

## CAESAREAN SECTION\*

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Only those who have practised both before and since World War II can really appreciate the extent of the extraordinary revolution in obstetrics which has taken place during the last 40 years. It covers attitudes of mind and outlook on the part of both obstetrician and patient, as well as changing techniques; and these are intimately related to results as revealed by maternal and foetal morbidity rates. Four decades ago the maternal mortality rate (excluding abortions) in Britain was of the order of 4/1,000, and the perinatal mortality rate at least 70/1,000. The comparable figures today are 0.2 and 25.0/1,000. The maternal mortality rate has been reduced 20 times and the perinatal mortality rate 3 times. In addition, maternal and infantile morbidity, by way of permanent injury and crippling ill-health resulting from pregnancy and childbirth, are now relatively rare whereas, previously, they were rampant. The factors responsible for this change are multiple. Some, such as improvement in the general health and physique of the childbearing community, and the introduction of sulphonamides and antibiotics, antenatal care and blood transfusion, paralleled by changes in obstetric techniques, are well known and require no emphasis.

One technical advance, however, preceded all the other developments mentioned, and its importance rarely receives the recognition it deserves. This was the replacement of classical caesarean section by the lower uterine segment operation, using the transverse incision. I emphasize the transverse incision because the vertical incision (laparotrachelotomy)<sup>†</sup> which was used by several obstetricians in the USA,<sup>2,3</sup> and by Eardley Holland<sup>4</sup> in Britain, during the early part of this century, is now generally regarded as not offering equal safety. Indeed, it is usually impossible to keep a vertical incision within the lower segment itself; its upper end almost invariably encroaches on the upper segment.

### LOWER SEGMENT SECTION

The transverse lower segment operation is of some antiquity.<sup>5</sup> So far as Britain is concerned this technique was advocated, and performed in a relatively small number of cases, by Munro Kerr before 1921.<sup>6</sup> But his advocacy, and the experience of Continental surgeons, passed unheeded. It was not until St George Wilson (1931)<sup>7</sup> reported the results of a consecutive series of 50 operations, performed mostly on women in labour, during the period 1926 - 1930, that obstetricians in the United Kingdom were impressed. All the younger Liverpool obstetricians (including MacIntosh Marshall who later wrote extensively on the operation) came under the influence of St George Wilson, with the result that from 1931 onwards they rarely, if ever, performed classical caesarean section. The cult then spread rapidly throughout the North of England<sup>8</sup> and to

Ireland, but it took 25 years to convert obstetricians working in some parts of Britain. The rate of spread to Commonwealth and other English-speaking countries was similarly patchy.

Lower segment caesarean section, which we now take for granted, revolutionized obstetric practice because it made abdominal delivery safe even when carried out late in labour, even when intra-uterine infection was already present. And this was true before any sulphonamides and antibiotics were available. During the first quarter of this century classical caesarean section carried out when labour was established and the membranes were ruptured carried an immediate maternal mortality rate of 10%, rising to 30% if there had been several vaginal examinations or attempts at vaginal delivery.<sup>9,10</sup> This made caesarean section unacceptable except as an elective operation, and outruled its use for conditions such as prolonged labour, foetal distress and prolapsed cord. Once a patient embarked on vaginal delivery there was no turning back, even if the alternatives were allowing the baby to die *in utero*, or internal version, high forceps delivery, craniotomy and other destructive operations. It was the introduction of the lower segment operation which permitted the obstetrician to change his mind and treatment in the interests of either mother or baby. It was this which resulted in the whole concept of trial of labour and subsequently of even trial of forceps; it was ultimately responsible for the virtual disappearance of difficult vaginal delivery and of birth injury to mother and baby. Moreover, the operation permitted the widening of the indications for caesarean section to include inefficient uterine action, malposition of the foetus, prolapsed cord, foetal anoxia arising during labour, and antepartum haemorrhage.

In short, the whole approach of the modern obstetrician to practically every obstetric problem is attributable to the acceptance of lower segment caesarean section as an essential part of his armamentarium. Chemotherapy, antibiotics and blood transfusion have in many respects merely been ancillary, although life-saving, aids.

