Obstet Gynecol 1984; 150: 225-8.
15. Seitchik J, Amico J, Robinson AG: Oxytocin augmentation of dysfunctional labor. IV. Oxytocin pharmacokinetics. Am J Obstet Gynecol 1984; 150: 225-8.
16. Seitchik J, Castillo M: Oxytocin augmentation of dysfunctional labor. II. Uterine activity data. Am J Obstet Gynecol 1983; 145: 526-9.
17. Fuchs AR, Goeschen K, Husslein P: Oxytocin and the initiation of human parturition. III. Plasma concentrations of

oxytocin and 13, 14-dehydro-15-keto-prostaglandin F2-alpha in spontaneous and oxytocin-induced labor at terms. Am J Obstet Gynecol 1983; 147: 497-501.

18. Woolfson J, Steer PJ, Bashford CC, Randal NJ: The measurement of uterine activity in induced labour. Br J Obstet Gynaecol 1976; 83: 934-7.
19. Arulkumaran S, Ingermarsson I, Ratnam SS: Oxytocin Titration to achieve Preset Active Contraction Areas does not improve the Outcome of Induced Labour. Br J Obstet Gynaecol 1987; 94: 242-8.
20. Gibb DMF, Arulkumaran S, Ratnam SS: A comparative study of methods of oxytocin administration for the induction of labour. Br J Obstet Gynaecol 1985; 92: 688-92.