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Plasma oxytocin in human pregnancy and parturition

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1 Introduction

A role has been postulated for oxytocin in parturition since DALE's original observation on the uterotonic effect of neurohypophyseal extracts. Since the elucidation of the structure and the synthesis of oxytocin [23], a considerable amount of information has become available on the production sites and mechanisms of transport/release of this hormone [5]. In spite of these discoveries and the extensive clinical use of oxytocin [49] the function of this hormone in human labor is still controversial [46]. One of the reasons for this situation is that although much of the information on the role of oxytocin in labor has been obtained in animals [7], investigation of the possible involvement of the maternal or fetal pituitary in human labor is necessarily restricted to pathological material and indirect observations.

Originally, the assessment of levels of circulating oxytocin during human pregnancy and labor was based on bioassay. This method is relatively insensitive and attempts to improve sensitivity led to the development of a radioimmunoassay.

Recently, a number of authors have used radioimmunoassays to investigate the role of oxytocin in human pregnancy and labor, but the results are highly divergent. In their original study, CHARD et al. [6] were unable to detect oxytocin in maternal plasma during pregnancy and labor, and found measurable amounts in only 40% of the umbilical cord plasma samples. Subsequently, the same investigators [31] reported measurable levels of oxytocin during labor, with a maximum of positive values during delivery. Their results have been confirmed by others [12, 13, 14, 15, 30, 32, 35, 36, 44, 50] but with wide differences in absolute concentrations and trends during pregnancy and labor. The study of oxytocin in the circulation is hampered by the fact that this hormone is rapidly broken down by oxytocinase, and immediate cooling of samples is required to reduce enzymic activity [35].

It has been demonstrated that the plasma oxytocin concentration rises gradually during pregnancy and first-stage labor, the highest levels being observed during the second stage [13, 31], and LEAKE et al.

Curriculum vitae

KOENRAAD DE GEEST *was born in 1952 in Ghent, Belgium. He studied medicine in the same city and obtained his MD, cum laude, in 1977. From 1977 to 1982 he was a resident at the Department of Obstetrics and Gynecology of the same university and he became Belgian Board Certified Obstetrician and Gynecologist in 1982. Present position: Fellow, Department of Gynecologic Oncology, Milton S. Hershey Medical Center, Pennsylvania State University, U.S.A.*

[36] reported a marked increase in oxytocin coincident with delivery of the fetal head. The increased oxytocin levels during labor have been attributed to the stimulatory effect of a neurohumoral reflex: during normal delivery, stretching of the lower birth canal is thought to trigger a reflex leading to a rapid secretion/release of oxytocin by the pituitary, resulting in strong uterine contractions [27]. This effect, known as FERGUSON's reflex, was first described by FERGUSON [25] in the postpartum rabbit and cat, and its humoral component was elegantly demonstrated by DEBACKERE et al. [19] in cross-transfused ewes. In the human, VASICKA et al. [50] described oxytocin surges during vaginal examination, after rupture of the membranes, after maximal cervical dilatation, and after vaginal distention, and these surges disappeared after administration of local anesthesia. GOODFELLOW et al. [33] reported a significant rise of plasma oxytocin concentrations in peripheral plasma samples from normal primigravidas, occurring between full dilatation and crowning. Continuous lumbar epidural anesthesia (CLEA) led to a reduction of circulating oxytocin levels and increased the forceps delivery rate.

An additional and seemingly constant finding has been that at spontaneous vaginal delivery and emergency cesarean section, the concentrations of oxytocin in umbilical/arterial and venous plasma are much higher than the maternal plasma levels [8, 14, 18, 35, 36, 44, 50]. This may indicate that the fetal brain contributes to the initiation/maintenance of human labor, a suggestion already made by BELL and ROBSON [3].

In view of the continuing controversy, the role of oxytocin in human pregnancy and labor was re-examined with the use of a highly sensitive radioimmunoassay. Since individual oxytocinase activity varies greatly [30], we chose serial measurements of plasma oxytocin in individual patients as the basis for this study. Our findings on plasma oxytocin concentration during pregnancy, labor, and delivery are reported here.

2 Patients and methods

Serial maternal plasma samples were collected from an antecubital vein via an indwelling catheter with a heparin lock. Informed consent was obtained, and at each sampling 3 ml of blood was collected from the following groups of women.