Munro Kerr's advocacy of the lower segment technique rested mainly on the fact that the resulting scar, unlike the upper segment scar, rarely ruptures in a subsequent pregnancy and labour. This is a real advantage, but the overriding consideration emphasized by Wilson<sup>7</sup> and his followers<sup>5,8</sup> is that the lower segment operation, if properly performed, carries a maternal morbidity rate which is very much lower than that of the classical operation. This is especially true in respect of postoperative peritonitis, but it also applies to other complications such as ileus, adhesion formation and intestinal obstruction.

These considerations are sometimes overlooked and, placing their faith in antibiotics, some obstetricians are carrying out and advocating a return to classical caesarean section for certain indications. Undoubtedly a vertical incision into the uterus may be preferable in dealing with an impacted shoulder presentation because it may then be

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†731 laparotrachelotomies were performed in the Chicago Lying-in Hospital between 1915 and 1928.<sup>1</sup>

impossible to deliver the baby through a transverse incision. A classical operation can be essential when labour is obstructed by a fibroid occupying the lower segment. But these are rare circumstances. The danger lies in the temptation to resort to classical caesarean section on the grounds that it permits a quicker and easier delivery when a baby is distressed, and when the mother is seriously ill with systemic disease. Another example is the modern tendency to avoid the lower segment in cases of placenta praevia because it is assumed that this makes for less risk of haemorrhage and is also advantageous to the baby. Those who adopt this attitude fail to recognize that it was shown many years ago, and even before the establishment of efficient blood banks, that no matter how threatening the appearance of dilated veins over the placental site may be, the lower segment operation is 9 times safer than the upper segment operation in cases of placenta praevia.<sup>11</sup> The safety of the operation in this and other respects depends on certain technical details which were emphasized by obstetricians of an earlier era but which are often overlooked or neglected. It is proposed here to mention only two; others, such as accuracy in the suturing of the uterine incision, are well known.

#### *Some Technical Points*

*Avoiding postoperative peritonitis and peritoneal adhesions.* The essential principle of the lower segment operation from the standpoint of avoiding peritonitis is to place the incision wholly within the lower uterine segment and as low down as possible. Any incision which, despite accurate closure, permits a direct line of communication between the uterine cavity and peritoneal cavity allows the transfer of organisms. A single wound, or suture lines which are directly superimposed, can never be watertight. The overriding object of the lower segment operation is therefore to have the uterine wound as far away as possible from the suture line in the uterovesical pouch. The reflection of the peritoneum from the uterus to the bladder marks the upper limit of the lower segment<sup>5</sup> (Fig. 1). When this is incised transversely the bladder needs to be pushed well down to permit the placing of the uterine incision 3 or 4 cm. below. The two suture lines are then ultimately at such different levels that infected material cannot pass from the uterus to the peritoneum. It may escape into the uterovesical space but is there arrested and controlled by pelvic cellular tissue and by the bladder itself which falls back to cover the lower segment wound. The proper placing of the incision is so important that those who first practised this operation often said that the operation should preferably never be performed until labour was so well established that the lower segment was well formed and of liberal extent.

A casual incision placed somewhere transversely immediately below the uterovesical pouch, rather than deep in the pelvis, may also lead to a scar which is less secure from the standpoint of rupture in a subsequent labour. Indeed, it may well be in the upper rather than the lower segment, and this may explain why rupture of a 'lower segment' scar appears to be more common now than it was 30-40 years ago.

Adequate displacement of the bladder and freeing of the uterovesical pouch of peritoneum also allows the

loose peritoneum to be subsequently gathered together with a running suture to leave a very small scar exposed to the abdominal contents. This, in turn, prevents seepage of blood to cause ileus, and minimizes the chance of peritoneal adhesion formation.



Fig. 1. The puerperal uterus divided sagittally to show the relationship of the lower segment to the uterovesical pouch of peritoneum. (Photograph by courtesy of the late Mr C. Marshall.)

