CLINICAL EXPERIENCE WITH THE SILC CUP VACUUM EXTRACTOR

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ABSTRACT

The relative merits of vacuum extraction have been extensively studied and its advantages analysed. These include its ease of application, encouragement of "autorotation" of the malpositioned foetal head and its safety for both foetus and especially the mother.

One hundred and eighty-six vacuum extraction assisted deliveries were performed at the Department of Gynaecological Oncology & Urology, Kandang Kerbau Hospital, from 1988 to 1990 using the 50 mm Silicone Silc Cup Vacuum Extractor (Menox AB).

Anaesthetic requirements were minimal with 97% of cases accomplished with local perineal anaesthesia. Maternal complications were very few and only 1.6% of cases had third degree lacerations. There was no maternal or foetal mortality. The most frequent foetal morbidity was neonatal jaundice (28%) with only 7% requiring phototherapy. Cephalohaematoma was found in 8% and 2% had minor scalp abrasions. There were 3 infants with subaponeurotic haematoma who subsequently recovered uneventfully. Vacuum deliveries that were attempted but completed by forceps deliveries ("failed" vacuum extraction) accounted for 10% of total cases.

The Silc cup vacuum extractor although not a replacement for all forceps manoeuvres offers a safe and efficient method of assisted delivery under the appropriate clinical circumstances.

Keywords: *Silc cup, vacuum extraction, assisted delivery, subaponeurotic haematoma*

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INTRODUCTION

Every year millions of women worldwide require instrumental delivery. Whether the vacuum extractor or forceps is used clearly depends on the suitability of the instrument for each case. For example, the forceps is the instrument of choice in assisting delivery of the aftercoming head in an assisted breech delivery while the vacuum extractor is invaluable in assisting the birth of the second twin.

However, in the vast majority of instrumental deliveries, the choice of instrument largely rests on the preferences of the attending obstetrician. Although the safety and efficiency of vacuum extraction for mother and neonate have been established, its use has gained popularity only in Europe. In the United Kingdom, Australia and the United States, the obstetric forceps is still largely the instrument of choice for assisted vaginal delivery. This may be due to the obstetricians' lack of familiarity with the vacuum extractor.

The relative merits of the vacuum extractor have been extensively studied and its advantages analysed. These include its ease of application, encouragement of "autorotation" of the malpositioned foetal head and its safety for both foetus and especially the mother. Therefore, a wider acceptance and usage of the vacuum extractor might result in better outcomes in the millions of instrumental deliveries performed each year.

The principle of applying traction using a vacuum suction device to the presenting part of the foetus was first suggested by the surgeon James Yonge in 1694. He recorded a case of prolonged labour where "a cupping glass fixed to the scalp with an air pump failed to draw out the head"[1]. The next reference to the principle came from Saemann of Jena (1794) whose brief paper described a dream in which he saw "an air pump wherewith one can seize the head of an infant without injury to mother or child ... This is a dream which might come true". There is no evidence that the dream in fact did come true till the time of James Young Simpson (1849) in Edinburgh. His first cup was fitted with a piston and consisted of a trumpet-shaped concave disc, covered with leather at its broader end. Simpson modified this design in 1855 and he stated that a tractor like this was safer than forceps which took up a certain amount of space between the head and the birth canal - a feature leading to greater maternal trauma. Through the years, modifications continued on the instrument by Stillman (1875), McCahey (1880), Kuntzsch (1912), Gladish (1933), Cornu (1934), Torpin (1938), Couzigou (1947) and Korber (1950) amongst others, with regard to various aspects of its design, such as the shape of the suction cup, its handle and the pump. In 1953, Malmstrom of Sweden presented his vacuum extractor, the VE/53. The shape and diameter of this model subsequently underwent further modifications till his model VE/65 was developed, allowing easier introduction into the vagina. In 1973, Kobayashi introduced a silicone rubber cup of 65 mm in diameter and had a stainless steel valve[2]. A recent modification of the Kobayashi cup is the Silc cup which is entirely fashioned from silicone rubber and has no valve.

