THE PREVENTION AND TREATMENT OF SOME OPERATIVE COMPLICATIONS AT LOWER SEGMENT CAESAREAN SECTION

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Operative complications at, and following caesarean section receive insufficient attention in the literature — probably because the operation is usually not difficult; consequently individual gynaecologists or surgeons may have limited personal experience of difficult cases. Difficult cases, on the other hand, are relatively common in the university unit at King Edward VIII Hospital, Durban. Here we have obtained an extensive experience of such cases and operative complications as a consequence of performing over 2,000 caesarean sections annually. Moreover, as the majority of these are emergency procedures for disproportion, the extent of our experience of complications is understandable.

In our experience meticulous attention to minutiae of the operation (not described in operative manuals) could have prevented or minimized many of the complications under consideration. Hence we feel that a description of the surgical techniques we employ merits publication, and may prove of value to those confronted with similar problems in the future.

All members of staff adhere strictly to our routine method of performing caesarean sections. This has evolved over the past years as a result of weekly staff discussions of any complications noted in our personal experience, and that of training and supervising the surgery of our registrars who perform the majority of more than 15,000 caesarean sections undertaken in our unit to date.

In this contribution we propose to confine ourselves to a consideration of:

1. (a) Pre-operative and (b) operative principles.
2. Haemorrhage, haemostasis and possible complications.
3. The mode of extraction of the foetus at caesarean section.

We discuss the operation in a sequential manner without embarrassment at the inclusion of very elementary precautions which might invite ridicule from an ultra-critical reader, because we have learnt that neglect of these precautions has been costly to mother and infant on a number of occasions.

PRE-OPERATIVE PRINCIPLES

In the preparation of the patient the following procedures are undertaken:

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(a) *General measures.* An emergency attitude is frequently essential to render the patient as fit as possible for major surgery and anaesthesia. For instance, the speedy correction of dehydration and acidosis by appropriate parenteral fluid therapy is sometimes vital, and similarly hypovolaemia or anaemia may require rapid correction. When blood is to be administered, careful consideration should be given to the possible desirability of preferring 'packed cells' to 'whole blood'.[1] The use of plasma is eschewed in our unit (apart from the use of fresh frozen plasma to remedy clotting defects). An intravenous glucose infusion should be set up before the operation commences and blood should be available in the theatre for every case.

(b) *The bladder.* When the caesarean section is elective it may be desirable to get the patient to empty her own bladder before operation. Other cases are catheterized in the theatre. When the catheter is removed at the conclusion of the operation the outflow of urine is examined to exclude haematuria indicative of vesical injury. The discovery of haematuria is an indication for insertion of a self-retaining catheter.

Disimpaction of an impacted head will facilitate the subsequent delivery of the head and may also facilitate the introduction of the catheter through a compressed trigone and urethra. Disimpaction is dangerous, however, when there is any suspicion of threatened rupture of the uterus.

Should it be impossible to catheterize the patient gently, the bladder is emptied abdominally with a needle and syringe during surgery.

OPERATIVE PRINCIPLES

1. Selection of Type of Caesarean Section

Our indications for the various uterine incisions are as follows:

(a) *The Vertical Upper Segment Operation*
   (i) Difficulty in approaching the lower segment (which may result from marked kyphosis or adhesions).
   (ii) Actual or impending uterine rupture in which extraction of the infant through a lower segment incision may aggravate existing damage, or produce uncontrolled tearing of the lower segment.
   (iii) When caesarean hysterectomy is to be performed.
   (iv) When an associated carcinoma of the cervix is present.

Neither placenta praevia nor uterine varicosities justify a vertical upper segment incision.

(b) *The Vertical Lower Segment Operation*
   (i) When the uterus is firmly contracted around a live foetus with a transverse lie.

(ii) When the lower segment is unformed early in the third trimester.

The upper segment is always involved when a so-called vertical 'lower' segment operation is performed. Consequently the 'vertical' lower segment incision inherits some measure of the additional risks of the classical incision.

(c) *The Transverse Lower Segment Operation*
    This is indicated in all other cases.

2. Opening the Abdomen

Extra care must be taken in opening the abdomen if there has been a previous operation, for bowel, uterus and bladder may be adherent or displaced and therefore vulnerable. The peritoneum is best opened at the top of the incision.

