Original Article

Term pregnancy with umbilical cord prolapse

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Abstract

Objective: To investigate the incidence, management, and perinatal and long-term outcomes of term pregnancies with umbilical cord prolapse (UCP) at Mackay Memorial Hospital, Taipei, from 1998 to 2007.
Materials and Methods: For this retrospective study, we reviewed the charts, searched a computerized birth database, and contacted the families by telephone to acquire additional follow-up information.
Results: A total of 40 cases of UCP were identified among 40,827 term deliveries, an incidence of 0.1%. Twenty-six cases (65%) were delivered by emergency cesarean section (CS). Of the neonates, 18 had an Apgar score of <7 at 1 minute, 10 of these scores being sustained at 5 minutes after birth, and three infants finally died. Eleven UCPs occurred at the vaginal delivery of a second twin, and nine with malpresentation. All of the infants who had good perinatal outcomes also had good long-term outcomes. Poor perinatal outcomes occurred in cases where there was a delayed diagnosis, or an inability to carry out an emergency CS or a prompt vaginal delivery.
Conclusion: Early detection of UCP and expeditious delivery are crucial to good perinatal outcomes. An emergency CS remains the mainstream management. Multiparous women whose cervixes are nearly fully dilated and who are expecting babies relatively smaller than their elder brothers or sisters born vaginally may still have vaginal deliveries managed by well-experienced birth teams, with good perinatal outcomes. Otherwise, vaginal delivery is not recommended and CS is the wiser choice.
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Keyword: umbilical cord prolapse

Introduction

Umbilical cord prolapse (UCP) is a rare obstetric emergency that threatens the life and wellbeing of the fetus. Its incidence ranges from 0.1% to 0.6% in the literature [1−9]. In recent decades, however, this incidence has decreased and perinatal outcomes have improved due to the more liberal use of cesarean section (CS) and better neonatal resuscitation with successive care [5−9]. To our knowledge, there is a higher chance of UCP when the pregnant woman is multiparous, the fetus is small, the fetus presentation is faulty, the fetus is male, the fetus is a second-born twin, or the baby is delivered prematurely [4−7, 9]. In fact, most cases of UCP occur in term pregnancies with fetuses of normal birth body weight and a vertex presentation [5−7].

UCP still carries a high perinatal mortality and morbidity [1,2,4,6−9], due to either a mechanical occlusion resulting from prolonged compression of the umbilical cord under the fetal presenting part, or an umbilical cord vasospasm triggered by the comparatively cooler temperature in the vagina. Both may lead to perinatal hypoxic encephalopathy or death. Consequently, UCP has the potential to become a medicolegal issue, especially when a low-risk pregnant woman with a term

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pregnancy suddenly experiences an unfavorable labor course with UCP and delivers a severely damaged newborn.

Additionally, we are very interested in the long-term outcome of newborns after UCP. Only two studies [10,11] have mentioned this topic. The first reported on cases of preterm premature rupture of membranes with UCP and the second on only four infants who had suffered UCP after term pregnancies. Important data on living neonates who had UCP are still conspicuously lacking based on our literature review. Because a controlled, prospective study of UCP would be not only impossible but also unethical, we decided to conduct a retrospective study. In order to develop a better strategy for managing UCP in the future, we analyzed risk factors and clinical management approaches, along with the perinatal and long-term outcomes of fetuses who had had UCP but whose mothers had previously been low-risk pregnant women.

Materials and methods

Included in this study were term pregnant women who delivered at Mackay Memorial Hospital, Taipei, Taiwan, from January 1998 to December 2007, whose newborns experienced UCP after the mothers had been admitted to hospital. UCP was diagnosed if there was descent of a segment of umbilical cord through the cervix into the vagina or onto the vulva during the first or second stage of labor. Cases of occult cord prolapse or cord presentation were excluded.

