

## The Use of the Vacuum Extractor in the Rhodesian African

BY

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The vacuum extractor has proved to be of value in obstetrical practice in Africa and enthusiastic articles have appeared from South Africa (Lasbrey *et al.*, 1964), Zambia (Hassim and Lucas, 1966) and Kenya (Bird and Bal, 1967). During the past 18 months we have made a prospective study of the use of this instrument in an endeavour to formulate a set of criteria for its use which could serve as a guide for district medical officers, mission doctors and our own junior staff.

### MATERIAL

Approximately 8,000 patients deliver annually at Harare Maternity Hospital with a preponderance of primigravidae, grande-multigravidae and abnormal cases. About 75 per cent. have attended the antenatal clinic and the remainder are unbooked or emergency admissions. For the 3½ year period from the middle of 1964 to the end of 1967 there were 27,638 deliveries, with a caesarean section rate of 6.2 per cent., a vacuum extraction rate of 6.5 per cent. and a forceps rate of 0.7 per cent. Over this period the total perinatal mortality was 2.7 per cent. and of vacuum extractions 7.3 per cent., corrected to 4.1 per cent. when premature infants and intra-uterine deaths were excluded (Bland, 1968). There were 1,733 extractions performed during this 3½ year period and this paper will discuss a prospective analysis of 186 of these cases.

### METHODS

During the first six months of 1967 an arbitrary set of criteria for the use of the vacuum extractor was worked out. These criteria are set out in Table I.

Table I

#### CRITERIA FOR VACUUM EXTRACTION

1. Head presenting.
2. Head less than two-fifths above brim *without* caput or moulding, or less than one-fifth above brim *with* caput or moulding.
3. Cervix 8 cm. or more dilated.

The description of the relationship of the head to the brim in fifths above the brim was first used

by Crichton (1964). It is of great use in African obstetrics where by virtue of the small android pelvis and excellent uterine action the head can mould to such a degree that a head apparently engaged on vaginal assessment is not necessarily through the pelvic inlet.

Where the head is 0/5 above the brim a house surgeon is allowed to perform the extraction. If the head is 1/5 above and there is a little caput and moulding or 2/5 above and no caput and moulding, a house surgeon is permitted to continue with the vacuum extraction in the presence of an experienced operator. In these cases one is fairly certain that the head will come through the pelvis. A "trial" is performed where there is doubt if the head will come through. A trial is therefore conducted on cases where the head is 1/5 above the brim with marked caput and moulding or 2/5 above with a little to moderate caput and moulding or 3/5 above with no clinical evidence of cephalo-pelvic disproportion. The conduct of a trial is discussed later.

After the first 121 cases had been performed we made a critical evaluation of our results to see whether any modifications of our technique or criteria were called for. This was found to be unnecessary. A study in greater detail was made of the subsequent 65 cases.

### RESULTS

One hundred and eighty-six vacuum extractions were performed in the University Department of Obstetrics and the following results recorded:

*Parity.*—Of 186 patients, 92 (49.5 per cent.) were primigravidae and 94 (50.5 per cent.) were multigravidae, of whom eight had borne more than six children. Forty-one patients (22.2 per cent.) were unbooked.

*Presentation.*—The vertex presented in all cases.

*Station of the Head.*—This has been expressed in fifths above the brim and is set out in Table II.

Table II

Station of head Number	THE BRIM				(179)
	0/5	1/5	2/5	3/5	
.....	48	65	55	11	

Some of the cases where the head was 2/5 above and all where the head was 3/5 above constituted trials of vacuum. Seven cases where the vacuum was used for the second twin are not included, as the criteria do not apply in these cases.

*Anaesthesia and Analgesia.*—Perineal infiltration was performed in 94 cases (50.5 per cent.), pudendal block in three (1.6 per cent.) cases, and general anaesthesia in one (0.54 per cent.). It is felt that a general anaesthetic is not only

unnecessary but unwarranted. The active co-operation of the patient is of utmost importance. No analgesia was used in 88 (47.3 per cent.) of cases and these predominate towards the end of this investigation. With increasing experience and confidence and a gentle re-assuring manner, local anaesthesia is largely unnecessary and is now only used if an episiotomy is performed.

*Indications.*—Only the primary indications are given, though in many instances more than one indication was present. These are recorded in Table III.

