THE PUERPERAL MORBIDITY RATE IN PATIENTS DELIVERED NORMALLY.*

A COMPARISON BETWEEN CASES EXAMINED VAGINALLY AND CASES
NOT SO EXAMINED, WITH REMARKS ON THE ADVANTAGES
AND LIMITATIONS OF RECTAL EXAMINATION.

BY

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MEDICAL students and pupil midwives at the Leeds Maternity Hospital have been taught for some years that vaginal examination during labour is a risky procedure, which should not be used except in certain indications. It was with a view to finding out whether this teaching was justified by the facts that I have investigated a series of 1,546 consecutive normal cases delivered in the hospital between August, 1926, and March, 1928, during which time I was the resident medical officer.

I have excluded from my normal category (1) all cases requiring intrauterine manipulation or instrumental assistance during labour; (2) all cases where there was any obvious predisposing cause of puerperal sepsis—for example, ante-partum and post-partum haemorrhage; (3) all cases of puerperal pyrexia, due to definite extragenital causes such as bronchitis, mastitis, phthisis, pneumonia, pyelitis, tonsillitis, etc. All cases with a perineal tear are classified separately to avoid confusing the issue.

A number of cases admitted from outside and subsequently delivered spontaneously without vaginal examination in the hospital are omitted, as, although they were almost certainly examined vaginally before admission, I have no sure information on the point. The morbidity rate in this class was abnormally high.

The normal cases remaining I have classified according to whether they were examined vaginally or not, and I have described the puerperium as either (1) morbid—by the Ministry of Health standard of puerperal pyrexia; (2) submorbid—where the temperature reached 99° or more at least twice during the twenty-one days following delivery; (3) normal—including apyrexial cases, cases where the temperature never reached 99°, and cases where the temperature reached or exceeded 99° on one occasion only. The temperature was taken in the axilla in all cases.

The vaginal examinations were done in almost all cases by pupil midwives under the supervision of the labour ward sister, in order to comply with the existing rule of the Central Midwives Board, which requires a pupil to perform a certain number of vaginal examinations before she can be signed up. It is a rule of the hospital that the labour ward sisters only perform abdominal and rectal examinations in their management of the normal cases.

The patient's vulva is shaved on admission and the external parts are cleaned with watery biniodide solution 1 in 1,000 before any vaginal examination is done, and also before delivery. The examiner wears gloves which have been boiled and steeped in biniodide solution.

The results of the investigation are rather what might have been expected. The morbidity rate of cases examined vaginally was almost twice that of cases examined only abdominally and rectally, and the morbid *plus* submorbid rate of cases examined vaginally was nearly one and a half times as great as that of those not so examined.

TABLE I.—Cases Examined Vaginally (309).

Number morbid	7 = 2.3 per cent.
Number submorbid	21 = 6.8 "
Total morbid and submorbid	28 = 9.1 "

TABLE II.—Cases not Examined Vaginally (778).

Number morbid	10 = 1.3 per cent.
Number submorbid	41 = 5.3 "
Total morbid and submorbid	51 = 6.6 "

The remainder of the 1,546 cases consisted of those with perineal tears. In this class the morbidity was, again as might have been expected, still higher.

* A paper read before the North of England Obstetrical and Gynaecological Society on May 24th, 1929.

TABLE III.—Cases with Perineal Tears (459).

Number morbid	12 = 2.6 per cent.
Number submorbid	50 = 10.9 "
Total morbid and submorbid	62 = 13.5 "

I quote the figures for forceps deliveries in the booked cases of the hospital over about the same period—that is, 1926, 1927, and 1928—to show how increasing the elements of vaginal examination and of trauma in a case increases still further the morbidity from sepsis. Of 199 cases, 21, or 10.6 per cent., were morbid from sepsis.

Presumably the increased morbidity in normal cases examined vaginally is not due, or at any rate not entirely due, to the introduction of organisms from outside by the examining finger, since this should be avoided by the precautions which are taken before a vaginal examination is made; it is probably due to the finger moving infected matter from a comparatively safe position in the vagina to a dangerous position within the cervix.

If it be accepted that vaginal examination during labour carries with it an increased risk of puerperal morbidity, I take it that we should avoid such vaginal examination when possible. In my view vaginal examination cannot be satisfactorily avoided in the following classes of case, and should be restricted to them:

1. Cases of ante-partum haemorrhage, however slight the loss, because of the importance of making an early diagnosis and establishing early treatment in cases of placenta praevia.
2. Cases where it is important to know the exact size of the os, and this cannot be gauged from the rectum; these are usually cases of breech presentation.
3. Cases where the doctor has been called in by a midwife or another doctor to a patient whom he has not seen before, where he cannot decide on the proper treatment without vaginal examination—for example, a case where there is some incompatibility between the head and the pelvis.
4. Cases where the doctor is about to resort to operative treatment—for example, before applying forceps or extracting a breech presentation.