The clinical characteristics, management, and perinatal outcomes were collected by retrospective chart reviews combined with computerized birth database searches, as well as telephone contacts postneonatal period follow-up. The data collected were analyzed using descriptive statistics, Student t test, Chi-square, or Fisher's exact test using the statistical software Statistica, release edition 7.0. Differences were considered significant at $p < 0.05$.

Results

A total of 40 cases of UCP were identified from 40,827 term deliveries over the study period of 10 years, registering an incidence of 0.1%. The mean maternal age was 30.3 ± 5.2 (21–40) years old, and the mean gestational age was 38.1 ± 0.8 (37–40) weeks. Twenty-six (65%) of the 40 women delivering with UCP were multiparous. Eleven (27.5%) had twin pregnancies with the UCP happening at vaginal delivery (VD) of the second twin. Nine of the UCPs occurred with malpresentation. Although malpresentation of the fetus predisposes to UCP, most cases (65%) of UCP actually occurred in women with a normal vertex presentation fetus. Twenty-eight (70%) newborns were male, and 26 cases (65%) were delivered by emergency CS.

Eighteen (45%) neonates had Apgar scores < 7 at 1 minute, 10 of these being sustained at 5 minutes after birth, and three finally died, giving a perinatal mortality rate of 75/1,000, which was much higher than the average of 15.8/1,000 seen in the population serving as a control over the same study period ($p < 0.01$). The admission rate to the newborn intensive care

unit (NICU) for patients suffering from UCP was also higher than the average (35% vs. 5.2%; $p < 0.01$). In summary, the cases with UCP tended to be characterized by a multiparous mother, a multifetal pregnancy, malpresentation, a male fetus, CS delivery, or low Apgar scores, along with higher NICU admission and perinatal mortality rates (Table 1).

Twenty-six babies (65%) were delivered by emergency CS, the other 14 cases having VDs with or without the assistance of vacuum aspirators, forceps, and fundal pressure. CS remains the main mode of delivery for patients with UCP because it may have the potential benefit of decreasing the number of newborns with low Apgar scores at 1 and 5 minutes, as well as lowering NICU admission and perinatal mortality and morbidity rates [5–8]. In our study, however, all of the indicators of perinatal outcome, including low Apgar score at 1 minute (38.5% vs. 57.1%) and 5 minutes (15.4% vs. 42.9%), NICU admission rate (30.8% vs. 42.9%), neonatal admission days (6.9 ± 4.9 vs. 5.0 ± 1.3), long-term neurological sequelae (3.8% vs. 0%), and perinatal mortality (38.5/1,000 vs. 142.9/1,000) were not statistically different between the CS and VD groups. One surviving newborn suffered from a neonatal seizure, and had hypotension during the first 23 days of admission, with long-term sequelae of epilepsy, severe spasticity in all four limbs, impaired vision and hearing, and the development of retardation requiring rehabilitation.

One neonatal death occurred in the CS group, a case of twin pregnancy originally planned as a VD. However, the fetal position of the second twin changed suddenly after delivery of the first twin and was combined with spontaneous amniochorion membrane rupture and UCP. Manual internal rotation was tried for nearly 10 minutes, with intermittent severe

Table 1
Clinical characteristics and perinatal outcomes of pregnant women delivering at term with and without umbilical cord prolapse (UCP).

	Cases with UCP ($n = 40$)	Cases without UCP ($n = 40,787$)	p
Maternal age (y)	30.3 ± 5.2	29.8 ± 4.9	0.83
Gestational age (weeks)	38.1 ± 0.8	38.3 ± 0.9	0.92
Parity	1.8 ± 0.8	1.5 ± 0.9	0.75
Multiparity (%)	65	43.3	0.056
Multifetal pregnancy (%)	27.5	4.8	<0.001
Fetal presentation at delivery			
Vertex (%)	65	96.4	<0.001
Breech (%)	27.5	3.5	<0.001
Transverse (%)	7.5	0.1	<0.001
Male newborn (%)	70	52.8	0.029
Percentage of cesarean sections (%)	65	30.3	<0.001
Vacuum or forceps-assisted vaginal delivery (%)	25	20.8	0.51
Newborn birth body weight (g)	2927 ± 393	3112 ± 446	0.68
Apgar score < 7 at 1 minute (%)	45	4.6	<0.001
Apgar score < 7 at 5 minutes (%)	25	3.4	<0.001
Neonatal intensive care unit admission rate (%)	35	5.2	<0.001
Perinatal mortality rate (%)	75/1,000	15.8/1,000	<0.001