**Table III**  
PRIMARY INDICATIONS FOR THE VACUUM EXTRACTOR

Indication	Number
Delay second stage	96 (51.6 per cent.)
Foetal distress	56 (30.2 per cent.)
Delay first stage	11 (5.9 per cent.)
Prolonged first stage	4 (2.1 per cent.)
Maternal distress	4 (2.1 per cent.)
Pre-eclampsia	3 (1.6 per cent.)
Eclampsia	3 (1.6 per cent.)
Previous caesarean section	7 (3.8 per cent.)

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Thirty-eight extractions were carried out in the first stage of labour and 148 in the second stage. Of extractions in the first stage of labour, 31 were carried out at 9 cm. dilatation, six at 8 cm. and one at 6 cm. dilatation of the cervix. The alternative to a first stage extraction is usually a caesarean section.

*Mode of Delivery*

Of the 186 vacuum extractions, four were unsuccessful, two being patients delivered by caesarean section and two by forceps delivery. The details of these cases are:

*Case 1.*—A grossly infected primigravida was transferred to us from a district hospital after a prolonged first and second stage of labour. Examination revealed that the head was 1/5 above the brim, and on vaginal examination the head was found to have a large caput and was grossly moulded. There was no evidence of foetal distress.

A trial of vacuum was decided upon and this was performed in the theatre. After three pulls there was no progress. The foetal heart was then 120 per minute. Caesarean section was performed and a fresh stillbirth delivered. There is reason to believe that a period of maternal anoxia was an important factor in this stillbirth. In retrospect a symphysiotomy would have been the treatment of choice.

*Case 2.*—This patient was also transferred from a district hospital following a prolonged first and second stage of labour. The head was 1/5 above the brim with caput and moulding. There was good progress with the first pull, but little progress with the second and third pulls. At this stage she had a fit despite a blood pressure of 110/70. A caesarean section was performed and she was delivered of a live baby with a large cephalhaema-

toma. Initially there were signs of cerebral irritation, but this child was normal on discharge.

*Case 3.*—This patient presented with a prolapsed, non-pulsating cord which slipped between the cup and the head when application was attempted. She was delivered by an easy forceps delivery.

*Case 4.*—A leak in the system prevented the attainment of an adequate vacuum and she too was delivered by forceps.

*Trial of Vacuum*

Seventeen were performed and 16 were successful. The one unsuccessful case has been described above.

*Symphysiotomy and Vacuum Extraction*

Five cases were performed during this investigation. We feel that the instrument is ideal for delivery when there is any delay after symphysiotomy.

In each of these five cases there was delay in the second stage of labour with the head 2/5 above the brim of the pelvis and marked caput and moulding. Symphysiotomy overcame this degree of disproportion and vacuum extraction completed the delivery very easily.

*Cup Slipping Off*

Apart from a few instances where a temporary leak developed in the vacuum system, the cup slipped off once in four cases and twice in one case. The latter was a case of intra-uterine death of the foetus with a very large caput.

*Application Time*

In the last 65 cases the cup was applied for less than five minutes in 28 cases and in only one case for longer than 20 minutes, and this patient was delivered moments after that time. We feel that 20 minutes should never be exceeded. Note that most of the patients were delivered within the 15 minutes.

**Table IV**  
APPLICATION TIME OF VACUUM EXTRACTION IN 65 CASES

Application time in minutes	1-5	6-10	11-15	16-20	20 +
Number in each group	28	17	17	2	1

*Number of Pulls Required*

A pull is defined as traction during one contraction. Traction is employed with the right hand while the thumb of the left hand maintains application of the upper edge of the cup to the baby's head. The index finger of the left hand is applied to the foetal scalp and monitors progress of the head which should occur with each pull.

**Table V**  
NUMBER OF PULLS REQUIRED

No. of pulls	1	2	3	4	5	6
No. in each group	20	13	14	7	1	—

*Apgar Scores*

In the last 63 liveborn infants delivered by vacuum extraction, the Apgar scores were:

Table VI

APGAR SCORES IN 63 LIVEBORN INFANTS

Apgar	.....	.....	.....	7-10	4-6	1-3	0
Number	.....	.....	.....	54	7	2	1

*Size of Cup*

In the last 65 cases the 60 mm. cup was used 33 times and the 50 mm. cup 32 times. The smaller (30 or 40 mm.) cups find occasional use in the first stage of labour or in delivery of the second twin.

