proportion of cases come for treatment they are in the secondary stage, and in such the original causative factors may no longer be operative. The condition is in fact a self-perpetuating one. The course of development from the primary to the secondary stage is complex, but as the child becomes aware that his symptoms produce unpleasant penalties he becomes anxious and uncertain, and a vicious circle of anxiety develops. The enuresis is no longer a response but a stimulus—a stimulus to both child and parent, or foster parent, creating in its wake still further anxiety and enuresis. If the causative factor is no longer operative there is every justification in using what might be criticized as symptomatic treatment. Only by preventing or minimizing a wet bed can the vicious circle be broken, and this conditioning apparatus seems to achieve the desired result. By such means not only is the child's anxiety allayed but, more important still perhaps, the parent's anxiety is also quickly reduced.

Suggestion plays a prominent part in the cure of many cases of enuresis, a factor often forgotten by the advocates of painful surgical procedures. Such suggestion may take the form of a pill or the purposeful use of suggestion under hypnosis as recommended by Strauss (1944). The effect, however, is much the same; the child is urged, either directly or indirectly, to believe that he will be dry in future, and sometimes this is indeed the case. The conditioning bell also has a suggestive effect. This is evidenced by some of our patients who were dry from almost the day the apparatus was installed. At least, from the time the apparatus is installed the patient feels secure in the knowledge that, if he does void, he is sure to wake up in time to prevent a very wet bed. In treating our cases by means of this apparatus we have taken full account of this factor, and have not hesitated to reinforce treatment by strong suggestion and reassurance. The child falls asleep knowing, in fact feeling, the pad is there.

Personality difficulties are often a prominent feature of enuretic individuals, but we are in some doubt whether such traits are not the effect rather than the cause in a good many cases. A surprisingly high proportion showed positive personality changes after acquiring the dry habit. Some patients were noticeably assertive, whereas previously they had been shy or introspective. In no case, however, did this over-compensation continue for longer than a week or two, and in no case was it by any means pathological. Children previously labelled dull even appeared brighter and more co-operative in their homes and school. We know that some enuretics are problem children, and that the enuresis is merely a symptom of general maladjustment, but we feel that in a good many cases personality difficulties are the effect rather than the cause of the enuresis. A few, especially during the early stages of treatment, refused to co-operate and did their best to sabotage our efforts. In this way the conditioning bell is also of value in quickly differentiating between those who are anxious to break the habit and those in whom the enuresis may be a positive "enjoyable outlet."

Four cases in the series were treated in their own homes, two being adults, and the response was such that seven consecutive dry nights were quickly achieved. Mowrer and Mowrer (1938) recommend the giving of fluids on going to bed, and then withdrawal of fluid and bell when a further consecutive seven dry nights have been obtained. This technique we found unsatisfactory. The giving of fluids reproduced the enuresis, and this had an adverse psychological effect. We now wait until the child has been dry for three consecutive weeks, then remove the apparatus, and in most cases this causes no relapse.

Summary

A method of treating nocturnal enuresis by means of an alarm that wakens the patient on the act of micturition was originally described by Mowrer and Mowrer. The results of treatment with this method in 20 cases are given.

The method is recommended as a helpful aid in the treatment of this condition.

We wish to thank Messrs. Henry Wiggin and Co., Birmingham, for supplying various forms of wire for our initial experiments. The apparatus was made in our own workshops.

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ANAESTHESIA FOR CAESAREAN OPERATION

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The general reduction in infant and maternal mortality and morbidity has coincided with an increase in the frequency with which caesarean operation has been undertaken. It is estimated that about 6% of all deliveries in hospital are effected by caesarean section. The favourable results of the lower-segment type of operation (Marshall and Cox, 1949) brought about by the improvements in surgical technique make it desirable to examine the problems of anaesthesia for this operation. Few papers have been presented in which the operative results have been correlated with the anaesthetic technique used, though many techniques have been described. With this in mind, a study of anaesthetics preferred by surgeons at the Liverpool Maternity Hospital has been undertaken and the advantages of their present choice reviewed. Since these techniques are not in universal use this publication may be of interest to both anaesthetist and surgeon.