*Avoiding haemorrhage.* To reduce the amount of bleeding from the incision in the lower segment—and this applies especially in cases of placenta praevia—the initial incision should be centrally placed and of a width sufficient only to admit one finger of each hand. The incision is then widened transversely merely by stretching it digitally. This technique, advocated by Marshall,<sup>5</sup> is easy and results in ready separation of the tissues without unwanted tearing. Large blood-vessels are not opened as they may be if the original incision is enlarged with scissors. Injury to major branches of the uterine vessels is also avoided

by recognizing and allowing for dextro-rotation of the uterus in late pregnancy.

#### THE INCIDENCE OF CAESAREAN SECTION

Under modern conditions, and with all ancillary therapeutic agents available, lower segment caesarean section carried out before or during labour is remarkably safe. The most dangerous feature is probably the anaesthesia. Even when anaesthetic catastrophes are included, the mortality rate in Britain is now no higher than 1.5 to 1.7/1,000, and at least half these deaths are attributable to the maternal disease indicating the operation, rather than to the operation itself.<sup>12,13</sup> The mortality rate is now 3 times less than it was in 1949. This permits a widening of the indications for caesarean section, and it is reckoned that the operation is now the means whereby 3.5% of all babies are delivered in England and Wales. The figure has risen by 1.0% in the last 10 years but, during this time, the mortality rate attending the operation has not diminished. In hospital practice in Britain 5% of births take place by way of caesarean section, the figure rising to 6.9% in teaching hospitals where the admission of patients is more selective. A similar picture is presented by study of the statistics at one of the hospitals in which my unit works, Mill Road Maternity Hospital. There, during the period 1951-1955, the section rate varied from 2.2 to 3.2% of deliveries. Thereafter it rose to reach a figure of 6.8% in 1962, since when it has fluctuated between 4.3 and 7.0% (Fig. 2). The annual fluctuations reflect changes in staff at

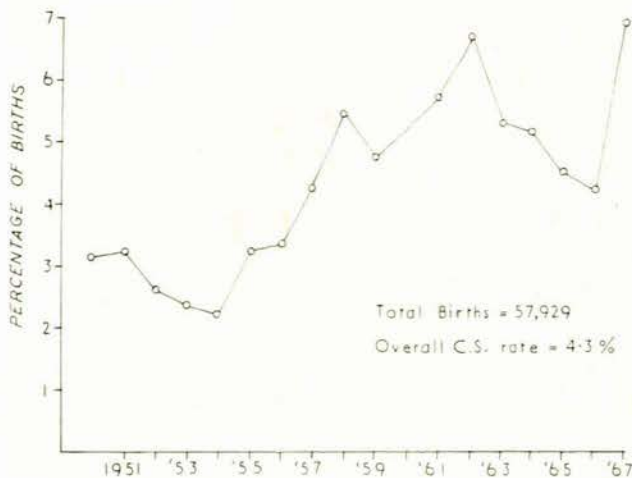


Fig. 2. Percentage of births by caesarean section at Mill Road Maternity Hospital.

the senior resident medical officer level, and indicate how often the indications for caesarean section are matters of personal opinion.

The increase in the caesarean rate, apparent in most countries during recent years, has occurred despite the gradual disappearance of contracted pelvis and is explained by the performance of more and more operations in the interests of the baby and for postmaturity, placental insufficiency and foetal distress arising in labour. Indeed, I have heard it said that to achieve the best foetal results,

even among communities where contracted pelvis is rare, 10% of all babies should be delivered by caesarean section. In fact, there is a limit to the value of abdominal delivery in this respect and often it results in nothing more than converting a stillbirth to a neonatal death, leaving the perinatal mortality unchanged. Experience in Aberdeen, which is confirmed by that in many centres, shows that an increase in the section rate beyond 6.3% for the whole community is unlikely to result in the saving of more babies.<sup>14</sup>

A major difficulty in assessing the place of caesarean section as a treatment for 'foetal distress' is the diagnosis of this condition. The diagnosis of 'distress' by the standard clinical methods is notoriously unreliable, and many sections carried out because the baby is passing meconium or has a change in heart rate may be unnecessary. Already it has been shown that foetal blood sampling to detect acidosis arising during labour is more reliable than any clinical sign of foetal distress. Moreover, it would appear that only when the presence of acidosis is clearly demonstrated is the foetus at risk.<sup>15</sup> So foetal blood sampling has the effect of reducing rather than increasing the section rate, and this without any adverse effect on the perinatal mortality rate among babies who show clinical signs of distress in labour.