3. Exposure of the Lower Segment

After making allowance for any rotation of the uterus, the peritoneum over the lower segment is incised transversely. Both peritoneal flaps are reflected, but the lower more than the upper.

The fascia over the lower segment should be incised as a definite layer to protect perivesical varicosities (which are adherent to this fascia) from being torn across when the bladder is reflected down. Should haemorrhage from this cause occur, local bleeding is better controlled by pressure than suturing until delivery of the foetus. Even the large foreboding varicosities overlying a placenta praevia are controlled in this manner, and do not constitute an indication for resorting to a classical caesarean section.

The bladder is now reflected down. Particular care should be taken to free and depress the bladder angles to remove them and the ureter from dangerous proximity to possible tears or haemorrhage which could occur in this region. If the bladder is firmly adherent 'sharp' is safer than 'blunt' dissection. It is unwise to proceed with the transverse incision into the lower segment in the presence of an inadequate exposure of the lower segment, because bladder injury occurs readily if the lower segment tears downwards and the bladder is also liable to be included in the subsequent stitching of the uterine incision. Hence such cases require an upper segment incision.

4. Incision of the Lower Segment

The exact level of the incision must now be selected. Most authors recommend a low incision, yet the lower the incision, the nearer the extremities will be to uterine vessels and ureters. An excessively low incision also invites risk of haemorrhage from perivesical varicosities, vesical adherence to the scar (making subsequent caesarean sections more difficult), and of inadvertently performing a cervical or vaginal caesarean section in cases of obstructed labour.

Therefore we prefer to make the incision about 1 inch below the utero-vesical reflection of peritoneum — unless the head is deeply impacted in the pelvis, when a slightly lower incision facilitates extraction of the head.

It is advantageous, and sometimes feasible, to disengage the foetal head by extra-uterine manipulation before inserting a central stay-suture about $\frac{1}{2}$ inch below the proposed site of incision. This suture is useful in pulling the uterine musculature away from the underlying presenting part lest it be injured at the time of making the small initial incision into the lower segment. After delivery of the infant, traction on this suture is also helpful in defining and stitching the uterine incision and applying Green-Armytage clamps.

Occasionally haemorrhage from the initial incision is sufficient to occlude visibility before the entire thickness of the uterine musculature has been transgressed, and the flow may defeat attempts to ensure the ideal of incising under direct vision (despite attempts to clear the field with a swab and compression). In such instances blunt-pointed scissors are pushed obliquely downwards through the few remaining fibres of the uterine musculature.

After entering the amniotic cavity a finger is slipped under the lower segment (along the line of proposed incision) to safeguard the underlying foetal parts from injury. Without this precaution partial amputation of fingers, ears or even umbilical cord can occur with surprising ease!

Scissors are usually preferred to 'finger stretching' of the uterine incision (unless haemorrhage is excessive) so that additional length of the incision can be obtained, where necessary, by curving up the extremities of the incision and thereby escaping the uterine vessels.

The incision is under better control with this method, and — especially if the lower segment is unduly stretched and friable — it is less likely to tear down in an undesirable direction.

If haemorrhage occludes visibility, however, 'finger-stretching' is safer than blind use of the scissors.

Stitching

The angle-sutures are inserted sufficiently far out to allow for any undermining of the incision, and tied firmly with a true surgical knot on the first bend.

A continuous suture is inserted with the purpose of achieving haemostasis and opposing the full thickness of the uterine musculature. For the former reason the suture must be pulled tight.

The less important second layer — a continuous Lembert suture — inverts the first layer, relieves it of some measure of tension, and adds to the efficiency of haemostasis.

The suture-line must be left dry. Any deficiency or uncertainty in satisfying this ideal demands the insertion of a corrugated rubber drain. Compression and oxytocic stimulation of a relaxed uterus aids haemostasis, but may be misleading in that oozing may start afresh if the uterus relaxes when the incision is already covered by the peritoneal (next) layer of sutures. When oozing from the suture-line ceases in response to uterine contraction and compression, the uterus should be returned to the abdomen and observed for a while before assuming that haemostasis is permanent.

Occasionally ligation of a bleeding point is feasible, and obviates the risk of further bleeding from entry or exit point of the suture needle. Usually, however, sutures are required and are best placed parallel to the uterine incision.