*Episiotomy*

The indications for this procedure are those that apply to any labour. With increasing experience the procedure was used less frequently than formerly.

*Position of the Head at Time of Application*

Of the 182 successful deliveries, the head was occipito-anterior in 44 (24.2 per cent.), occipito-lateral in 75 (41.2 per cent.) and occipito-posterior in 63 (34.6 per cent.). Rotation to the anterior position occurred in all but one of the lateral positions; this one case was a premature infant in an eclamptic patient. Of the occipito-posteriors, all but nine rotated to the anterior, and these nine delivered in the direct occipito-posterior position. When rotation took place, in nearly every case it occurred on the perineum. A slight lessening in traction and an extra push by the mother facilitates rotation.

Table VII

LENGTH OF LABOUR IN 65 CASES

Hours	.....	.....	.....	0-12	13-24	25-36	36 +
No. of patients	.....	.....	.....	32	25	5	3

In each case where labour had exceeded 24 hours the patient had been transferred from elsewhere. The time taken to transport the patient naturally added to the duration of labour.

Table VIII

BIRTHWEIGHTS

Birthweight:	Below 5½ lb.	5½-6½	6½-7½	7½-8½	above 8½
Number	.....	.....	.....	.....	.....
	10	45	65	48	18

As the antenatal assessment of the baby's weight is notoriously inaccurate, we find that 10 cases weighed less than 5½ lb. This is an average proportion of normal sized babies.

*Pelvic Contraction*

This was noted clinically in 33 cases in the last 65 patients.

MORBIDITY AND MORTALITY

*Maternal*

There was no maternal death in the series. There were no cases of puerperal pyrexia. There was one patient with a cervical laceration and four with vaginal lacerations. Four cases of post-partum haemorrhage were observed; in three cases the loss only just exceeded 20 ounces and in one case the loss was 30 ounces.

*Perinatal Mortality*

The total perinatal mortality was 11 out of 186 extractions, giving a rate of 5.9 per cent. There were six stillbirths and five neonatal deaths. Of the six stillbirths, five were known to be dead before the vacuum extractor was used, therefore giving a corrected perinatal mortality rate of 3.3 per cent.

(A) The one fresh stillbirth has already been discussed.

(B) *Neonatal Deaths*

(1) A primigravida aged 16 years was admitted deeply unconscious with eclampsia. There was a slow irregular foetal heart and the head was on the perineum. An easy extraction delivered her of a 5 lb. 2 oz. baby with an Apgar score of 2. The baby died two hours later.

(2) A para 2 with a small pelvis was admitted with the head 2/5 above the brim. The cervix was fully dilated and there was no moulding or caput. Three strong pulls delivered her of a 7 lb. 4 oz. baby with an Apgar score of 5. This baby died 18 hours later and a *post-mortem* revealed an intracranial haemorrhage.

(3) A para 1 who had had a prolonged first and second stage of labour was transferred to our unit. The head was 2/5 above the brim and there was no moulding or caput. Three moderately strong pulls delivered her of a baby with an Apgar score of 3 who died 1½ hours later. The *post-mortem* examination revealed pulmonary atelectasis.

(4) A para 4 had an easy extraction performed for delay with the second twin. Only one pull was necessary. The baby weighed 7 lb. 5 oz. and had an Apgar score of 10. It died 48 hours later and *post-mortem* revealed that the cause of death was a cephalhaematoma. The first twin spent three weeks in the neonatal unit with haemorrhagic disease of the newborn. Following this experience, vitamin K<sub>1</sub> 1 mg. is routinely given to all babies delivered by vacuum extraction.

(5) A primigravida, aged 18 years, was transferred from a district hospital. She had had a prolonged second stage of labour. There was gross foetal distress. A very easy vacuum extraction was performed and delivered her of a 6lb. 7 oz. baby with an Apgar rating of 1. The baby died 15 minutes later when resuscitation failed to establish respiration. *Post-mortem* revealed that the cause of death was foetal anoxia.

*Perinatal Morbidity*

All infants show a typical "chignon" which disappears in nearly every instance within a few hours. This is not regarded as significant. Three infants developed cephalhaematomata, one of which resulted in a neonatal death that has

already been described. No case of scalp necrosis occurred.