#### SCAR RUPTURE

One reason for adopting a conservative attitude towards the practice of caesarean section has long been the fear that the resulting scar in the uterus may prejudice future childbearing. This consideration remains important, especially in those countries where family size is uncontrolled and where women with a section scar in the uterus may not report to hospital for delivery.

A main advantage of the lower segment operation is that the resulting scar is less liable to subsequent rupture than is an upper segment scar. The risk quoted for the latter is generally that reported by Holland<sup>16,17</sup> namely 4%, but rarely is the basis for the percentage calculation appreciated. Holland calculated the risk as 4% of all subsequent pregnancies which progressed to 36 weeks or more, and irrespective of whether the baby was delivered vaginally or by elective repeat section.

The fact that he included late pregnancy is important, because unexpected rupture with the patient not in labour is a dangerous feature of classical scars, and rarely, if ever, occurs as a symptom-producing entity with lower segment scars. The risk of rupture of upper segment scars under modern conditions is unknown, partly because the classical operation is not performed sufficiently often for statistics to be collectable. With the growing number of therapeutic abortions carried out by hysterotomy, however, upper segment ruptures during either pregnancy or labour may become an increasing problem in the future.

One of the chief disadvantages of the vertical incision in the lower segment is that it carries a higher risk of rupture than the transverse incision. This is because the upper end of the incision often encroaches on the upper segment and it is this portion which disrupts. Poor scars following laparotrachelotomy were studied by Greenhill and Bloom.<sup>1</sup>

The risk of rupture of a transverse lower segment scar, unlike that for a classical scar, is generally calculated in terms of a percentage not of all pregnancies but only of those in which subsequent vaginal delivery is attempted; so the figure usually reported is not comparable to that quoted for the classical scar.\* Moreover, the diagnostic criteria of rupture are important in so far as a lower segment scar can rupture silently and cause no symptoms even though vaginal delivery is accomplished. At Mill Road Maternity Hospital it is made an absolute rule to palpate the scar by intra-uterine examination immediately after vaginal delivery in all cases, and the finding of a hole is often the only evidence of rupture. Indeed, in recent years a rupture so diagnosed was left untreated on 2 occasions and the patient came to no harm.

In this hospital, during the years 1951-1967, 1,513 women with section scars in the uterus were delivered, and 20 of those who were allowed to go into labour sustained ruptures. In one case the scar was a rare example of an upper segment one.

Of the 1,513 women, 570 were delivered by elective caesarean section at term. In one of these cases the lower segment scar was found completely disrupted, but many other findings of a defective scar and bulging membranes are not recorded. Of 943 women who were allowed to attempt vaginal delivery with a lower segment scar in the uterus, 19 (2.0%) sustained a rupture of the scar (Table I). The incidence was 1.1% for those who delivered vaginally, and 8.0% for those who came to abdominal section after attempted vaginal delivery. The latter very high figure is explained by the fact that it was the occurrence of rupture which often prompted laparotomy.

TABLE I. LOWER SEGMENT SCARS AT MILL ROAD MATERNITY HOSPITAL (1951-1967)

| Type of delivery                                   | No. of cases | Scar ruptures | %   |
|--|--------------|---------------|-----|
| All deliveries of women with scars                 | 1,513        | 20*           | 1.3 |
| Vaginal deliveries                                 | 817          | 9             | 1.1 |
| Caesarean section after attempted vaginal delivery | 126          | 10            | 8.0 |
| All vaginal or attempted vaginal deliveries        | 943          | 19            | 2.0 |

\*This figure includes one rupture discovered at elective caesarean section. Many other weak or defective scars with bulging membranes were found in these circumstances but are not recorded.