This study will review the experience of Silc cup vacuum extractions in a clinical setting of a large maternity hospital over a three-year period. Indications for intervention, foetal outcome, maternal and foetal morbidity were reviewed with particular attention being given to the efficiency and safety of the Silc cup vacuum extractor.

MATERIALS & METHODS

One hundred and eighty-six Silc cup vacuum extraction assisted deliveries were performed at the Department of Gynaecological Oncology and Urology of the Kandang Kerbau Hospital during the 3-year period from January 1988 to December 1990. Nineteen obstetricians participated in the 186 vacuum deliveries with 84% of these deliveries being performed by 9 of the 19 obstetricians. All the vacuum deliveries reported

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here were accomplished using the 50 mm silicone Silc cup vacuum extractor (Menox AB). Negative pressures were obtained by means of an electric vacuum pump (Ameda) operated by the obstetrician with a foot pedal control or with a hand control by a nurse assistant. Maternal and neonatal records were reviewed individually, and all Silc cup extractions occurring during the 3-year study period were included in the present review.

Electronic foetal monitoring during labour is the standard of obstetric care at the author's institution, with more than 99% of all the patients receiving this level of care. The author's department provides care for both high and low risk obstetric patients, private patients averaging 70% of all 5,000 annual deliveries in the department. The remaining 30% are subsidised clinic patients whose prenatal care, labour and delivery are managed by trainees under the direct supervision of an attending obstetrician. Of the 186 vacuum deliveries, all the patients were monitored for foetal heart rate and uterine contractions with an external pressure transducer. The proportion of private to subsidised patients involved in this study remained as the ratio stated above. Each patient had an intravenous line in place during labour, and an electronically-controlled intravenous drip was used for those patients requiring oxytocin augmentation of labour. Thirty-four percent of the patients had a foetal scalp electrode placed during labour and this was removed before placement of the Silc cup on the vertex.

Obstetric analgesia was administered in each case by the obstetrician during labour and delivery. Intramuscular pethidine hydrochloride and Entonox were used during labour and 1% lignocaine was used for local anaesthesia and pudendal blocks. Epidural anaesthesia was also offered to patients in labour.

Apgar scores were assigned by the paediatrician who was standing by to receive the baby in all cases of vacuum extraction. Neonatal complications were recorded by the paediatric staff attending to the neonate.

The general rules, principles and indications that apply to forceps delivery were and should be applied for vacuum extraction. A vertex presentation at low or low-mid station, ruptured membranes, absence of absolute cephalopelvic disproportion, full or almost full cervical dilatation and adequate analgesia were the prerequisites in the department to ensure a safe vacuum delivery. Presentations other than true vertex were not candidates for vacuum delivery nor was the premature infant who is at risk of cranial and intracranial trauma. Specific indications for vacuum extraction focussed on second stage labour problems. Prolonged second stage, poor maternal effort and foetal distress accounted for 66.5% of the indications. Malpositions of the vertex such as transverse arrest and persistent occiput posterior accounted for 24% of the indications. Elective vacuum extraction is as acceptable as elective low-forceps delivery, although only 4% of the extractions were accomplished for elective reasons.

Traction with the Silc cup in place was synchronised with maternal expulsive efforts during contractions. No high station delivery (zero station and above) was attempted and each extraction was accomplished with the vertex at +1 station or lower.

RESULTS

Characteristics of the 186 patients in the study are listed in Table I. Eighty-six percent of the 186 Silc cup vacuum deliveries were clinically indicated procedures for one or more indications. Four percent were carried out on an elective basis to shorten the second stage. Vacuum deliveries that were attempted but completed by forceps delivery accounted for 10% of the total cases. This group of patients was not evaluated separately to assess the effect of forceps after vacuum on foetal and maternal outcome. None of the cases that involved an unsuccessful vacuum delivery required Caesarean section.