variable decelerations, in this woman who had a history of two successful VDs, but to the infant could not be delivered vaginally. An emergency CS was performed and the baby was delivered 28 minutes later after a diagnosis of UCP with Apgar scores of 2 and 5 at 1 minute and 5 minutes, respectively. Unfortunately, the newborn died 5 days later.

Another two newborns died in the VD group. One suffered sudden intrauterine fetal demise (IUFD) during labor after a diagnosis of UCP for only 5 minutes, but this was preceded by a critical period of 30 minutes of fetal bradycardia when the heart rate dropped to 60 beats per minute. An emergency CS was initially arranged but was abandoned for a VD due to IUFD. Another newborn died after an attempted VD following a diagnosis of UCP for 9 minutes with severe fetal distress and low Apgar scores (Table 2).

The severity and duration of ongoing fetal distress before, during, and after the identification of UCP play a major role in results for neonates with low Apgar scores (< 7) at 5 minutes and are partly related to poor perinatal outcomes [12]. Although several other factors may account for a low Apgar score, it remains one of the most commonly used indicators in our hospital, since it is easily performed given quick access to the newborns and the fact that it is much more convenient for clinicians than measuring an umbilical cord blood pH. We defined severe fetal distress as cases with any recurrent abnormal fetal heart beat decelerations, including prolonged decelerations, moderate-to-severe variable decelerations, late decelerations combined with absent or minimal variability, or bradycardia with a reduction in baseline fetal heart rate to less than 70 beats per minute [13].

In our study, six (60%) of the 10 neonates with low Apgar scores at 5 minutes had shown severe fetal distress before the diagnosis of UCP, and eight (80%) had coincident severe fetal distress when UCP occurred. In contrast, only two (6.7%) and eight (26.7%) neonates with higher Apgar scores at 5 minutes had antecedent or coincident severe fetal distress respectively (both $p < 0.01$). Compared with the cases with higher Apgar scores at 5 minutes, the newborns with low Apgar scores at 5 minutes tended to receive a relatively higher percentage of intrauterine resuscitation (80% vs. 63.3%; $p = 0.33$), including intravenous fluids and oxygen when in the left decubitus position, along with shorter diagnosis to delivery intervals (DDIs; 19.0 ± 9.6 minutes vs. 26.4 ± 25.2 minutes; $p = 0.54$).

However, neither reached statistical significance. Furthermore, 10 (35.7%) of the 28 male neonates had low Apgar scores at 5 minutes compared with none (0%) of the 12 female neonates ($p = 0.02$) (Table 3).

Considering the factors relating to neonates with UCP and low Apgar scores at 5 minutes, the strongest indicator of such a poor condition in the CS group was the presence of antecedent or coincident severe fetal distress. The second most important indicator was whether immediate decompression procedures (IDPs) were adopted when severe fetal distress occurred. IDPs, such as digital elevation of the baby's head [14] or rapid infusion of 500 mL or more of fluid into the mother's bladder [15], in order to elevate the fetal presenting part and relieve the compression due to the UCP, might improve neonatal outcome while the mother is prepared for or awaits a CS. Among the four babies with severe fetal distress who had low Apgar scores, only two (50%) received IDP. In contrast, all (100%) of the five cases with severe fetal distress and higher Apgar scores had received IDP ($p = 0.17$). The mean DDI for CS was 23.8 ± 10.9 minutes in the low Apgar score group and 25.6 ± 12.1 minutes in the high Apgar score group ($p = 0.92$). Only two babies had a DDI of 30 minutes or more. Neither of these had severe fetal distress and both had a good perinatal outcome.