Group 1 comprised 10 gravidas (6 nulliparas) between 8 and 42 weeks of amenorrhea. The pregnancies were uncomplicated, and all patients were delivered at term of a healthy singleton.

Group 2 included 10 women studied during spontaneous labor. Samples were collected during early labor (cervix dilated at 3 cm), at 5–7 cm dilatation, and as close to the time of delivery as possible. All women subsequently had a spontaneous vaginal delivery of a normal infant.

Group 3 comprised 5 normal primigravidas with CLEA (0.25% bupivacaine). Serial samples were collected as for group 2. Analgesia was adequate in all women, and autonomic block was confirmed with the perianal scratch test. All patients were in active spontaneous labor, and none required augmentation with oxytocin or prostaglandins (PG). The 5 subjects had a spontaneous vaginal delivery of a clinically and biochemically normal infant.

Group 4. From these 15 clinically normal patients, at term and not in labor, who were scheduled for elective induction of labor by low amniotomy (5 patients) or by the administration of a single extra-amniotic instillation of 0.5 mg PGE_2 in Tylose® gel, via a transcervically inserted Foley catheter [48], peripheral-blood samples were taken 3 min and 1 min before vaginal examination (5 patients), sweeping of the membranes (5 patients), and low amniotomy (5 patients); additional samples were collected during these procedures and 1, 3, and 5 min later.

Group 5. From these 17 normal gravidas (10 nulliparas), in spontaneous non-augmented labor, plasma samples were obtained 5 min before and 5 and 10 min after elective vibration of the cervix [20]. Low-frequency vibration is known to effectively dilate the uterine cervix [2] without causing deleterious effects perinatally [20]. Cervical pro-

gress was assessed by vaginal examination, and the effect of the procedure on uterine contractility was calculated from amniotic fluid pressure measurements as reported elsewere [51].

In addition to the maternal blood samples umbilical arterial and venous plasma samples were collected. In the patients belonging to groups 2 and 3, the umbilical vessels were punctured directly after immediate cord clamping and before the intravenous administration of 0.2 mg methyl ergometrine maleate. Umbilical plasma samples were also obtained in 5 cases at the time of elective abdominal delivery for a previous cesarean section (4 patients) or cephalopelvic disproportion (1 patient), and in all cases a maternal peripheral venous blood sample was taken simultaneously.
Blood samples (5 ml) were collected in ice-cold heparinized plastic tubes. Plasma was separated within 5 minutes by centrifugation at 1,500 g for 15 min, and stored at $-20\,^{\circ}C$ in 1- or 2-ml aliquots containing phenantroline (0.1 ml) to inhibit oxytocinase activity. Oxytocin was measured by a specific direct radioimmunoassay in diluted plasma. The assay has been fully described elsewhere [41]. The inter-assay coefficient of variation was 6% and the lower limit of detection 4 μU/ml. All samples were processed as a single run from one standard curve.
Statistical analysis of serial observations was carried out by the Friedman two-way analysis of variance. For paired-sample observations, Wilcoxon's signed rank test and the Kruskal-Wallis test were used. Where it is stated that no significant change was found, P was > 0.05.

3 Results

3.1 Plasma oxytocin in pregnancy (group 1)

Measurable concentrations of oxytocin were found in all maternal plasma samples during pregnancy. There were wide differences in values between patients throughout pregnancy (Tab. 1), some patients producing low and others high levels of oxytocin. Except in one case (no. 7), serial samples from individual patients revealed a pattern of gradual rise of oxytocin levels with advancing gestation (Fig. 1) and the increase in concentration was statistically significant ($P < 0.01$).

Tab. I. Maternal plasma concentrations of oxytocin (μU/ml) during pregnancy.