Table I - Characteristics of Patient In the Study

Characteristics	Number	Per cent
Maternal and foetal		
Mean maternal age (years)	29	SD 6.3
Nulliparity	131	70
Gestation > 37 weeks	182	98
Incomplete cervical dilatation	12	6
Spontaneous onset of labour	133	72
Oxytocin in second stage	143	77
Occiput posterior/transverse	44	24
Moulding + + or + + +	30	16
Large occiput	86	46
Operator's status		
Consultant	68	36.5
Senior Registrar	65	35
Registrar	52	28
Trainee	1	0.5
Neonatal characteristics		
Mean birth weight (g)	3216.5	-
Male sex	99	53

The indications for the vacuum extractions are listed in Table II. Several cases had multiple indications but one was identified as the principal indication for intervention for the purposes of this review. It should be noted that 5% of the cases were attempted forceps deliveries that were subsequently abandoned in favour of the vacuum extraction because the obstetrician was unable to lock the forceps. This was the result of a transverse or posterior occiput in all 10 cases. Delivery was successfully effected by the Silc cup vacuum extractor. One patient was severely distressed in labour and demanded a Caesarean section. The cervical os was 9 cm dilated and a vacuum extraction was performed. Delivery was easily effected by a single pull with no significant maternal injury.

Table II - Indications for Vacuum Extraction

Indications	Number	Per cent
Prolonged second stage	63	34
Poor maternal effort	27	14.5
Foetal distess	34	18
Transverse arrest	40	22
Occiput posterior position	4	2
Severe maternal distress	1	0.5
Occiput posterior/transverse	44	24
Shorten second stage	7	4
Failed forceps	10	5
Indications for forceps		
a. Prolonged second stage/poor maternal effort	5	50
b. Foetal distress	1	10
c. Occiput posterior/transverse	3	30
d. Shorten second stage	1	10

The anaesthetic requirements for the 186 Silc cup extractions were minimal. The large majority of the extractions (97%) were accomplished with local perineal anaesthesia, and this was supplemented in 8.6% with a pudendal block. No anaesthesia was used in 3% of the cases. Epidural regional anaesthesia initiated during the first stage of labour for patient comfort was maintained during the second stage in one (0.5%)

patient. One (0.5%) patient refused to cooperate during the procedure and had to be placed under general anaesthesia.

Maternal complications were very few. Eight (4.3%) patients had vaginal lacerations and 3 (1.6%) third degree lacerations were encountered. In the immediate postpartum period, 6 (3%) patients had voiding difficulties and required an indwelling catheter. They were subsequently able to void normally.

Table III - Foetal Weights

Foetal weights(g)	Number	Per cent
2000-2500	3	1.6
2500-3000	55	30
3000-3500	82	44
3500-4000	34	18.4
>4000	12	6

The summary of the foetal weights in the study can be found in Table III. Less than 32% of the infants were under 3000g, and more than 60% were between 3000 and 4000g. Six percent were larger than 4000g. These weight distributions represent the general trend of all deliveries at the author's department.

The Apgar scores of each newborn were assigned by a paediatric staff who was in attendance during the vacuum extraction, in case neonatal resuscitation was required. Table IV describes the Apgar scores assigned to the 186 infants delivered by Silc cup vacuum extraction. Only 5 (2.7%) infants had one-minute Apgar scores less than 5. One of these was a 4158g baby born to a diabetic mother who had a prolonged second stage due to deep transverse arrest. The one-minute Apgar score was 2 and 5-minute Apgar score was 8. He was diagnosed as having mild birth asphyxia and was managed in the Neonatal Special Care Unit (NSCU) on hood oxygen. The baby was subsequently well. Twenty-seven (14.5%) infants had one-minute Apgar scores between 5 and 7, and 154 (82.8%) of the infants had one-minute scores better than 7. None of the infants had 5-minute Apgar scores less than 5; while 4 (2.2%) infants had 5-minute Apagar scores of 5 - 7. One of these infants had a 5-minute Apgar score of 5. She had a tight umbilical cord round her neck with thick meconium stained liquor. Vacuum extraction was performed for foetal distress

Table IV - Apgar Scores of Newborn

1' apgar score	Number (%)	5' apgar score	Number (%)
<5	5 (2.7)	<5	0 (0)
5-7	27 (14.5)	5-7	4 (2.2)
>7	154 (82.8)	>7	182 (97.8)

and upon delivery she was intubated and ventilated. Within 5 minutes, she had good spontaneous respiration and was extubated. She recovered uneventfully. By 5 minutes, 182 (97.8%) of the newborn had Apgar scores greater than 7.