In the VD group, however, the presence of severe fetal distress did not produce a difference. The six patients with VD and low Apgar scores had longer DDIs than the other eight infants with VD and higher Apgar scores (16.8 ± 7.9 minutes vs. 5.2 ± 3.3 minutes; $p < 0.01$). Five (83.3%) of the six severely affected fetuses had a DD ≥ 10 minutes, while none (0%) of the eight cases with a good neonatal outcome had a DDI ≥ 10 minutes ($p < 0.01$). All eight successful VDs occurred in multiparous women with cervixes that were at least nearly fully dilated. The other two multiparous women gave birth to newborns with low Apgar scores at 5 minutes who were relatively larger than their elder brothers (Table 4).

Thirty-four (91.9%) of the 37 surviving neonates were followed up within a mean of 31.3 ± 21.2 months and a range of 6−84 months for an evaluation of their development outcome. Only two (5.9%) of the 34 traceable neonates were underdeveloped, one showing mild mental retardation and the

Table 2
The relationship of perinatal outcomes and delivery methods in patients with umbilical cord prolapse (UCP).

	Cesarean section ($n = 26$)	Vaginal delivery ($n = 14$)	p
Apgar scores < 7 at 1 minute, n (%)	10 (38.5)	8 (57.1)	0.26
Apgar scores < 7 at 5 minutes, n (%)	4 (15.4)	6 (42.9)	0.056
Neonatal intensive care unit admission rate, n (%)	8 (30.8%)	6 (42.9)	0.45
Neonatal admission (d)	6.9 ± 4.9	5.0 ± 1.3	0.36
Long-term neurological sequelae, n (%)	1 (3.8)	0 (0%)	0.46
Perinatal mortality, n (proportion)	1 (38.5/1000)	2 (142.9/1000)	0.23

Table 3
Clinical characteristics related to low Apgar scores (<7) at 5 minutes in patients with umbilical cord prolapse (UCP).

	Apgar scores < 7 at 5 minutes ($n = 10$)	Apgar scores ≥ 7 at 5 minutes ($n = 30$)	p
Antecedent severe fetal distress, n (%)	6 (60%)	2 (6.7%)	<0.01
Coincident severe fetal distress, n (%)	8 (80%)	8 (26.7%)	<0.01
Initial intrauterine resuscitation, n (%)	8 (80%)	19 (63.3%)	0.33
Diagnosis to delivery interval (min)	19.0 ± 9.6	26.4 ± 25.2	0.54
Newborn gender ratio (male:female)	10:0	18:12	0.02

Table 4
The clinical characteristics of low Apgar score neonates with umbilical cord prolapse (UCP) having a cesarean (CS) or vaginal delivery (VD).

	Apgar score < 7 at 5 minutes	Apgar score ≥ 7 at 5 minutes	p
CS group, n	4	22	
Antecedent severe fetal distress, n (%)	3 (75)	1 (4.5)	<0.01
Coincident severe fetal distress, n (%)	4 (100)	5 (22.7)	<0.01
IDP when severe fetal distress, proportion (%)	2/4 (50)	5/5 (100)	0.17
DDI (min)	23.8 ± 10.9	25.6 ± 12.1	0.92
DDI ≥ 30 min, n (%)	0 (0%)	2 (9.1%)	0.71
VD group, n	6	8	
Antecedent severe fetal distress, n (%)	2 (33.3)	1 (12.5)	0.38
Coincident severe fetal distress, n (%)	4 (66.7)	3 (37.5)	0.29
DDI (min)	16.8 ± 7.9 (9−30)	5.2 ± 3.3 (1−10)	<0.01
DDI ≥ 10 min, n (%)	5 (83.3)	0 (0)	<0.01
Multiparity with at least a nearly fully dilated cervix, n (%)	2 (33.3)	8 (100)	0.01

DDI = diagnosis to delivery interval; IDP = immediate decompression procedure.

other having long-term sequelae of epilepsy, severe spasticity in all four limbs, impaired vision and hearing, and the development of retardation requiring rehabilitation. The long-term outcome for these neonates should not have been different from that of the normal population, who also have a fair chance of insults to their neurological systems.