The accompanying Chart shows diagrammatically the relative number of times each anaesthetic technique was employed for all the caesarean operations undertaken during the past 20 years; for convenience the time has been divided into four-year periods, and the fifth column represents the first half of 1949. The early predominance of general inhalation is apparent, but its unpopularity is indicated by the decline in the number of cases in which it was used when alternative methods became available. It will be noted that spinal block had a popularity that was brief owing to the general (Maxson, 1938) and particular (Greenhill, 1948) risks involved. Local infiltration was accepted as the most favourable technique as regards outcome, though its use during the war years was limited by difficulty in obtaining supplies. Most noticeable is the general acceptance of the advantages of the curare sequence, introduced during the past two years. For all practical purposes the last two techniques are the only ones now in use in this hospital.

Local Analgesia

The advantages of local infiltration of a weak solution of procaine as a means of analgesia need no emphasis. It is harmless to mother and infant, and is eminently satisfactory to the surgeon. Unfortunately it is not applicable to all cases. For one thing, there is a strong preference, born of long tradition, among British patients in favour of sleep during surgical operations. This is more especially the case in caesarean section, where the most perfect analgesia does not abolish the discomfort caused by traction

during delivery of the head; the alleviation which might be afforded by heavy premedication is not available because of the necessity for avoiding depression of the respiratory centres of the infant. The importance of the event gives the mother great fortitude, but she rapidly senses when all is not well with the infant and becomes greatly distressed.

Not all surgeons are temperamentally suited to the employment of local analgesia for all the cases. In one year when all were enthusiastically in favour of the method it was found

Chart showing relative numbers of caesarean operations performed under different forms of anaesthesia, divided into four-yearly periods. The total number of cases was 4,120.

necessary to supplement with general anaesthesia in no fewer than 78 out of 164 cases. This practice of combining local with "a little general intravenous or inhalation anaesthesia for incision of the uterus" is to be condemned. Not all surgeons are aware of the difficulty and danger of inducing surgical anaesthesia half-way through an operation begun under local analgesia. It cannot be too clearly emphasized that this practice courts disaster to both mother and child: induction at this stage is apt to be punctuated with bouts of struggling and anoxia which cannot fail to be prejudicial to their post-operative condition, a risk which may be enhanced by overdosage of anaesthetic agents.

Advantages of the Curare Sequence

Many of the objections to the local infiltration technique are avoided by the use of the curare sequence described by Gray (1947). Proper relaxation of the abdominal muscles is needful in the lower-segment type of operation (Malpas, 1947; Hewer, 1948), and is readily secured. In addition, the patient is brought rapidly under control, anoxia due to spasm or vomiting thus being avoided. Aided respiration makes it possible to maintain full oxygenation at the lightest plane of anaesthesia with minimal balanced dosage of agents. The toxic action of the agents, which can be a matter of vital concern to both mother and infant, is thereby reduced to a minimum. For example, in the diabetic or toxæmic patients on whom the method was employed no depression of the infants was noticeable, nor was there any metabolic or biochemical upset in the mothers. Control of respiration also makes it easy to raise the carbon dioxide content of the maternal

and foetal blood rapidly to a level which will stimulate the respiratory centre of the infant.

One advantage of this technique that is not shared by spinal block with hyperbaric solutions is that a Trendelenburg position can be adopted immediately after induction. Hypotension, haemorrhage, and anaemia are not contraindications to the new method, as they are for spinal block.

No more difficulty has been encountered in extracting the infant under this form of anaesthesia than under the other methods (local, spinal, or light general). The tonic state of the uterus occasionally encountered is probably no more than the normal contraction of the unanaesthetized muscle; it always diminishes in a short time, and the surgeon should wait for this. Likewise the property of retraction of the uterus is so well retained that haemorrhage seems to be no more than is normal in the unanaesthetized subject.

In cases for which operation is urgently required the curare sequence offers a means whereby proper anaesthesia may be secured in a shorter time than by any other method. On numerous occasions it has been possible to get the patient into the theatre, prepare the skin, and deliver the infant within seven minutes of the discovery of foetal distress in the labour ward. The mother suffers less from the unpleasant after-effects than with a general anaesthetic, and in addition rapidly becomes co-operative, rendering prolonged supervision during the recovery phase unnecessary. The mothers are solidly in favour of this technique as against local analgesia alone.