Table V summarises the foetal morbidity encountered in the 186 Silc cup vacuum extractions. The most frequent finding was neonatal jaundice, occurring in 52 (28%) of the infants. However, only 13 (7%) required phototherapy. Cephalohaematoma was a frequent finding - in 15 (8%) of the infants. Four (2%) of the infants had minor scalp abrasions. There were 3 cases of subaponeurotic haematoma with no associated fracture on skull X-ray. All 3 infants recovered uneventfully on follow-up. One infant was noted to have congenital bilateral facial nerve palsy with slightly increased tone in all 4 limbs and "stary" eyes. An ultrasonographic scan of the head did not show any evidence of intracranial haemorrhage. The possibility of Herpes encephalopathy was considered although serum and cerebrospinal fluid assays were negative for Herpes virus. No long-term consequences have been noted in this infant to date. There was no maternal or foetal mortality.

Table V - Foetal Morbidity

Morbidity	Number	Per cent
Major		
Subaponeurotic haematoma	3	1.6
Nerve palsy	1	0.5
Minor		
Cephalohaematoma	15	8
Scalp abrasion	4	2
Neonatal jaundice	52	28
Phototherapy	13	7

DISCUSSION

In 1966 Roman[3] presented a comprehensive review of the intracranial pressure changes that occur during forceps and vacuum deliveries. By directly measuring intracranial pressures on dead foetuses, he demonstrated that there is a 1 to 2 mmHg increase when forceps were used. Hence, the vacuum extractor was shown to minimise large increases in intracranial pressure while effecting vaginal operative delivery. Previous comparisons of the vacuum extractor and forceps have also confirmed that selection of the ventouse as the instrument of first choice for operative vaginal delivery results in a substantial reduction in maternal morbidity as demonstrated by Vacca (1983)[4], Johanson (1989)[5], Berkus (1986)[6], Dell (1985)[7], Carter (1987)[8] and Meyer (1987)[9], especially when performed by less experienced operators[10]. There were no significant differences in neonatal morbidity although vacuum extraction appeared to predispose to an increase in cephalohaematoma and mild neonatal jaundice, but not in all studies.

However, the use of the vacuum extractor has not been without its problems. The tractional force that it can develop is about 12 to 13 kg compared with approximately 25 kg with the forceps. Problems with its design include suction tubing leakage, cup detachment, foetal trauma and temporary cosmetic disfigurement. New designs of the original rigid cup have been introduced to reduce the likelihood of delivery failure resulting from cup leakage by a "tilting" force of traction or from tubing leakage.

On the other hand, the problem of the cosmetically unsightly caput succedaneum was addressed when Kobayashi introduced a silicone rubber cup which had a stainless steel valve. The Silc cup is a modified version which is entirely fashioned from silicone rubber and has no valve. These soft cups move away from the principle of developing a pediculate caput, relying instead on a larger surface area to develop sufficient traction. From practical experience, the tractional force using the Silc cup extractor is less than that produced by the metal cup, although not significantly so.

A large randomised prospective study to assess the relative merits and disadvantages of the Silc cup extractor was conducted by Cohn in 1989[11]. A failure rate of 19% was noted, and this occurred especially in more difficult deliveries - cervix not fully dilated, deflexed head, occiput posterior with high degree of moulding and large amount of caput. A

similar method failure of 21% was noted by Johanson in 1989 for the Silc cup with a range of 9.9%[9] to 35%[6] failure rates for the Silastic Kobayashi soft cup extractor. In our study a relatively low failure rate of 10% (19 cases) was found. In all 19 cases, delivery was successfully completed by forceps.