In the remaining cases rectal examination is quite sufficient if any pelvic examination is necessary.

In cases seen at the ante-natal clinic where there is any question of incompatibility between the head and the pelvis, we avoid the necessity for making a vaginal examination during labour by examining the patient under anaesthesia at the thirty-sixth week and estimating, by Munro Kerr's method, the probability of the head passing through the pelvis undamaged at term; the diagonal conjugate is measured on the same occasion.

I now propose to amplify the statement already made that rectal examination, except in the four categories mentioned, is sufficient when a pelvic examination is necessary during labour.

Pelvic examination during labour is most usually undertaken to find out the amount of dilatation of the cervix, virtually all the other facts which it is desirable to know being ascertainable by abdominal examination. Any person of average intelligence who has had the necessary amount of experience can tell the size of the cervix by rectal examination, except in a very small proportion of cases. This small proportion is largely composed of breech presentations, where the consistency of the presenting part so closely resembles that of the cervix that it is not easy from the rectum to distinguish the one from the other; the same difficulty is encountered rarely in cases of head presentation where there is a large amount of caput.

Rectal examination can supplement abdominal examination in several other points of diagnosis. For example, if the membranes are intact their presence is no more difficult to recognize from the rectum than from the vagina. If the anterior tip of the cervix is oedematous, this can be felt from the rectum, though its treatment generally requires vaginal examination. Prolapse of the cord is another condition usually calling for treatment involving vaginal examination; in the majority of cases the cord appears at the vulva immediately after prolapse; if it does not it can be felt on rectal examination. Diagnosis of presentation can nearly always be made from the abdomen; but it is seldom possible to be sure of a

face presentation abdominally, while the diagnosis is easily made from the rectum as soon as the face is within reach of the examining finger; I have seen it so made by a pupil midwife on several occasions.

Let us consider the position of the midwife with regard to vaginal examination, in view of the four indications for it which I have already given.

1. If one of her patients bleeds ante partum, her duty is to summon medical aid; vaginal examination should be done, not by her, but by the doctor who is going to treat the patient.

2. If she has a case of breech presentation, she should again obtain medical aid. By the existing Central Midwives Board rules she is allowed to treat the uncomplicated breech, but who can be certain that a breech will be uncomplicated until delivery is in progress?

The third and fourth indications are not applicable to the midwife.

I therefore hold that it is not necessary for midwives to make vaginal examinations, and very desirable that they should be forbidden to do so.

Lastly, I should like to point out that if a doctor makes no vaginal examination on a given patient, and she subsequently develops puerperal sepsis, he can be quite clear in his own mind that he has not introduced the infection.

I am indebted to the honorary staff of the Leeds Maternity Hospital for their permission to make use of the records of cases under their care in compiling this paper, and particularly to Mr. William Gough for suggesting the investigation.

THE MICROSCOPICAL EXAMINATION OF MATERIAL CONTAINING FILTERABLE VIRUSES, AND THE LIMITS OF VISIBILITY.

BY

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THE term ultra-microscopic applied to the filter-passers seems somewhat unfortunate, and this expression, together with the idea that they could only be studied by means of ultra-violet photomicrography, and the erroneous idea of the limit of the ordinary microscope, is perhaps responsible for the meagre account of the actual appearance of some at least of these bodies.

THE EXTENT OF VISIBILITY WITH THE ORDINARY MICROSCOPE.

The size of a minute organism or particle that is visible with the microscope depends on several factors, amongst which are: the numerical aperture of the objective; the wave-length of the colour by which it is illuminated; the method of illumination, whether by transmitted, oblique, or dark ground; the refractive index of the medium in which it is mounted; and the depth of the stain. The numerical aperture (N.A.) of the objective and the wave-length of the colour used are by far the most important elements, and, speaking generally, the higher the N.A. and the shorter the wave-length of light the smaller the particle that can be seen.