5. Closure of the Vesical Peritoneum and Abdomen

It is customary to close the vesical peritoneum so that a small watertight scar remains. We condemn this practice

because any haemorrhage enclosed thereby, tracts retro-peritoneally. Large broad-ligament haematomata and retro-vesical haematomata overlying the uterine scar develop silently in this manner and easily assume large proportions without producing clinical symptoms. The impairment in healing of the scar and secondary infection are real risks in such cases.

It follows that the peritoneal edges should be approxi-mated loosely so that any fluid that does accumulate can escape into the peritoneal cavity, where it is more easily recognized and more efficiently handled. An extraperitoneal rubber drain should be inserted whenever there is doubt about the efficiency of haemostasis or any clotting defect present.

Finally the adnexae should be inspected to exclude any associated pathology before closing the abdomen, because unsuspected pathology is occasionally discovered.

HAEMORRHAGE, HAEMOSTASIS AND POSSIBLE COMPLICATIONS

Visibility for Haemostasis in Haemorrhage

The dangers of haemorrhage are twofold; not only is there the danger arising out of the amount of blood lost, but there is the additional risk of endangering neighbouring structures while achieving haemostasis in an obscured operative field. The greater the haemorrhage the more inefficient is suction to ensure visibility — only pressure and swabbing can clear a truly haemorrhagic operative field. Suction should be re-served for clearing the foetal air passages at caesarean section and its importance in this regard will be emphasized.

Haemorrhage before Delivery

Haemorrhage before the delivery of the foetus demands speedy temporary tamponade and expeditious delivery of the foetus, bleeding is predominantly traumatic and arises from

Ergometrine should not be given until the head has been delivered, lest difficulty in extracting the foetus results.

Postpartum Haemorrhage

1. *Traumatic haemorrhage.* Shortly after delivery of the foetus bleeding is predominantly traumatic and arises from the margins of the uterine incision. Traction on the stay-suture followed by application of Green-Armytage clamps at the angles, upper and lower margins of the incision, and to salient bleeding points, usually achieves haemostasis.

Manual removal of the placenta follows, and the uterus is 'exteriorized' onto the anterior abdominal wall.

2. *Downward tear in lower segment.* An unpleasant com-plication is a downward tear in the lower segment. From this blood usually wells up laterally below the uterine incision (usually on the left side). This is usually apparent after application of Green-Armytage forceps and the situation de-mands that there should be no delay in ramming a swab or pack over the bleeding area and instructing the assistant to apply compression while the surgeon proceeds with the im-mediate manual removal of the placenta followed by exteriori-zation of the uterus.

A combination of upward traction upon the uterus and compression maintains efficient haemostasis while the exact relationships of ureter, bladder angle, bleeding point and mar-gins of the tear are defined with accuracy. Only following these precautions (and mobilization of the bladder and ureter, if necessary), is the application of artery forceps and suturing permissible. One of us (D.C.)[2] has repaired a number of ureteric injuries following insufficient observance of these precautions.

Oozing from veins deep in the pelvis may require compres-sion with an indwelling gauze packing in those rare instances when ligation and suturing fail. Such cases also require counter-drainage with a rubber drain.

3. *Atonic haemorrhage.* Haemorrhage due to uterine atoni-city is usually prevented by the anaesthetist giving intravenous

ergometrine once the foetal head is delivered through the uterine incision. Yet should the uterus fail to contract after manual removal of the placenta, haemorrhage can be severe, so there should be no delay in exteriorizing and applying manual compression to the uterus through an encircling swab. If the uterus fails to remain contracted after a couple of minutes of such compression, a further dose of ergometrine seldom resolves the problem, nor (contrary to popular belief) do 'hot' swabs. Ten units of Syntocinon, on the other hand, injected into the uterine fundus, usually produces a strong wave of uterine contraction heralded by crinkling of the uterine surface.

The effect of intravenous ergometrine wears off quickly and cases which have manifested a tendency to uterine atonicity should be given a further injection of intramuscular ergome-trine 15 minutes after the intravenous dose.

There are very rare instances in which the uterus relaxes repeatedly and oozing arouses sufficient concern to require a hysterectomy. If such is the case it is vital not to defer the decision until the patient is moribund.

Post-caesarean Section Haemorrhage

Upon completion of the caesarean section a variable degree of uterine atonicity associated with clot retention is noted at the time of rubbing up the uterus, expressing clots and remov-ing the catheter. To forget to express clots can potentiate further serious haemorrhage concealed within the expanding uterine cavity.