	Case no.	Weeks of gestation 8–12	20–24	30–34	38–42
Nulliparas (n = 6)	1	42	83	126	185
	2	54	32	234	174
	3	68	120	115	134
	4	32	157	134	202
	5	130	85	176	172
	6	27	102	94	134
Paras (n = 4)	7	70	79	54	33
	8	21	56	178	145
	9	15	22	63	87
	10	10	34	78	91
Total (n = 10)					
Mean		47	77	125	136
SEM		11	13	18	16
Lowest value		10	22	54	33
Highest value		130	157	234	202

3.2 Plasma oxytocin during labor and the effect of epidural anesthesia (groups 2 and 3)

There were no significant differences in oxytocin levels between groups 2 and 3 at any stage of labor (Tab. II). In both groups, there was no consistent change in levels with the progress of labor, and oxytocin levels at the onset of the second stage did not differ statistically from those at crowning. Comparison of cross-sectional data showed no significant difference between the mean oxytocin concentration in early labor and in late pregnancy. In some instances oxytocin surges occurred but not in a regular pattern.

3.3 Maternal plasma oxytocin and the Ferguson reflex (groups 4 and 5)

The oxytocin concentrations associated with vaginal examination, membrane sweeping, and

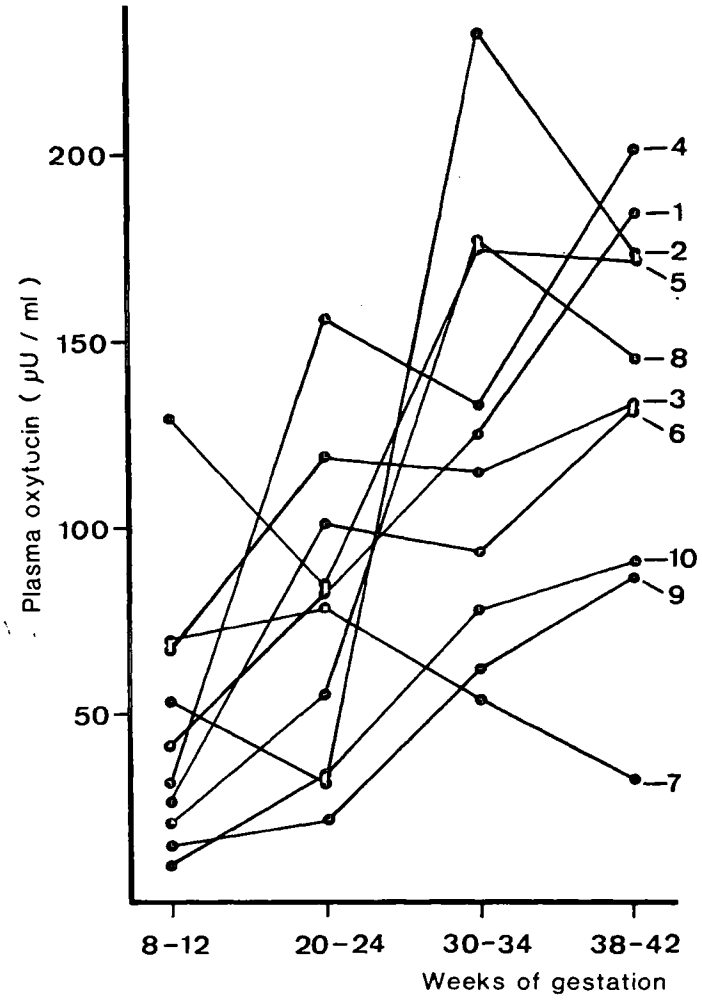

Fig. 1. Plasma oxytocin concentrations in individual serial samples during pregnancy (group 1).

Tab. II. Maternal plasma oxytocin concentration (μU/ml) during labor.

	Case no.	Cervical dilatation ≤ 3 cm	5–7 cm	10 cm	Second stage
Without CLEA (group 2)	1	118	210	178	134
	2	142	272	278	195
	3	95	110	115	150
	4	116	95	70	125
	5	185	179	160	147
	6	90	70	173	85
	7	141	113	125	153
	8	136	223	135	121
	9	379	152	129	131
	10	278	370	331	420
Total (n = 10)					
Mean		168	179	169	166
SEM		29	29	25	30
With CLEA (group 3)	11	104	121	113	119
	12	98	77	154	93
	13	212	278	254	263
	14	95	273	194	173
	15	63	134	176	224
Total (n = 5)					
Mean		114	177	178	174
SEM		25	42	23	31

amniotomy, are shown in Tab. III and those before and after cervical vibration in Tab. IV. The oxytocin concentrations in the two-minute samples showed marked fluctuations with occasional spurts, but there were obviously no significant oxytocin surges in relation to the specific procedures under investigation. Vibration effectively dilated the cervix in 10 patients, and this effect was only associated with a moderate and transient increase of uterine activity in two cases.