This finding of a relatively high incidence of lower segment scar rupture is not in accord with the generally accepted opinion as to the rarity of the accident. It may be explained in part by the care taken to palpate the scar in every case following vaginal delivery. Unless this had been done, and if it had been assumed that an apparently normal delivery meant an intact scar, 9 of the ruptures would have been missed and many of the women concerned would probably have come to no harm. It seems likely that women with a hole in their lower segment can remain in apparent good health.

Nevertheless, my impression is that, in my own centre, rupture of the lower segment scar is much more common

\*In Holland's<sup>4,10</sup> series there was one rupture for every 4.3 successful vaginal deliveries.

now than it was 30 years ago. In Liverpool, in the period 1929-1939, rupture of the lower segment scar was hardly ever recorded. The change is, in part at least, explained by the modern failure to appreciate the need to place the scar low in the uterus. This in turn may be related to the fact that, with widening indications, the operation is frequently performed on women not in labour and with poorly formed or defined lower segments. In the early days of the operation, it was for the most part carried out for disproportion which only became proved by failed trial of labour. Many modern 'lower segment' operations are carried out by way of an incision placed in or very near the upper segment. It is the scar resulting from these which is most likely to rupture.

#### Diagnosis of Lower Segment Scar Rupture

Rupture of the lower segment scar is difficult to anticipate and to diagnose. Pain and tenderness over the scar in late pregnancy are, in our experience, of no prognostic value. The woman with a strong scar may complain of lower abdominal pain, while the one with a weak scar may be symptomless. Tenderness over the lower segment scar in labour, together with the formation of a swelling in that area, did, however, lead to the diagnosis in several cases. Rupture of the scar is rarely manifested by collapse or other symptomatic upset of the patient, because the lesion is extraperitoneal and because bleeding from the torn fibrous tissues tends to be minimal. An escape of blood vaginally during labour may, however, be a pointer.

When the patient delivers vaginally the only reasonably certain method of excluding scar rupture is by intra-uterine palpation, and this should be made a rule. In one of our cases, however, the examination carried out by a less experienced medical officer failed to reveal a defect, which was only discovered later when the patient developed symptoms and these prompted further exploration of the uterus by a more expert obstetrician.

In making a decision to permit vaginal delivery after previous caesarean section, it would be helpful to have available some means of prior assessment of the integrity of the lower segment scar. In regard to classical scars, and entirely because of Holland's<sup>4,10</sup> findings of 40-50 years ago, great attention is always paid to a history of pyrexia and infection occurring after the primary operation. Many assume that the same applies to the lower segment operation, but there is little evidence that it does. The lower segment incision heals by fibrosis and it can be argued that the presence of low-grade infection in the uterovesical space may strengthen rather than weaken the scar. Certainly, in our experience, the occurrence of scar rupture cannot be related to a previous morbid puerperium.

There are some who believe that every succeeding pregnancy and labour further weakens a scar, but again the evidence for this is scanty. The fact that a woman with a scar delivers one baby safely and then ruptures the scar in the next labour does not mean that the previous labour weakened the scar. The probability is that a defect was present even before the first labour, at which time silent rupture occurred but passed unnoticed because the uterus was not explored. The value of scar palpation lies not merely in detecting silent ruptures but in assessing the thinness of the scar as a guide to management in the

next pregnancy. Thus, if a good scar is found, vaginal delivery can be allowed in the next pregnancy; if the scar is thin or depressed, there is a clear indication for elective section next time.

One method of assessing the scar from the standpoint of future childbearing is to carry out hystero-graphy 3 months after the original section. This technique was devised by Baker<sup>16</sup> whose method was seen and subsequently adopted by Poidevin.<sup>17</sup> Its applicability to the individual case is limited, but the over-all results are of great interest in that they indicate that defective healing of the lower segment is not uncommon; indeed, a hole in the lower segment may persist in apparently healthy women (Fig. 3). These are the ones who are likely to show the syndrome of scar rupture in any subsequent labour. In other words, the defect is present both before and during pregnancy; labour merely results in its extension.

