CLINICAL EXPERIENCE WITH THE SILC CUP VACUUM EXTRACTOR

J Low, T Y Ng, S Y Chew

ABSTRACT
The relative merits of vacuum extraction have been extensively studied and its advantages analysed. These include its ease of application, encouragement of “auto-rotation” 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. Cephalohæmatoma was found in 8% and 2% had minor scalp abrasions. There were 3 infants with subaponeurotic haematomata 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

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 “auto-rotation” 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”(10). 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), Couziou (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, Malstrom 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(10). 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...
here were accomplished using the 50 mm silicone Silc cup vacuum extractor (Mesox 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 a palpable cephalopelvic disproportion, full or almost full cervical dilation 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 focused 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.

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 ef-

### Table I - Characteristics of Patient In the Study

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal and foetal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean maternal age (years)</td>
<td>29</td>
<td>SD 6.3</td>
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<tr>
<td>Nulliparity</td>
<td>133</td>
<td>70</td>
</tr>
<tr>
<td>Gestation &gt; 37 weeks</td>
<td>182</td>
<td>98</td>
</tr>
<tr>
<td>Incomplete cervical dilatation</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Spontaneous onset of labour</td>
<td>133</td>
<td>72</td>
</tr>
<tr>
<td>Oxytocin in second stage</td>
<td>143</td>
<td>77</td>
</tr>
<tr>
<td>Occiput posterior/transverse</td>
<td>44</td>
<td>24</td>
</tr>
<tr>
<td>Moulding ++ or +++</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>Large occiput</td>
<td>36</td>
<td>19</td>
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<tr>
<td>Operative status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consultant</td>
<td>68</td>
<td>36.5</td>
</tr>
<tr>
<td>Senior Registrar</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>Registrar</td>
<td>52</td>
<td>28</td>
</tr>
<tr>
<td>Trainee</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Neonatal characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean birth weight (g)</td>
<td>3216.5</td>
<td>-</td>
</tr>
<tr>
<td>Male sex</td>
<td>99</td>
<td>53</td>
</tr>
</tbody>
</table>

### Table II - Indications for Vacuum Extraction

<table>
<thead>
<tr>
<th>Indications</th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolonged second stage</td>
<td>63</td>
<td>34</td>
</tr>
<tr>
<td>Poor maternal effort</td>
<td>27</td>
<td>14.5</td>
</tr>
<tr>
<td>Foetal distress</td>
<td>34</td>
<td>18</td>
</tr>
<tr>
<td>Transverse arrest</td>
<td>40</td>
<td>22</td>
</tr>
<tr>
<td>Occiput posterior position</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Severe maternal distress</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Occiput posterior/transverse</td>
<td>44</td>
<td>24</td>
</tr>
<tr>
<td>Shortened second stage</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Failed forceps</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Indications for forceps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Prolonged second stage/poor</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>b. Foetal distress</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>c. Occiput posterior/transverse</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>d. Shortened second stage</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

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%) affected by a single pull with no significant maternal injury.
patient. One (0.5%) patient refused to cooperate during the procedure and had to be placed under general anaesth- 
aesthesia.

Maternal complications were very few. Eight (4.3%) pa-
tients had vaginal lacerations and 3 (1.6%) third degree lacer-
ations were encountered. In the immediate postpartum pe-
period, 6 (3%) patients had voiding difficulties and required an 
indwelling catheter. They were subsequently able to void nor-
mally.

<table>
<thead>
<tr>
<th>Table III - Foetal Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foetal weights (g)</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>2000-2500</td>
</tr>
<tr>
<td>2500-3000</td>
</tr>
<tr>
<td>3000-3500</td>
</tr>
<tr>
<td>3500-4000</td>
</tr>
<tr>
<td>&gt;4000</td>
</tr>
</tbody>
</table>

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 ex-
traction, in case neonatal resuscitation was required. Table IV 
describes the Apgar scores assigned to the 186 infants deliv-
ered 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 Apgar 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 
lipor. Vacuum extraction was performed for foetal distress 

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 IV - Apgar Scores of Newborn

<table>
<thead>
<tr>
<th>1st Apgar score</th>
<th>Number (%)</th>
<th>5th Apgar score</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>5 (2.7)</td>
<td>&lt;5</td>
<td>0 (0)</td>
</tr>
<tr>
<td>5-7</td>
<td>27 (14.5)</td>
<td>5-7</td>
<td>4 (2.2)</td>
</tr>
<tr>
<td>&gt;7</td>
<td>154 (82.8)</td>
<td>&gt;7</td>
<td>182 (97.8)</td>
</tr>
</tbody>
</table>

Table V - Foetal Morbidity

<table>
<thead>
<tr>
<th>Morbidity</th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subpneumoneurotic haematoma</td>
<td>3</td>
<td>1.6</td>
</tr>
<tr>
<td>Nerve palsy</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Minor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalohaematoma</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Scalp abrasion</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Neonatal jaundice</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Phototherapy</td>
<td>13</td>
<td>7</td>
</tr>
</tbody>
</table>

DISCUSSION

In 1966 Roman10 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 
nmHg 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 substi-
tual reduction in maternal morbidity as demonstrated by Vacca 
Carter (1987)9 and Meyer (1987)9, especially when performed 
by less experienced operators19. 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 cos-
metic disfigurement. New designs of the original rigid cup 
have been introduced to reduce the likelihood of delivery fail-
ure resulting from cup leakage by a “tilting” force of traction 
or from tubing leakage.

On the other hand, the problem of the cosmetically un-
sightly 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 suf-
ficient traction. From practical experience, the tractional force 
using the Silc cup extrator is less than that produced by the 
metal cup, although not significantly so.

A large randomised prospective study to assess the rela-
tive merits and disadvantages of the Silc cup extractor was 
conducted by Cohn in 198910. 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

and 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 haemor-
rhage. The possibility of Herpes encephalopathy was consid-
ered although serum and cerebrospinal fluid assays were nega-
tive for Herpes virus. No long-term consequences have been 
noted in this infant to date. There was no maternal or foetal 
mortality.
similar method failure of 21% was noted by Johansen in 1989 for the Silc cup with a range of 9.9% to 35% 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) 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 "autodetachment" of the head with full cervical dilation to a more favourable position had enabled the delivery to be completed by forceps. By virtue of its design (smaller cup, 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 than 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 tends 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. Mallstrom and Janson (1965) believe that late subgaleal haemorrhage results from rupture of the intraparietal synchondrosis with bleeding from the sagittal suture into the subgaleal space. The subaponeurotic space is continuous across the cranium with no perilobal 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 infants nursery course, hours or even days after delivery. If the indications and techniques of vacuum extraction are followed, subaponeurotic haemorrhage should not be a complication associated with its use. 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 33 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, 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. Anaesthetic 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.

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.

REFERENCES