3.4 Fetal plasma oxytocin

The mean oxytocin concentrations in umbilical arterial and venous plasma and in peripheral maternal plasma collected after spontaneous vaginal delivery and at the time of elective cesarean section are shown in Fig. 2. There was a significant arterio-venous difference at spontaneous vaginal delivery ($P < 0.01$) the levels in arterial blood being consistently higher. In the CLEA group the umbilical arterial plasma concentration was higher than the plasma level from the umbilical vein, but the difference did not reach significance. At spontaneous vaginal delivery with and without CLEA, plasma oxytocin levels from the umbilical artery were significantly higher than the maternal levels ($P < 0.01$). There were no significant differences between umbilical arterial and venous plasma concentrations and maternal plasma levels at the time of elective cesarean section, although the concentrations from the umbilical artery were generally higher. The values at spontaneous vaginal delivery with and without CLEA, did not differ significantly. The umbilical plasma levels were significantly higher at spontaneous vaginal delivery than

Tab. III. Maternal plasma oxytocin concentration (μU/ml) in relation to vaginal examination, sweeping of the membranes, and low amniotomy.

Case no.	− 3 min	− 1 min	vaginal examination	+ 1 min	+ 3 min	+ 5 min
1	141	98	206	150	126	134
2	115	70	79	198	183	120
3	214	198	305	316	250	213
4	250	198	173	152	207	161
5	188	167	198	133	152	142
Total (n = 5)						
Mean	182	146	192	190	184	154
SEM	24	26	36	33	48	16
			sweeping of the membranes			
6	103	119	151	134	143	124
7	444	468	379	454	364	313
8	150	153	149	180	154	187
9	151	145	121	165	135	152
10	222	149	143	189	185	95
Total (n = 5)						
Mean	214	207	189	224	196	174
SEM	61	66	48	58	43	38
			low amniotomy			
11	234	207	236	223	234	172
12	50	57	55	26	20	16
13	410	251	361	421	379	340
14	60	39	61	66	69	74
15	459	379	401	438	416	393
Total (n = 5)						
Mean	243	187	223	235	224	199
SEM	85	63	73	86	80	73

Tab. IV. Maternal plasma oxytocin concentration (μU/ml) and cervical vibration.

Case no.	− 5 min	+ 5 min	+ 10 min
16	158	300	291
17	250	246	266
18	324	341	355
19	275	340	152
20	190	167	133
21	419	434	355
22	107	92	96
23	291	286	273
24	198	216	198
25	310	187	199
26	142	137	155
27	203	182	180
28	110	144	121
29	112	181	158
30	132	166	136
31	111	110	109
32	152	153	121
Total (n = 17)			
Mean	211	217	194
SEM	22	23	20

at elective cesarean section (artery: $P < 0.01$; vein: $P < 0.05$). The maternal plasma concentrations of oxytocin were higher at vaginal delivery compared with cesarean section, but the difference was not significant.

4 Discussion

The maternal plasma oxytocin concentrations rose steadily with advancing gestation and the oxytocin levels showed a fluctuating pattern. Furthermore, there was a wide scatter of individual values throughout pregnancy. Gradually rising levels of neurophysine, an oxytocin carrier protein, have been reported by LEGROS and FRANCHIMONT [37]. Using a radioimmunoassay, CHARD et al. [6] could not detect measurable amounts of oxytocin during pregnancy and LEAKE et al. [36] found that values throughout pregnancy did not differ