Discussion

There were three perinatal deaths and one surviving newborn living with severe neurological sequelae. Tracing their histories, the infant with sudden IUFD during labor was identified as having had UCP for only 5 minutes, but there was a preceding critical period of 30 minutes of fetal bradycardia when the heart rate fell to 60 beats per minute, which had not been noticed by the nursing staff or resident doctor on a very busy night. This delayed diagnosis was the major reason for such a sad loss of life, one potentially open to medicolegal claims. If we enhanced the education of delivering women and their accompanying families about the importance to keep alert to the alarm sound of the fetal monitor and to notify the on-duty staff should it occur, or reinforced the scheduled timing of the on-duty staff's rounds, we might be able to decrease the chances of such a tragic outcome.

The other two deaths were postnatal. The first was a CS following a failed VD, with manual internal rotation for nearly 10 minutes after the delivery of the first twin; the second was a VD with a DDI of only 9 minutes. Both showed severe fetal distress during the attempted VD and both finally suffered from low Apgar scores. Although a short DDI can mitigate risk, cases have been reported [16,17] in which the fetus was delivered promptly within 15 minutes but still experienced hypoxemic encephalopathy. Thus, there must be factors other than DDI that influence neonatal outcome. The obstetrician must be aware that, in an attempted VD, UCP may result in the complete occlusion of the fetal circulation and the occurrence of hypoxemic encephalopathy within a relatively short time period, compared with cases with only partial or no occlusion that proceed to CS.

Another woman who showed decreased heart beat variability and one severe variable deceleration of the fetal heart beat during labor progressed to having recurrent prolonged decelerations and absent variability within 2 hours. The membranes were ruptured and severe meconium-stained amniotic fluid with UCP was immediately noted. An emergency CS was performed, and the newborn was delivered with a DDI of 27 minutes. Although the baby's head was elevated to decrease compression of the umbilical cord, and both prenatal and neonatal resuscitation were applied, the newborn had very low Apgar scores of 0 at 1 minute and 1 at 5 minutes, along with long-term severe neurological sequelae.

Umbilical cord presentation should be kept in mind especially in delivering women having recurrent variable or prolonged decelerations. Otherwise, UCP would occur immediately after rupture of the membranes. Although more than half of the umbilical cord presentations occurring before labor will not usually lead to UCP [18], the obstetrician should be very cautious if a potentially problematical cord presentation is noted during labor. More importantly, timely and effective management of severe fetal distress occurring with or before the identification of UCP may be the only way to avoid an adverse outcome.

In our study, most babies (60%) of UCP with low Apgar scores had severe fetal distress diagnosed by abnormal fetal heart beat tracing before delivery, with three of them finally dying and one living with severe neurological sequelae. Thus, we considered antecedent severe fetal distress to be an important prognostic factor. However, Koonings et al [19] reported that 66% of their cases of UCP had variable decelerations, and 34% of their cases of UCP showed prolonged deceleration, yet there were no fetal deaths in their study. We believe that the degree and duration of fetal distress caused the differences between these two studies, although the degree to which the cord was occluded simply cannot be estimated from the fetal monitor alone. Nizard et al [10] said that those fetuses with a normal fetal heart tracing at the time of the UCP diagnosis had a low incidence of adverse neonatal outcomes.