#### *Management of Labour after Previous Caesarean Section*

If the above concept is accepted, it means that little can be done to protect the scar during a subsequent labour. It is often suggested that a prophylactic forceps delivery should be carried out once the cervix is fully dilated. In fact, any extension of a pre-existing defect occurs early in labour, with the first expulsive contractions of the uterus. If a scar remains intact throughout the first stage, it is almost certain to withstand uterine activity in the second stage.

The most important part of management of a subsequent labour is to avoid any obstetric manipulation of any kind, for this may disrupt even a reasonably good scar. In 7 of our cases of rupture this rule was broken and mid-forceps delivery (with rotation of the head in 2 cases) was performed. The guiding principle should be only to allow vaginal delivery if the obstetric situation is normal in all respects. If there is any abnormality such as post-maturity, breech presentation and multiple pregnancy, let alone a recurrent indication for abdominal delivery, repeat section is indicated. The same is true if there is any need for interference. Even induction of labour by rupture of the forewaters should not be performed if there is a scar in the lower segment.

#### *Vaginal Delivery after Previous Caesarean Section*

Bearing in mind the risk of rupture of the scar, some might find no place for subsequent vaginal delivery. Nevertheless, rupture of a lower segment scar is not so dangerous as rupture of a classical scar. Haemorrhage and shock of serious degree are exceptional results and the accident is rarely fatal. None of the patients in the series reported here died.

Lower segment scar rupture nevertheless carries a real hazard in that very often the bladder, which is adherent to the scar, is also involved. The bladder was torn and had to be repaired in 3 out of the 19 ruptures recorded here, and the operations involved to establish cures were not easy.

The realization of these points has affected the practice at Mill Road Maternity Hospital over the years. Thus, 80% of women with a section scar were allowed to enter labour in 1951 and 70% delivered vaginally. In 1967 the figures were 51% and 37% respectively (Fig. 4). Annual

fluctuations between these 2 years again represent the individual outlooks of senior resident medical staff.