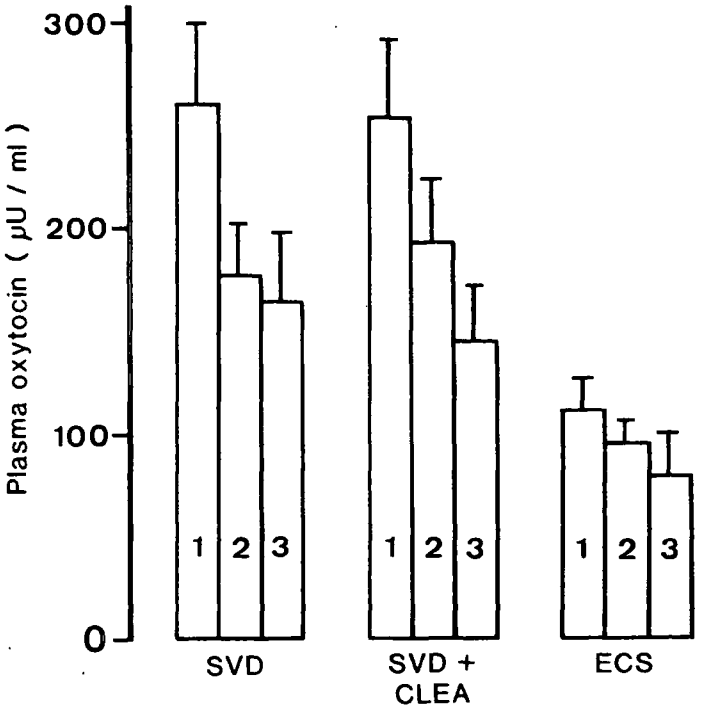

Fig. 2. Mean (± SEM) cord (1 = umbilical arterial blood; 2 = umbilical venous blood) and maternal (3 = maternal venous blood) plasma oxytocin at spontaneous vaginal delivery without (SVD) or with CLEA (SVD + CLEA) and at elective cesarean section (ECS).

significantly from those in non-pregnant women. However, most of the other authors reported a rising trend with gestation, either on the basis of cross-sectional data [30, 35, 44] or serial maternal plasma samples [15, 50]. Our values are consistent with those published by VASICKA et al. [50], but the oxytocin concentrations reported by DAWOOD et al. (1979a) [15] and SELLERS et al. [44] are lower than ours and those of KUMARESAN et al. [35] and GAZAREK et al. [30] much higher.

The discrepancies in the absolute values reported may be attributable to the use of different radioimmunoassay procedures. Differences in the sensitivity of the antibody, the use of different extraction techniques and acidification with normal hydrochloric acid to a pH of 1 or 2, and the performance of the radioimmunoassay in whole plasma with the addition of phenantroline and disodium ethylenediamine tetraacetate (EDTA) for the inhibition of oxytocinase, must all be taken into consideration. Furthermore, VASICKA et al. [50] reported considerable difference between the immunological potency of various commercial and research oxytocins in the absence of an international reference preparation of this hormone. Accuracy studies have shown that the assay we used is highly specific for oxytocin and that there is no interference of non-specific proteins or proteolytic destruction of tracer hormone due to the use of phenantroline or EDTA [41]. In addition to these methodological considerations, the disparity of the results may be partially explained by the pattern of oxytocin secretion itself. GIBBENS and CHARD [32] found an increasing number of plasma samples containing a detectable amount of oxytocin in the course of the first stage of labor, and they concluded that oxytocin is released from the pituitary in spurts. This implies that both the frequency and the timing of blood sampling are important in view of the very short half-life of oxytocin in the circulation. We observed brief fluctuations in plasma oxytocin levels and sometimes spurt release in term subjects (group 4) subjected to frequent sampling. DAWOOD et al. [13] demonstrated episodic release of oxytocin during pregnancy and labor: the spurts were variable and tended to have a greater amplitude during labor. These authors suggested that during pregnancy there is a basic or tonic release of oxytocin with superimposed rhythmic or episodic release, similar to the release of gonadotropins by the anterior pituitary gland. The physiological significance of spurt-release and short-term fluctuations is not known, and the oxytocin spurts bear no relationship to uterine activity [15, 16, 40, 50]. The pulse-like release of oxytocin during pregnancy and labor has been questioned and both continuous low-dose and titrated infusion of oxytocin have been reported to effectively induce labor at term, provided the myometrium is receptive [49]. According to electrophysiological investigations in pregnant and suckling rats, the tonic elevation of oxytocin dominates during labor, whereas during milk ejection a more spurt-like release is required [46].