Although a high percentage of the newborns that suffered from UCP and had low Apgar scores at 5 minutes required intrauterine resuscitation, this does not mean that intrauterine resuscitation is harmful. We believe that the fetuses who received intrauterine resuscitation had more situations of

severe fetal distress. The procedures of intrauterine resuscitation, including intravenous fluid and oxygen supplied in the left decubitus position, function only as the initial management of fetal hypoxia, but do not work well when there is severe fetal distress resulting from nearly complete occlusion of fetal circulation due to UCP. These procedures may play some role in mild fetal distress resulting from partial umbilical cord occlusion. Thus, although intrauterine resuscitation was used more often in UCP patients with severe fetal distress, they did not significantly improve the neonatal outcomes. The truly effective rescue procedure is to immediately relieve the UCP compression and then deliver promptly delivery by either CS or VD.

The mean DDI was 24.6 ± 11.9 minutes in the CS group and 8.5 ± 6.4 minutes in the VD group ($p = 0.01$), except for the one case of sudden IUFD during labor, for which the DDI was 212 minutes. Only two (7.7%) women undergoing CS had a DDI exceeding 30 minutes, and both had good neonatal outcomes. Thus, we believe that the DDI does not have a great impact on perinatal outcomes in CS cases unless there is severe fetal distress that is not effectively relieved through intrauterine resuscitation and IDP for UCP. Therefore, the so-called "30-minute rule" [20] of DDI should not be used as the only criterion for judging whether or not medical service has been adequately provided. In fact, approximately one-third of medical institutions in the United States and United Kingdom could not provide an emergency CS within 30 minutes, and a DDI within 30 minutes also could not guarantee good perinatal outcomes [21,22]. However, in our study, the DDI in the VD group did play a major role in determining perinatal outcome. Murphy and Mackenzie [2] also reported that as DDI increases, so does risk for neonatal morbidity and mortality. Although most of the VD cases (90.9%) in our study delivering within 10 minutes had good outcomes, there was still one perinatal death that occurred with a DDI at 9 minutes.

Not unusually, some overly self-confident obstetricians often underestimate the time required to complete the VD of a fetus with UCP, which may result in an adverse perinatal outcome and a potential medicolegal issue. The mean DDI of the VD cases with low Apgar scores was much longer than that of the cases with higher a Apgar score (16.8 ± 7.9, range 9−30 minutes vs. 5.2 ± 3.3, range 1−10 minutes; $p < 0.01$). In order to avoid tragic complications, we concluded from our data that multiparous women whose cervix is nearly fully dilated and who are expecting babies relatively smaller than their elder brothers or sisters born vaginally may still have vaginal deliveries by well-experienced birth teams and yield good perinatal outcomes. Otherwise, VD is not recommended and CS is a wiser choice.

The study by Enakpene et al [8] also supports our point of view, describing two cases (5.6%) of fetal demise out of 36 cases undergoing CS, two (22.2%) fetal demises out of nine cases with forceps or vacuum extraction delivery, 10 (83.3%) fetal deaths out of 12 cases undergoing spontaneous delivery, and four instances (57.1%) of fetal demise out of seven cases having assisted breech vaginal delivery. However, the very high mortality rate in this study from Nigeria reported that 75.8% of the dead fetuses were born to mothers who had never had a prenatal examination, and it also took premature babies into account.

As far as we know, this is the largest and longest long-term follow-up study of patients with term pregnancy with UCP. If no immediate severe insult to the neurological system occurs, a good long-term outcome can be predicted with some confidence. This report could be used as a believable reference to alleviate emotional responses when explaining to anxious families the outcomes for neonates suffering from UCP. In this way, some unnecessary medicolegal problems could also potentially be averted.

We believe that this retrospective study provides useful information to clinicians and forces them to pay greater attention to UCP, a very high-risk condition that may result in perinatal death and long-term sequelae, most of which could be avoided if adequately managed. Although the incidence and perinatal morbidity and mortality of UCP have sharply declined in modern obstetric practice, poor perinatal outcomes still occur in cases where there is a delayed diagnosis, or an inability to carry out an emergency CS or a prompt VD, combined with inadequate prenatal management after UCP has been identified.

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