In stained preparations the depth or the duration of the staining makes a very considerable difference in the apparent size of an object. For example, if a film containing *T. pallidum* be stained for only five minutes with Giemsa, and then examined dry, without a cover-glass, with an 8 mm. objective, using dark-ground illumination, it is possible to find a spirochaete. If this be examined with 1/12 inch oil immersion with ordinary illumination it will be very difficult to see the spirochaete, but when seen it will appear as the most delicate spiral that can be imagined. Let the film be stained for twelve or twenty-four hours, and the spirochaete will appear as a thick spiral cord. Even greater differences will be found in the apparent size of an object when faintly stained with one of the aniline

dyes, when compared with one stained or impregnated with one of the flagella stains.

It is often stated in the literature dealing with filter-passers (Boycott, Martin, Cowdry) that organisms of the size of 0.2 or 0.25 μ are "somewhat about the limit of direct microscopic vision" (Boycott¹), and that anything smaller than that would be invisible with the highest powers of the microscope. But this is very far from being correct.

It would seem that the limit of resolution or separation has been confused with that of visibility, whereas they are totally different things. The resolution of an object glass is its power of dividing or separating a certain number of lines or dots to the inch, and our present limit of resolution of two lines or dots with ordinary light and axial illumination is generally given as 0.25 μ , and for oblique light 0.2 μ . The limit of visibility, or extinction limit, is the size of the smallest isolated dark particle that can be seen with transmitted light on a bright field with a given numerical aperture.

Whilst the limit of resolution with a lens of N.A. 1.4 is about 0.25 μ , the limit of visibility of the same lens employed at full aperture would be considerably greater; and with this object glass, using white light, a dark isolated germ or particle just over 0.074 μ in diameter will be visible, whilst with green light a germ just over 0.0673 μ should be seen.

Mr. Edward Miles Nelson, who has devoted the whole of his life to the microscope, and who is undoubtedly the greatest authority on the subject, more than twenty years ago communicated a paper to the Royal Microscopical Society² "On the measurement of very minute microscopical objects." He states: "Briefly, then, the method is to bring the object just to the point of invisibility by reducing the W.A. (working aperture), and then the correction for antipoint will be the measure of the object." A full table of the values of the N.A. is given in the paper. I may add that one can determine the minimal visible of any objective by the following calculation: for white light of 43,000 waves per inch divide 1.041 by the N.A.; for green light of 50,000 waves per inch divide 0.942 by the N.A. of the object glass. These figures assume that the objective is used at its full aperture, and not, as is so commonly the case, by using, or rather degrading, say a 1/12 inch lens of N.A. 1.3 or 1.4 with an ordinary Abbé condenser.

Mr. Eliot Merlin, also a very great expert on both the microscope and telescope, has stated the case very clearly in *Watson's Microscope Record*, 1929, No. 17.

"The separating limit of any given N.A. should not be confused with its visibility limit for an isolated particle, such as a stained coccus viewed by transmitted light on a bright field. Unfortunately such confusion is common, it being frequently assumed that the minimum diameter of an isolated particle, or germ, observable under such conditions in the ordinary microscope must exceed about 0.25 μ , this being really only slightly beyond the limit for an object glass of only N.A. 0.4 (that is, about that for a low-apertured cheap 1/2 inch objective) employed at its full working aperture in white light (5,607 wave-lengths), while the visibility limit for the same object glass with a screen (5,080 wave-lengths) is 0.236 μ . That the separation and visibility limits are different can be quite easily demonstrated. Select on a virus preparation two cocci, the diameter of which happens to be about their distance apart. Reduce the aperture of the object glass until no interval between the two cocci can be detected. This is the separation limit for that aperture for germs or particles of similar diameter, but the joined-up pair of cocci will still be quite visible. Of course, it will be borne in mind that two distinct just-in-contact images of the two equal-sized (in reality well separated) cocci are being dealt with. It will require a considerable further reduction in the N.A. of the object glass to cause the images to completely fade away, which they will be found to do at a certain very definite aperture, this forming the visibility limit. Any selected single isolated coccus of accurately estimated (or otherwise measured) similar size will be found to exhibit a like visibility limit."

In an earlier number of the same journal³ Mr. Merlin says:

"Apparently the difficulty of demonstrating living filter-passing cocci is in most cases merely due to their transparency in aqueous media, and not to their minute dimensions being beyond the defining power of the ordinary microscope. This difficulty can be readily overcome by observing them on dark ground."

In conclusion he says:

"In the writer's opinion it is of paramount importance that the true optical capacity of the ordinary worker's microscope, furnished with ordinary glass and fluorite achromatic or apochromatic object glasses, should be clearly understood and not underrated, this being the tool in exclusive use by thousands of