The early impression that the infant was not made atonic by the placental transfer of curare under these circumstances has been upheld in a large series of cases, in which none has shown evidence of such a state. This practical result seems more important than the less definite experimental evidence produced so far.

In the series analysed in the next section the average duration of operation was 38 minutes. In 75% of these cases the mother's tidal air was adequate at the end of the operation. The remaining 25% needed a single intravenous injection of neostigmine and atropine to restore respiration to normal. No toxic effects were met with as a result of this measure.

Complications of the Curare Sequence

Occasionally, after the test dose of curare has been given, patients complain of a choking sensation or difficulty in breathing; immediate induction is indicated when this occurs. This invariably gets the patient settled, and she usually has amnesia for the event when she awakes.

There has been a very low incidence of complications fairly attributable to anaesthesia in recent years, which contrasts favourably with the incidence found twenty years ago. Pulmonary atelectasis and infection, as well as distension of bowels or bladder, are relatively rare occurrences post-operatively, which is consistent with the favourable results reported from other fields of surgery where this new technique is employed. None of the maternal deaths could be ascribed to the choice of anaesthetic. The actual causes of deaths which occurred in the 1,954 most recent operations are shown in Table I.

TABLE I.—List of Causes of Maternal Death Occurring in 1,954 Cases of Caesarean Section

Causes of Death	General	Local	Curare
Pulmonary embolism ..	2	1	0
Intestinal obstruction ..	1	0	1
Toxaemia ..	1	0	0
Cardiac failure ..	0	1	0
Sepsis ..	1	1	0
Malignancy ..	0	1	0

Relation of Anaesthetic to Neonatal Death Rate

This analysis is based on a sample of 1,960 infants delivered by caesarean section during the past six and a half years. This period was chosen because the anaesthetic techniques were well established, their use was fairly evenly distributed in the series, and the operative procedure was standardized throughout. The cases fall into two separate groups: in the first all the infants delivered were mature, whilst in the second the infants were of varying degrees of immaturity. The anaesthetic techniques used were three in number: ordinary general anaesthesia, local infiltration without general anaesthesia, and curare followed by intravenous thialbarbitone ("kemithal"), cyclopropane, and oxygen.

The agents used as general anaesthetics were not always recorded, but from inquiry it has been found that the most commonly employed ones were ether, nitrous oxide, and cyclopropane; the techniques of administration varied a good deal with the skill of the anaesthetists, who were often house-surgeons or resident anaesthetists and only relatively rarely (15% of cases) specialists. Local analgesia was administered by the surgeon; procaine was the drug used. The technique of administration of curare was essentially that described by Gray (1947) except that a 10% solution of thialbarbitone was used. Ergometrine, 0.5 to 1 mg., was given intravenously after delivery. In Table II the numbers of cases operated upon under the

TABLE II.—*Showing the Numbers of Mature and Immature Infants Delivered by Caesarean Section Performed Under General, Local, and Curare Anaesthesia*

Anaesthetic	Mature Infants	Immature Infants	Total
General	664	57	721
Local	676	128	804
Curare	397	38	435
Total ..	1,737	223	1,960

three methods of anaesthesia are shown, together with the numbers of mature and immature infants delivered. Immature infants were those whose weight at birth was less than 5.5 lb. (2.4 kg.).

Examination of the case histories showed that the reasons for operation were evenly distributed in the mature group.

A similar consideration of the immature cases suggested that the three anaesthetic groups into which they fell were not comparable. The birth weights of the infants in each group are shown in Table III. It is noticeable that the

TABLE III.—*Showing the Mean Weights of Immature Infants Delivered by Caesarean Section under General, Local, and Curare Anaesthesia*

Anaesthetic	Mean Weight of Immature Infants $\pm$ S.E. lb.	No. of Infants
General	4.63 $\pm$ 0.82	57
Local	3.49 $\pm$ 1.20	128
Curare	4.90 $\pm$ 0.75	38

mean weight of immature infants in the "local" group is the smallest of the three, though this discrepancy is not statistically significant. It was also found, however, that clinical factors had seriously altered the distribution of cases between the three groups in such a way that all those cases in which the mothers were most seriously ill were operated upon under local analgesia. This was not surprising, nor was it surprising to find that the infants delivered tended to be more immature than in the other two groups. For these reasons the mortality in this group is recorded for completeness and not for strict comparison with the other two groups.