The quantity of blood lost *per vaginam* in the first few hours after delivery has never been assessed, yet we believe that the average blood loss *per vaginam* at this stage is far more than is generally realized. Even more serious is the risk of blood and clots retained in an atonic uterus, which can amount to a number of pints. All too easily this can escape detection by the nursing staff, especially if the enlarged uterus underlies a vertical incision in the anterior abdominal wall.

For the foregoing reasons 10 units of Syntocinon are added to the intravenous infusion as a routine upon completion of the anaesthetic (i.e. when the very rare risk of ventricular fibril-lation, which might be precipitated thereby, is removed).

There are those rare instances in which the foregoing pre-cautions do not suffice and the volume and duration of vaginal bleeding give cause for alarm. If uterine atonicity and clot retention are the cause, the problem may be solved by the aforementioned procedures, but if the uterus is well contracted and bleeding persists, the origin of haemorrhage is the suture line and the uterine cavity must then be packed firmly under anaesthesia with a continuous gauze roll (e.g. 9 in. in width). Naturally a preliminary check on the efficiency of the patient's blood-clotting mechanism is made.

Should these measures prove unfruitful, the abdomen should be reopened forthwith before the patient's general condition deteriorates. If the bleeding is from the suture line it may have to be reopened and resutured. If this is unsuccessful or if the bleeding is due to recalcitrant atonicity, hysterectomy is the only recourse.

THE MODE OF EXTRACTION OF THE FOETUS
AT CAESAREAN SECTION

We are highly critical of the generally accepted method of removing an infant from the uterus by some haphazard 'slash and grab' technique.

Delivery of the Head in Vertex Presentation

We have evolved 4 distinct manoeuvres to be observed in the delivery of a head whose final mode of egress should be gentle, controlled and slow in mimicry of its ideal passage through the vaginal outlet.

The steps in question are: (*i*) Disimpaction of the head, (*ii*) correction of asynclitism, (*iii*) delivery of the head, and (*iv*) clearance of the air passages.

(*i*) *Disimpaction of the head.* Nothing surpasses the hand for this manoeuvre. If the head is impacted in the

pelvis it is essential that an assistant should disimpact it *per vaginam* before the insertion of stay-suture and incision into the lower segment. Following the incision of the lower segment, the vaginal hand of the assistant pushes the foetal head to a level convenient for the surgeon's hand to take over.

Once the foetal head is stabilized at the desired level in the palm of the surgeon's hand, the position of the anterior ear is established (with 2 fingers of the surgeon's free hand).

(ii) *Correction of asynclitism (aligning head to axis of proposed exit).* If the occiput is oblique or posterior it is easily manoeuvred into the transverse position and asynclitism is realigned favourable to the proposed direction of exit of the foetal head through the uterine and abdominal wall incision. Slight fundal pressure facilitates this procedure.

Knowledge of the exact position of the ear and the establishment of favourable synclitism permits the accurate application of the posterior blade of Wrigley's forceps followed by the application of the anterior blade. Difficulty in the application of the posterior blade will be experienced if the surgeon has failed to disimpact and further elevate the head sufficiently.

If the foetal mouth presents in the uterine incision, as much surrounding blood and liquor as possible is swabbed away and the air passages are cleared with the aid of suction through a rubber catheter. Wrigley's forceps are then applied in this position.

(iii) *Extraction of the head.* Gentle traction on Wrigley's forceps results in the foetal head distending the uterine incision, thereby 'corking' the remaining liquor in the uterine cavity and enabling the surgeon to ensure that the area surrounding the foetal mouth will be dry at the time of egress.

For a number of reasons we regard the surgeon's hand as inferior to forceps for 'delivery' of the foetal head: firstly because the cross-section area of the hand adds considerably to the area which must traverse the uterine incision when the head crowns — consequently greater force is required to achieve delivery; secondly because the further rotation of the hand which finally achieves delivery of the head is the most important cause of tears of an over-distended lower segment (a fact which we have proved beyond doubt in extensive experience of this serious complication) ; and finally because delivery of the foetal head by means of the surgeon's hand requires the application of an additional force at the uterine fundus which results in the expulsion of remaining liquor — (possibly infected and contaminated with blood or meconium) at the time of delivery of the foetal head. As a consequence the infant's first inspiration may be dangerously contaminated with potentially noxious fluid which could prejudice its chances of survival.