The real justification for permitting vaginal delivery

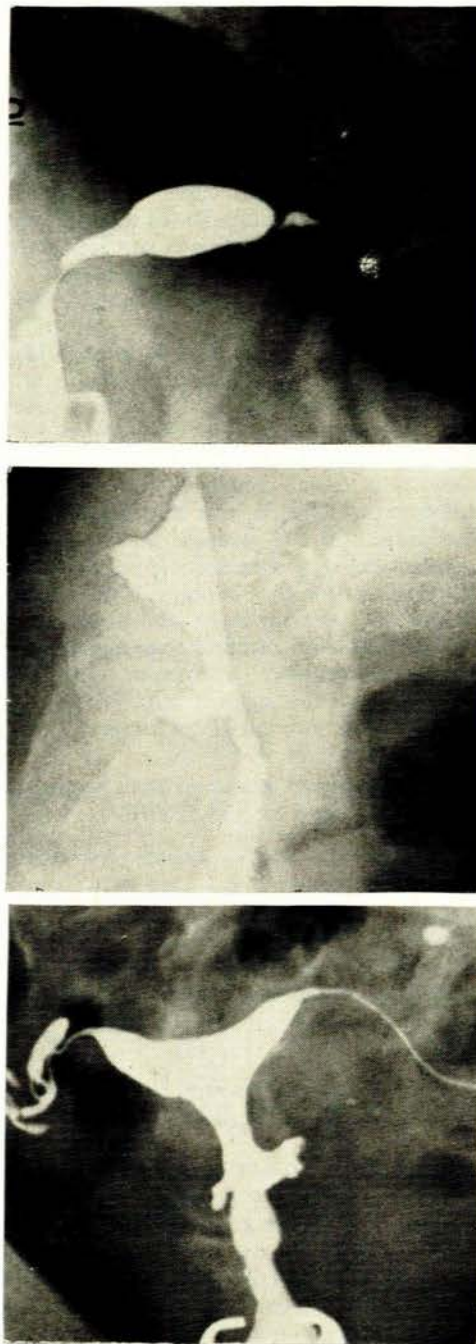


Fig. 3. Hystero-graphy 3 months after lower segment caesarean section. *Above*: Lateral hystero-graph showing a normal-shaped lower segment with a presumed sound scar. *Centre*: Lateral hystero-graph showing a major defect in the anterior wall of the lower uterine segment. *Below*: Anteroposterior hystero-graph showing evidence of a hole in the lower segment scar with escape of the radio-opaque medium into the broad ligaments. Patient well and symptomless. (Photographs by courtesy of Dr K. Baker.)

after previous caesarean section is to avoid repeated major operations on women who intend to have large families. The time has now come to recognize, however, that more and more women wish to limit the number of their children to 2-4 and this makes it necessary to review present policy in line with the habits and outlook of any community.

her as is vaginal delivery. Moreover, in England and Wales the mortality rate attending the operation has not fallen in the last 10 years. Thus, valuable though the operation is when abnormality arises, caesarean section can never be acceptable merely as a labour-saving device.

## SUMMARY

The adoption of the lower uterine segment operation in place of the classical operation 30-40 years ago is, it is suggested, the basis for modern obstetric practice. Its safety depends on the observance of certain technical points which, emphasized in the past, are now sometimes overlooked. An increased incidence of caesarean section, and a broadening of its indications to cover the interests of the foetus, have contributed to the lowering of the perinatal mortality rate, but there is a limit beyond which foetal results are not improved.

Despite its relative security the lower segment scar ruptures in 2% of women who subsequently attempt vaginal delivery. Rupture of a lower segment scar does not usually threaten maternal life but it involves real risk of injury to the bladder. The diagnosis of impending and of actual rupture of the lower segment scar is discussed.

The place of caesarean section, and that of vaginal delivery after previous lower segment section, require to be reassessed against the background of the present tendency to family limitation.

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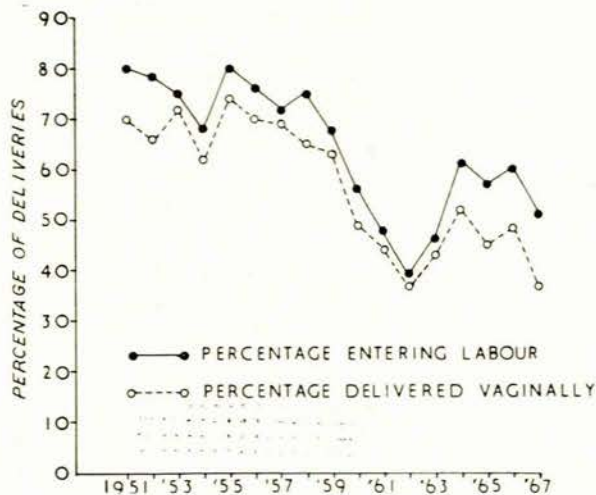


Fig. 4. Patients in labour after previous caesarean section at Mill Road Maternity Hospital (1951-1967).

These considerations apply equally when deciding the place of primary caesarean section. If women do not intend to have large families there is no need to risk the health of mother or baby in any pregnancy by avoiding caesarean section on the grounds that it prejudices future childbearing. If need be, each of the 2 or 3 children of the family can be delivered abdominally. Nevertheless, as emphasized previously, there is a limit to the use of caesarean section carried out with the main object of achieving the best results for the baby. Too liberal a use of the operation, without real justification, is also condemned by the fact that caesarean section carries a much higher maternal risk than does vaginal delivery. In England and Wales the maternal mortality rate for caesarean section is 1.5/1,000; for all deliveries it is 0.2/1,000.<sup>13</sup> Although such a direct comparison contains fallacies, there is little question that caesarean section carried out on a healthy mother is probably 3-7 times as dangerous for