#### DISCUSSION

In discussing this apparatus and its use in African obstetrics we would like to define the particular problem that we meet in the Rhodesian African parturient. Approximately a half of our patients have a small android pelvis. This is probably related to the nutrition of the mother during her formative years. As nutrition improves and anaemia and pre-eclamptic toxæmia are treated with adequate antenatal care, so the babies get bigger, but naturally the pelvis remains contracted. We trust that the next generation will have adequate pelvises to match their larger babies.

The head descends in the occipito-posterior position in nearly a third of the cases because of adaptation to the narrow fore-pelvis. The flat sacrum impedes spontaneous and even manual rotation of the head.

The pelvic problems are balanced by excellent uterine contractions and an enthusiastic willingness to push in the second stage of labour. For this reason, in the second stage of labour we expect to see steady progress towards delivery within 20 minutes in a multiparous patient and 30 minutes in a primiparous patient. This teaching is also applied in the teaching schools of Durban, South Africa, and Ibadan, Nigeria.

#### *Methods of Delivery Available Prior to the Advent of the Vacuum Extractor*

Delay and foetal distress in the first stage required caesarean section.

#### *Second Stage Delay*

- (a) *Forceps*.—As explained, the head is often in the lateral or posterior position and therefore Kielland's forceps delivery—a major vaginal procedure—is indicated.
- (b) *Caesarean Section*.—If the head is not engaged a caesarean section is indicated.

By comparison with both these procedures, the vacuum extractor offers a simple vaginal delivery. The practical and psychological advantages of vaginal delivery in African obstetrics cannot be over-emphasised. Furthermore, the low mechanical forces to which the baby is exposed in using the vacuum extractor are of great importance. Snoeck (1960) states that when using the vacuum extractor the intracranial tension under the least favourable circumstances (i.e., using the 40 mm. cup) is one-twentieth the tension of forceps under the most favourable circumstances. This statement is challenged by

de Boer (1961), who maintains that the forceps blades protect the foetal head.

Kelly and Mishell (1962) and Donald (1966) have shown that the vacuum cup detaches from the scalp at a force of 35 lb. per sq. in., whereas in difficult forceps delivery the force may reach 100 lb. per sq. in. Pearse (1963) has shown that the average maximum traction with the forceps is 42 lb. per sq. in. as compared with 17 lb. per sq. in. with the vacuum extractor.

#### INDICATIONS FOR THE USE OF THE VACUUM EXTRACTOR

##### (A) *First Stage Indications*

(1) *Foetal Distress*.—This is regarded by some obstetricians (Snoeck, 1960) to be a contraindication to the use of the vacuum extractor, because of the time taken to assemble the extractor and obtain the necessary vacuum. However, if the instrument is assembled beforehand and kept sterile, the first objection is overcome. Wider *et al.* (1967), using a transparent "plexiglas" cup, have shown that the artificial caput forms at once and that it is therefore unnecessary to take 10 minutes to create a vacuum. Our practice is to apply the cup, obtain a vacuum of 2 lb./sq. in. and then make sure that there is no maternal tissue between the cup and the head. We then create the vacuum required for the extraction, usually 20 lb./sq. in., as quickly as possible. This is every bit as quick as a forceps application. In fact, foetal distress has become one of our main indications for the use of the vacuum extractor, and certainly where the head is not lying in an anterior position it is far quicker than using forceps.

(2) *Uterine Inertia*.—In Malmstrom's (1957) original work inertia was regarded as an important indication for the use of the extractor. Because of the good uterine action we have referred to, this is not a feature of its use in the Rhodesian African.

When the cervix is 8 cm. or more dilated and the head low, the vacuum extractor can safely be used. In most cases where the cervix is less than 8 cm. dilated and there is foetal distress, the treatment of choice is caesarean section, since the time taken to complete dilatation of the cervix and extract the infant will be longer if embarked upon with the extractor.

Foetal distress with the cervix 8 cm. or more dilated is our main indication for vacuum extraction in the first stage. Where the extractor is used for a longer period than 20 minutes the incidence of foetal damage rises considerably.

**(B) Second Stage Indications**

(1) *Use in Disproportion.*—The use of the extractor in disproportion must be clearly defined.