The gentle traction required to extract the foetal head with forceps in a slow controlled manner mimics the ideal natural slow distension of the perineum at vaginal delivery and contrasts strikingly with the forceful — often very forceful — pressure which an assistant not infrequently exerts upon the fundus to achieve delivery when the hand is employed for this purpose.

Extraction of the foetal shoulders and trunk does not constitute a problem.

(iv) *Clearance of the air passages.* Protection of the foetal mouth and nose from contact with liquor, meconium and blood by the interposition of a dry abdominal swab, and urgent clearance of upper respiratory passages with the aid of a size 10 Jacque's catheter attached to suction is an emergency requirement of paramount importance before the infant takes its first breath. Synchronous gentle upward massage of the trachea may aid in the expulsion of potentially noxious meconium if present, as may gentle compression of the foetal thorax after delivery of the shoulders.

A second aspiration of the foetal respiratory passages should follow delivery of the trunk (while the foetus lies head-dependent and semi-prone on the operating towels) before handing the infant over to the staff responsible for its further care.

Breech Delivery

The vaginal delivery of a breech as opposed to a vertex presentation entails additional risks. These risks are reflected — in some measure — when delivery is by lower segment caesarean section. Thus the risks of cerebral haemorrhage, premature aspiration of noxious contaminants of liquor amnii, and difficulty in delivering the after-coming head, are complications which must be fully appreciated and averted in the safe delivery of a breech by lower segment caesarean section:

(*i*) The breech is extracted up to the shoulders by traction upon the foetal feet.

(*ii*) The anterior followed by the posterior shoulder is delivered by a combination of appropriate inclination of the foetal trunk and flexion and adduction of the infant's humerus across its chest, 1 or 2 fingers of the surgeon's hand being employed for this manoeuvre.

(*iii*) The safest method of delivering the after-coming head of a breech is with forceps. The manual method involving more force, mis-directed force, more stimulation to the infant and less control of escape of the head through the incision, predisposes to cerebral haemorrhage, premature aspiration of liquor amnii and of possible noxious contaminants. The head should be brought through the incision occipito-lateral and — particularly in the case of a premature infant — the incision should be adequate, to avoid undue cranial compression.

The anlage of the incision should be maintained as dry as possible with swabs during egress of the head in order to avoid aspiration of liquor and contaminants, and emphasis should be laid upon the immediate suction-clearance of the infant's upper respiratory passages once its mouth becomes visible rather than upon the rapid extraction of the foetal head.

Transverse Lie

(*i*) When the liquor amnii is plentiful and the membranes intact, it may be possible to convert a transverse lie into a vertex presentation before incising the lower segment.

(*ii*) When the foetus is slightly less mobile within the uterine cavity and the foetal back is not posterior, it may be possible to convert a transverse lie into a vertex presen-

tation after incising the uterus. In order to do so, however, efficient disimpaction of the presenting part is essential and this progress must be maintained by upward pressure on the anterior shoulder by the assistant or surgeon. Thereafter the surgeon's free hand is slipped between the uterine wall and the foetal head and an attempt is made to bring the foetal head in line with the uterine incision while upward pressure on the anterior shoulder is maintained. The head is then delivered as a normal vertex delivery.

(*iii*) The majority of neglected cases require internal version. This procedure commences with the surgeon grasping one or both foetal feet, upon which undue traction should not be exerted until the foetal head has been disimpacted from the iliac fossa upwards towards the hypochondrium.

Thus internal version should not be performed by merely pulling upon the foetal feet. The foetal head should be pushed up synchronously with the surgeon's remaining hand to enable the version to be performed in the roomiest upper portion of the uterus. Thereafter the infant is delivered as already described in breech presentation.

When the lower segment is unduly thinned, with a firmly impacted dead foetus, it is safest to deliver the foetal shoulders first, after performing an intra-uterine decapitation with heavy scissors.

SUMMARY

Close personal observation and repeated staff discussions of complications which have occurred during and after more than 15,000 caesarean sections performed in the Obstetric Unit at King Edward VIII Hospital, since this became the Obstetric Unit of the University of Natal, have led to an appreciation of the risks of this operation which received insufficient attention in the literature.

The prevention and treatment of complications related to pre-operative and operative technique, to haemorrhage and haemostasis and to the mode of extraction of the foetus at caesarean section are described.

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