Berkus (1986)[12] found that in a cohort of unsuccessful vacuum extractions, a trial of soft cup vacuum extraction delivery adds no significant morbidity to mother or infant and may avoid a difficult mid-forceps delivery or Caesarean section. In our experience the overwhelming majority of operators attributed the cause of failure to the detachment of the cup at the outlet. Analysis of these cases showed that in fact the descent or "autorotation" of the head with full cervical dilatation to a more favourable position had enabled the delivery to be completed by forceps. By virtue of its design (smaller caput, reduced suction time) the Silc cup tends not to hold on to the scalp as firmly as the metal cup and thus may detach or slip from the scalp more frequently but this is not associated with higher neonatal morbidity. Conversely, the rather more gentle separation of the cup's soft edge eliminates the possibility of a "cookie cutter" scalp avulsion of metal cups which tend to "fly off". As long as progress is made it is probably safe to apply the silc cup more than twice. Improper technique can also lead to cup detachment but this would decrease with increasing familiarity with the instrument. Amongst the successful Silc cup vacuum extractions, 75% required only one pull to effect delivery with a mean delivery time of 12.7 minutes.

Complicated foetal scalp trauma and cranial injuries are always a major concern. Subaponeurotic or subgaleal haemorrhage is the most serious foetal injury attributable to the vacuum extraction. It probably occurs when emissary veins are ruptured beneath the galea aponeurotica. Malmstrom and Janson (1965)[13] believe that late subgaleal haemorrhage results from rupture of the intraparietal synchondrosis with bleeding from the saggital suture into the subgaleal space. The subaponeurotic space is continuous across the cranium with no periosteal attachments. A haematoma in the space may dissect across the cranial vault, elevating a position or all of the scalp. Subgaleal bleeding may thus be massive and life-threatening. Subgaleal bleeding is often manifested late in the infant nursery course, hours or even days after delivery[14]. If the indications and techniques of vacuum extraction are followed, subaponeurotic haemorrhage should not be a complication associated with its use[15]. The cause and effect relationship between the vacuum extraction and subaponeurotic haemorrhage has not really been established, as they have been known to occur spontaneously especially in association with prolonged labour. In our study, 2 of the babies with subgaleal haemorrhage were delivered after premature labour at 35 weeks gestation. In the first baby, forceps delivery was attempted initially but the blades failed to lock. A vacuum extraction was then performed. The baby required a blood transfusion as a result of the subgaleal bleeding. The second baby was delivered by vacuum extraction for prolonged second stage and had a small 1.5 cm subaponeurotic haematoma that did not require transfusion. The third baby also had a small subaponeurotic haematoma that did not require transfusion. All 3 recovered uneventfully.

Vacuum extraction is more likely to cause cephalohaematoma than forceps[4,7,16], but less likely to cause other scalp injuries. Our figures of 8% for cephalohaematoma and 2% for other scalp injuries are very similar to those by Vacca (1983) - 9.21% and 4.61% respectively.

In our study, 28% of the babies were found to be jaundiced. However, only 7% required phototherapy. We were also pleased to note that the incidence of maternal trauma was extremely low as compared to forceps deliveries.

CONCLUSION

The Silc cup vacuum extraction method of delivery was introduced at the author's institution 4 years ago. Although not a replacement for all forceps manoeuvres, it has been found to be an efficient method of assisted delivery with a low failure rate. In well-selected cases performed by senior obstetricians, head rotation can be effected, thus avoiding a difficult Kielland forceps delivery. Analgesic requirements were minimal and there was a low incidence of maternal trauma. Cephalohaematoma and neonatal jaundice were common, but the majority did not require phototherapy. Major foetal trauma in the form of subaponeurotic haemorrhage could be avoided if vacuum extraction was confined to term deliveries, and avoiding difficult vacuum extraction[17].

Good obstetric judgement is a prerequisite to safe and successful operative vaginal delivery by any method. Clearly, the potentially least traumatic mode of delivery should always be considered in every obstetric situation. Based on clinical experience in the author's department, we conclude that the Silc cup vacuum extractor offers a safe and efficient method of delivery under the appropriate clinical circumstances.

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