In the present study we did not find a significant difference between oxytocin concentrations in late pregnancy and early labor, which is in agreement with the observations of SELLERS et al. [44]. However, because cross-sectional data were used for this comparision in both studies, rises in the concentration of maternal plasma oxytocin immedi-

ately before the onset of labor may have been missed. DAWOOD et al. [15] collected serial samples during the latter part of gestation and found no distinct increase. It seems unlikely that the onset of labor is triggered by a sudden increase of oxytocin secretion, as proposed by CALDEYRO-BARCIA and SERENO [4]. According to THEOBALD [47], the opposite is the case, i.e., labor begins not because the secretion of oxytocin increases but because the myometrium becomes increasingly sensitive to oxytocin. From observations in rats, SOLOFF et al. [45] suggested that myometrial oxytocin receptors may play an important role in uterine contraction. High concentrations of oxytocin receptors have been reported not only in the myometrium but also in the decidua at term [28, 29]. Prostaglandins derived from arachidonic acid and synthesized in the fetal membranes and the decidua play a key role in the process of myometrial stimulation, which may be facilitated by oxytocin of maternal origin [1]. Recently, FUCHS et al. [28, 29] demonstrated that oxytocin stimulates PGE and PGF production in vitro by the human decidua, amnion, and myometrium at term. They postulated that oxytocin of maternal and fetal origin initiates the chain of events leading to parturition by providing the signal for the accelerated production of PGs in the decidua and the fetal membranes. Sofar no convincing evidence has been presented to support the idea that maternal or fetal oxytocin triggers labor in the human.

No significant changes in the maternal plasma levels of oxytocin were observed at any stage of labor, although second-stage samples were collected as close to the time of crowning of the fetal head as possible. This absence of change suggests that circulatory endogenous oxytocin plays little if any part in the course of human labor and delivery. Our findings are in agreement with those of KUMARESAN et al. [35], GAZAREK et al. [30], and SELLERS et al. [44]. COCH et al. [9] described a marked rise in oxytocin activity in jugular-vein plasma but these authors expressed reservations as to the exact nature of the substance measured. DAWOOD et al. [12, 13, 14] reported increasing peripheral blood levels of oxytocin during labor, with a maximum being reached in the second stage, and LEAKE et al. [36] found significantly increased maternal oxytocin concentrations at delivery of the fetal head. GOODFELLOW et al. [33] found a significant increment in oxytocin between paired peripheral blood samples taken at full dilatation and at crowning. This increase was not observed in CLEA patients, and the authors postulated that the oxytocin deficiency associated with CLEA was the result of the blockade of a birth reflex of the type described by FERGUSON [25]. They also suggested that the high rate of forceps delivery in primigravid patients receiving CLEA might be partially explained by the absence of a significant rise of the maternal plasma oxytocin level during the second stage of labor, and are confident that they have proved that in most patients an intravenus infusion of oxytocin will overcome this effect. However, CLEA is not always associated with an increased incidence of vaginal operative deliveries [24], and when a higher incidence is observed, other factors such as relaxation of the pelvic musculature affecting internal rotation, lack of cooperation of the patient, and the attitude of the attendant must be taken into consideration as well [21]. Using a similar set-up, we were unable to confirm the observations of GOODFELLOW et al. [33]. Unlike these authors, we performed a vaginal examination at full dilatation before sampling, and this may have masked a subsequent increase of the oxytocin concentration at crowning, by provoking a spurious release of oxytocin [50]. However, plasma oxytocin concentrations in serial samples obtained from subjects at term, before the onset of labor, and collected at the same time as vaginal examination, sweeping of the membranes, or low amniotomy, were not statistically divergent. Cervical vibration during spontaneous labor increased dilatation in 10 out of 17 cases, but only two showed a concomittant increase in uterine contractility and no significant change of the plasma oxytocin concentration was observed. VASICKA et al. [50] described oxytocin surges during vaginal examination, after rupture of the membranes, after maximal cervical dilatation, and after vaginal distention. These surges were attenuated by pudendal, caudal, or paracervical block, and this was cited as evidence that the FERGUSON reflex exists in humans. Most of the