Lastly, it is necessary to add that none of the infants included in the sample died from congenital lesions which were incompatible with extrauterine life, from Rh dyscrasia, or before operation was begun. Stillbirths were included wherever foetal heart sounds were heard before operation.

Death Rates of Mature Infants

The overall deaths of mature infants under all three types of anaesthetic numbered 38 out of 1,737—i.e., a rate of 2.187%. The individual mortalities observed with each form of anaesthesia are recorded in Table IV.

TABLE IV.—*Showing the Percentage Death Rates, with their Standard Errors, of Mature Infants Delivered by Caesarean Section under General, Local, and Curare Anaesthesia*

Anaesthetic	No. of Mature Infants Delivered	No. of Infant Deaths	Observed Death Rate
General	664	26	3.9%
Local	676	4	0.6%
Curare	397	8	2.0%
Total ..	1,737	38	2.2%

In order to find out whether these death rates differed significantly from one another or could have arisen frequently by chance in random selections of appropriate size from the parent distribution, the χ^2 test was applied. This procedure gave a value of 17.372 for χ^2 , which is highly significant. The inference is that the group death rates differ from a chance distribution.

The next step was to regard the three anaesthetic groups as three independent distributions, differing only in the anaesthetic technique used, and to determine the significance of the differences between their respective neonatal death rates. The three anaesthetic groups were taken in pairs and the neonatal mortalities were examined by means of three "fourfold" tables. Owing to the obvious "skewness" of the distributions Yates's adjustment was made in each case. The results of these tests are given in Table V.

TABLE V.—*Showing Comparison Between Neonatal Mortalities in the Three Anaesthetic Groups*

Groups Compared	Value of χ^2	Significance, $n = 1$
General and local ..	15.425	Highly significant
Curare and local ..	3.386	Not significant
General and curare ..	2.313	" "

It was thought advisable to check these results owing to the high degree of asymmetry caused by the low death rates. Use was therefore made of Table VIII compiled by Fisher and Yates (1948). This procedure confirmed the results given above.

Death Rates of Immature Infants

In this series comparison may safely be made between the curare and the general group. It has already been suggested that the local group was not a fair one for comparison with the other two. Applying the fourfold table to the neonatal mortalities observed in the curare and general groups it is found that there is no significant difference. The actual neonatal mortalities are contained in Table VI.

The high death rate shown in the local group merits notice. If the sample is trimmed so as to exclude the eleven infants whose weights were lowest, the mortality is reduced to 10.9%—i.e., nearly halved. While this manoeuvre is of doubtful validity statistically, it does suggest that the high death rate is due, at least in part, to extreme immaturity of some of the infants. It may be

TABLE VI.—Showing the Percentage Death Rates, with their Standard Errors, of Immature Infants Delivered by Caesarean Section under General, Local, and Curare Anaesthesia

Anaesthetic	No. of Immature Infants Delivered	No. of Infant Deaths	Death Rate	S.E. of Death Rate
General ..	57	8	14.0%	± 4.8
Curare ..	38	2	5.3%	± 3.7
(Local) ..	(128)	(27)	(21.09%)	(± 3.7)

The figures for local analgesia are included for rough comparison, but they are not strictly comparable with the others.

agreed that, though the mortality in this group is very high, it is difficult to incriminate the anaesthetic technique, especially when the favourable results encountered in the corresponding group of mature infants are taken into consideration.

Summary

The advantages of local analgesia and curare with light general anaesthesia for caesarean section are discussed. A statistical analysis of the neonatal mortality occurring after caesarean section performed under ordinary general anaesthesia, curare sequence, and local analgesia supports the view that local analgesia is to be preferred to ordinary general anaesthesia. There is no evidence to indicate clearly the position of the curare sequence in the three methods considered.