(a) *Minor Disproportion.*—The extractor is a valuable instrument, as it improves flexion of the head and aids maternal powers.

(b) *Major Disproportion.*—The extractor has no place in delivery where there is major cephalo-pelvic disproportion.

(c) *Suspected Moderate Disproportion.*—Here it may be used on a strictly trial basis by a skilled operator. The intention in these cases is not that absolute disproportion should be overcome by additional force, but by increasing flexion of the head relative disproportion will be overcome and further extraction be facilitated. According to the specific problem each patient presents, preparation for either caesarean section or symphysiotomy must be made beforehand and the trial performed in a suitable theatre. If facilities for these procedures have not been made, then a trial should not be embarked upon. An early decision must be made to abandon the trial if progress is not shown with each pull. Often only one pull will suffice to gain the required information, and never more than three pulls should be necessary.

(2) *Use in Malposition.*—It is in cases of occipito-posterior and occipito-lateral position that we have had our most dramatic results. The great advantage of the vacuum extractor is, as Evelbauer (1966) states, that it does not encroach upon the birth canal and does not fix the head in a certain position as do the forceps. Therefore spontaneous rotation or "auto-rotation" will occur at the station which the shape of the pelvis and the vertex determine. The extractor increases flexion and therefore reduces the presenting diameters, so hastening delivery, especially in transverse arrest. The cup should be placed as far back on the occiput as possible and the pull angled slightly to increase flexion. In many instances of occipito-posterior position the head is drawn steadily down to the perineum and rotation through an arc of 180 degrees occurs, followed by an easy delivery in the anterior position. In other instances the head delivers in the face to pubis position. Whichever occurs, the decision is determined by the head and the birth canal and not by the operator, and is therefore the most advantageous for the patient.

In deep transverse arrest, anterior rotation invariably occurs under the pubic arch at the time of crowning. This again contrasts with forceps delivery where the operator arbitrarily decides where rotation will occur.

We must stress that malposition and disproportion are closely allied, and in every case of malposition a careful examination must be performed to ensure that disproportion is not greater than at first realised.

(3) *Combined Use of Symphysiotomy and Vacuum Extraction.*—There is a place for symphysiotomy in a rural community where there is anxiety concerning what will happen to a scarred uterus in future pregnancies. Lawson (1967) recommends that it should be used for established obstruction and not employed in anticipated obstruction. It should be confined to patients who have had no antenatal care or who at least are poor attenders and who live far from medical aid. This pattern would be likely to recur in subsequent pregnancies. Thus one of the cases of symphysiotomy where delivery was completed by vacuum extraction was a primigravida who had received no antenatal care; she had moderate disproportion and had been in the second stage of labour for five hours at an outside hospital. After symphysiotomy, delivery took place with great ease; one pull brought the head from three-fifths above the brim on to the perineum and the second pull effected delivery. Forceps delivery is contra-indicated following symphysiotomy since the bladder and urethra, having lost their bony protection, are particularly vulnerable. By contrast, the extractor is able to keep the head well posterior without itself encroaching on the birth canal.

Our major indication for symphysiotomy is the primigravid patient where obstruction occurs in the second stage of labour with two- to three-fifths of the head still above the brim and marked caput and moulding. We apply the vacuum extractor first, and if the head does not dislodge with one pull we then do the symphysiotomy and complete the delivery with the extractor. This sequence has ensured that we have not done any unnecessary symphysiotomies.

(4) *An Elective Procedure.*—We have used the vacuum extractor as an elective procedure to shorten the second stage in cases of eclampsia, pre-eclampsia, cardiac disease and previous caesarean section and for maternal exhaustion. In these circumstances it has proved most satisfactory. Eclampsia might be regarded as a contra-indication since the patient is usually unconscious or semi-conscious. In the three cases recorded, expulsive efforts coincided with contractions and there was no difficulty. In 13 cases the vacuum extractor was used in cases of previous caesarean section.

(5) *Converting a Brow to a Vertex.*—This is an interesting use of the extractor and can be used in suitable cases where there is no caput or moulding and the cervix fully dilated. The cup is placed as far back on the head as possible and

traction is made, flexing the head. The cup is removed and replaced a little further back. After two or three repositionings of the cup the conversion into a vertex is complete.