experiments in which this reflex was seen were performed in postpartum animals and under anesthesia, and the degree of vaginal stretching had to be enormous to elicit a moderate effect on the paraventricular neurosecretory cells [22]. Mechanical stretching of the cervix enhances uterine activity in several species, including man [26, 43], and according to SALA et al. [42] spinal anesthesia and CLEA effectively block this effect. However, there seems to be a discrepancy between the effects on the uterus and the mammary gland. Milk ejection during labor or after artificial cervical dilatation is extremely rare [10, 26, 43]. This could be due to a good sphincter function in the mammary gland and/or to a more tonic release of oxytocin during labor compared with the pulsatile release required for milk ejection [46]. Our observations raise doubts that the stimulatory effect of stretching the cervix or the vagina is mediated in man by a neurohumoral reflex, as suggested by FERGUSON [25]. Furthermore, the rising oxytocin levels described during the second stage of labor [33] or in relation to specific events [50] seems to represent relatively modest increases related to the oxytocin concentrations already present and lie within the range of variation seen in the plasma oxytocin levels before the onset of labor. This means that even if the FERGUSON reflex does occur in normal human deliveries, it is unlikely that it will lead to any appreciable extra stimulation of the uterus.

Oxytocin need not necessarily come from the mother; it can be fetal in origin [7, 14]. The higher concentrations we found in umbilical-artery plasma compared to umbilical-vein plasma and maternal peripheral blood, seem to suggest that the fetal neurohypophysis releases oxytocin. This fetal arterio-venous difference did not reach significance in the group delivered by cesarean section, but this may be due to the small number of cases. The lower oxytocin concentrations found at elective cesarean section vs. spontaneous labor and delivery indicates that fetal oxytocin release occurs mainly during labor, and DAWOOD et al. [17] have shown that the oxytocin concentration controlled by the human fetal pituitary increases with advancing gestation. The cause of oxytocin release by the fetus and its significance for the process of human labor are unknown. In sheep, the fetal hypothalamic pituitary axis plays a key role in the onset of labor by triggering the release of corticotropin [38], whereas fetal oxytocin probably does not contribute to the mechanism underlying ovine parturition. Injection of posterior-lobe hormones into human anencephalic fetuses has produced maternal uterine contractions [34].

Oxytocin can cross the primate placenta in both directions without degradation, according to DAWOOD et al. [16]. However, to reach the myometrial receptor sites the hormone has to be circulated in the maternal bloodstream, and this pathway is likely to lead to its inactivation [39]. Although it is conceivable that the fetus contributes to the oxytocin in the maternal circulation, it alone cannot be considered capable of accounting for the maternal plasma levels, in view of the larger maternal blood volume. The possibility remains that biologically active oxytocin of fetal origin in the amniotic fluid acts directly on the receptors in the myometrium [13].

From the present results it may be concluded that the fetus may be an important source of oxytocin and that in human parturition neurohumoral birth-reflexes like those described in animals do not occur regularly.

Summary

Oxytocin concentrations were determined in serial peripheral plasma samples collected from clinically normal women during pregnancy and labor.

Measurable concentrations of this hormone were detected in all maternal plasma samples during pregnancy, but there were wide differences in values between patients. Serial samples from individual patients revealed a pattern of gradual rise of oxytocin levels with advancing gestation and the increase in concentration was statistically significant. There were no significant differences in oxytocin levels at any stage of labor, with or without epidural analgesia. Oxytocin levels at the onset of the second stage did not differ statistically from those at crowning. Comparison of cross-sectional data showed no significant difference between the mean exytocin concentration in early labor and in late pregnancy. Oxytocin surges occurred, but not in a regular pattern. Plasma oxytocin concentration did not increase after pelvic examination, sweep-

ing of the membranes, low amniotomy or after cervical vibration. After spontaneous vaginal delivery, umbilical arterial plasma levels of oxytocin were consistently higher than plasma concentrations from the umbilical vein. The fetal arterio-venous difference was less pronounced at elective cesarean section. At spontaneous vaginal delivery, with and without epidural anesthesia, plasma levels from the umbilical artery were significantly higher than the maternal levels. After vaginal delivery, oxytocin levels in cord plasma were significantly higher than at elective abdominal delivery.
Some methodological aspects with regard to blood sampling and to plasma oxytocin radioimmunoassay procedures are discussed.
From the results presented it is concluded that the human fetus can be an important source of oxytocin and that neurohumoral birth reflexes described in animals do not occur systematically in man.

Keywords: Ferguson's reflex, fetal oxytocin, maternal oxytocin.