(6) *Delivery of the Second Twin.*—In cases of foetal distress or delay with the second twin, the extractor was used in seven cases and found to be very satisfactory. This is the one occasion where the extractor may be used on a head above the brim of the pelvis.

#### CONTRAINDICATIONS TO VACUUM EXTRACTION

##### *Malpresentations*

Face presentation and transverse lie are absolute contraindications. We regard breech presentation as a contraindication, but there have been reports of the extractor applied successfully to the buttocks.

##### *Major Disproportion*

This is an absolute contraindication and has been discussed already. A degree of disproportion greater than that at first anticipated is suggested by the cup slipping off. We feel that the cup should never slip off the head and certainly never more than once.

##### *Prematurity*

Our series contains ten premature infants. Where the indication for assisted delivery is prematurity *per se*, very little traction is required and the main object is to protect the foetal head. The instrument of preference is then the forceps (de Boer, 1961).

#### DANGERS OF VACUUM EXTRACTION

##### *To the Mother*

These are minimal if the instrument is used correctly. Cervical tears occur mainly when the instrument is used at 6 cm. dilatation or less. Damage to cervix and vagina can occur if these tissues are accidentally incorporated in the vacuum and it is most important to re-examine the edge of the cup after a vacuum of 2 lb./sq. in. has been created.

##### *To the Infant*

The chignon is an artificial caput succedaneum, the shape of the inside of the cup. It improves in a matter of minutes and disappears within a few hours. It is not considered significant. Chalmers and Fothergill (1960) describe small ecchymoses round the perimeter of the chignon which may persist for a day or two.

Scalp necrosis follows prolonged suction, especially with continuous traction. These are

usually cases where the vacuum is used during the first stage. We regard 20 minutes as the maximum length of time the vacuum should be applied. We have never seen the severe intracranial injuries described by Boon (1961) and ascribe our success to the avoidance of the use of the vacuum extractor to overcome absolute disproportion.

Cephalhaematomata occur more frequently than with forceps delivery. Our one foetal death which could have been attributed solely to the use of the vacuum extractor was in the case of a second twin. These details have been given already and its prevention discussed.

#### ADVANTAGES OF VACUUM EXTRACTION

##### *To Mother*

- (1) The vacuum cup does not encroach on the birth canal.
- (2) The mother shares in the delivery.
- (3) General anaesthesia is not required, and in fact is contraindicated. Even pudendal block is unnecessary, and the most we now use is an infiltration of the perineum where an episiotomy is thought likely.

(4) The infection rate is less than with forceps. This has been shown in nearly every series of vacuum extractions (Schenker and Serr, 1967) and is to be expected since the tips of the forceps blades traverse the potentially infected vagina and enter the uterine cavity above the head. Furthermore, less trauma is caused when using the vacuum extractor.

(5) Episiotomy is not obligatory as with forceps delivery.

(6) Blood loss is less than with forceps, due in the main to the absence of general anaesthesia and fewer episiotomies and other trauma.

##### *To Baby*

- (1) Less force is used than with forceps.
- (2) The foetal head, through autorotation, passes through the birth canal in the optimum position.
- (3) The foetus is not depressed by a general anaesthetic.

##### *To Obstetrician*

The technique can be learnt more quickly and easily than that of forceps delivery.

#### CONCLUSION

We are now prepared to advise district medical officers and mission doctors and to teach our

junior staff that the vacuum extractor is the instrument of choice for assisted deliveries in the Rhodesian African provided that the following criteria are strictly adhered to:

- (1) The vertex must be presenting.
- (2) The cervix must be 8 cm. or more dilated.
- (3) With regard to the level of the head:
  - (a) When 0/5 above, proceed with extraction.
  - (b) When 1/5 above with slight caput and moulding or 2/5 above with no caput or moulding, an experienced operator should handle the case.
  - (c) When 1/5 above with marked caput and moulding or 2/5 above with slight caput and moulding, a trial of vacuum, with suitable preparation for caesarean section or symphysiotomy, may be employed.

Notwithstanding these criteria, progress must be shown with each pull and three pulls should be sufficient to effect delivery. Twenty minutes is never exceeded and the cup should never slip off. The operator must always be willing to admit that a greater degree of disproportion might exist than initially thought likely and recourse must then be made to alternative forms of delivery.

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