Zusammenfassung

Oxytocin-Plasmaspiegel in der Schwangerschaft und unter der Geburt
Serienmäßig wurde bei klinisch unauffälligen Frauen während der Schwangerschaft und unter der Geburt Blut entnommen, um die Oxytocinkonzentrationen im Plasma zu bestimmen.
In allen Proben waren während der Schwangerschaft meßbare Hormonspiegel vorhanden, deren Höhe bei den einzelnen Frauen jedoch erheblich variierte. Die individuellen Verläufe zeigten eine stetige Zunahme der Oxytocinkonzentrationen mit dem Fortschreiten der Schwangerschaft; der Anstieg war statistisch signifikant. Zwischen den einzelnen Geburtsphasen gab es hinsichtlich der Oxytocinspiegel keine statistisch signifikanten Unterschiede, unabhängig davon, ob die Geburt in Periduralanästhesie erfolgte oder nicht. Auch zwischen dem Beginn der zweiten Geburtsphase und der Austreibungsphase waren die Unterschiede nicht statistisch signifikant. Querschnittsuntersuchungen zeigten, daß sich die mittleren Oxytocinspiegel in der Spätschwangerschaft und zu Beginn der Geburt statistisch nicht unterschieden. Oxytocinspitzen traten auf, jedoch war kein einheitliches Muster erkennbar. Nach vaginaler Untersuchung, digitaler Blasendehnung, Blasensprengung oder Cervixberührung erfolgte kein Konzentrationsanstieg. Nach vaginalen Spontangeburten war der Oxytocin-Plasmaspiegel in der Nabelarterie stets höher als in der Nabelvene. Die fetale arterio-venöse Differenz war nach primär indizierten Sectiones nicht so stark ausgeprägt. Bei vaginalen Spontangeburten, ob mit oder ohne Periduralanästhesie, lag der Plasmaspiegel in der Nabelarterie signifikant über dem maternalen Spiegel. Nach vaginalen Entbindungen waren die Oxytocinkonzentrationen im Nabelblut höher als bei elektiven Sectiones.
Es werden außerdem einige methodologische Aspekte hinsichtlich der Technik der Blutentnahme und der radioimmunologischen Oxytocinbestimmung im Plasma diskutiert.
Wir schließen aus unseren Ergebnissen, daß der menschliche Fet eine wichtige Oxytocinquelle darstellen kann. Neurohumorale Reflexe unter der Geburt, wie sie bei Tieren beschrieben sind, müssen nicht systematisch auch beim Menschen vorkommen.

Schlüsselwörter: Ferguson-Reflex, fetales Oxytocin, maternales Oxytocin.

Résumé

L'ocytocine plasmatique pendant la grossesse et l'accouchement
L'évolution de la concentration de l'ocytocine pendant la grossesse et l'accouchement a été étudiée à l'aide de prélèvements sériés de plasma périphérique de femmes enceintes normales.
Au cours de la grossesse, une augmentation continue de l'ocytocine plasmatique a été observée chez la mère. Par contre, pendant le travail et l'accouchement, avec ou sans anesthésie péridurale, les taux d'ocytocine ne présentent pas de changement significatif. Au moment de la distension maximale du périnée, les concentrations d'ocytocine sont comparables à celles observées au début de la phase d'expulsion. Il n'y a pas d'augmentation systématique de l'ocytocine plasmatique après toucher vaginal, décollement du pôle inférieur de l'œuf ni après vibration du col utérin. Après l'accouchement spontané les taux d'ocytocine sont plus élevés dans l'artère ombilicale que dans la veine ombilicale. Cette différence est néanmoins nettement moins accusée après césarienne élective. Au moment de l'accouchement spontané, avec ou sans anesthésie épidurale, la concentration de l'ocytocine plasmatique dans l'artère ombilicale est nettement plus élevée que le taux trouvé dans le plasma maternel. Après l'accouchement vaginal, les taux d'ocytocine dans le plasma ombilical sont significativement plus élevés que suite à une césarienne.
Quelques réflexions méthodologiques sont présentées.
En conclusion, il semble que le fœtus peut être une source importante d'ocytocine et que les réflexes neurohormonaux (réflexe de Ferguson) décrits chez certains animaux n'interviennent pas régulièrement dans la parturition humaine.

Mots-clés: Ocytocine fétale, ocytocine maternelle, réflexe de Ferguson.

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