We gratefully acknowledge our debt to the authorities of the Liverpool Maternity Hospital for giving us access to their records, and to Professor T. N. A. Jeffcoate for his helpful criticism.

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Medical Memoranda

Suppurative Pericarditis Complicating Osteomyelitis Treated with Streptomycin

Much has been written on suppurative pericarditis, and consequently the methods of treatment have been varied. The successful treatment of a critically ill patient by the administration of streptomycin is recorded.

CASE REPORT

A boy aged 10 was admitted to hospital with a history of pain in the right hip for ten days. He subsequently developed flitting pains in other joints, but there was no articular swelling. He had been given sulphonamides and salicylates by the family practitioner, but the boy's condition deteriorated and he was admitted to hospital.

On admission he looked ill and toxic. His temperature was 104° F. (40° C.), pulse 130, respirations 26. The tongue was dry and covered by a brown fur, the lips were cracked, and sordes had accumulated on the teeth. He was restless and delirious. In the cardiovascular system, the pulse was rapid and thready but regular; the apex beat was in the fifth space inside the mid-clavicular line, with a wavy precordial impulse. The maximum impulse of the apex beat was palpable

$\frac{1}{2}$ in. (1.25 cm.) inside the outer border of the area of cardiac dullness. No thrill was detected. On auscultation the heart sounds were normal, with no appreciable diminution in intensity. At the base there was the typical to-and-fro murmur of pericardial friction. The blood pressure was 110/60. Electrocardiographic tracings were not done owing to the patient's condition. No abnormality was detected in the respiratory, alimentary, or central nervous systems, and no swelling of any of the joints was found. There was, however, marked diminution of movement of the right hip, with spasm of the muscles of the thigh. Some movement of the hip-joint was definitely present in all directions and there was no pain on percussing the heel with the leg extended. There was, however, excruciating pain on palpation over the upper and outer end of the right femur. The urine contained no sugar or albumin. A blood count showed: white cells, 9,200 c.mm. (polymorphonuclear neutrophils 63%, lymphocytes 32%, monocytes 5%). The "stab" cells numbered 25%.

The white cell count was comparatively low, but it was realized that the boy had been given liberal sulphonamide therapy, and the high relative number of "stab" cells indicated the presence of a suppurative process. The quality, and not the number, of the polymorphonuclear cells present was the all-important factor.

Osteomyelitis of the femur was diagnosed, and at operation pus was released from the upper part of the right femur. Culture of the swab produced moderate growth of *Staphylococcus aureus*. He was given 200,000 units of penicillin three-hourly by intramuscular injection. During the next few days his general condition improved slightly, but he still ran a remittent fever (100–102° F.—37.8–38.9° C.) and the pulse remained at 100 to 120 a minute.

The pericardial friction rub, however, persisted at the base, and paracentesis of the pericardium performed on the second day after operation yielded 10 ml. of a turbid yellow fluid, which on culture produced a few colonies of *Staph. aureus*. Unfortunately, the fluid clotted before microscopical examination, so a cell count was not possible. The dosage of penicillin was increased with no better result after 48 hours. Streptomycin, 0.25 g., by intramuscular injection was given six-hourly and the fever began to subside, but the evening temperature was still between 99 and 100° F. (37.2 and 37.8° C.) and the pericardial rub was still audible. Streptomycin, 0.25 g. in 3 ml. of distilled water, was then injected intrapericardially. The temperature became normal the next day and the patient made an uninterrupted recovery.

Five months after discharge from hospital the boy leads a normal life and plays all games. No evidence of adherent pericardium could be discerned by clinical, radiological, or electrocardiographic examination and, most important of all, the heart was functionally normal.

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Intra-arterial Injection of Thiopentone-Curare Mixture

In these days, when it is not unusual for anaesthetists to use thiopentone-curare mixtures, the following case report may be of interest.

CASE REPORT

A youth aged 17 was operated on for acute appendicitis on September 6, 1949. He was premedicated with "omnupon" 1/6 gr. (11 mg.) and scopolamine, 1/300 gr. (0.22 mg.) one hour before operation. A mixture of 3 ml. of thiopentone (5%) and 5 mg. of "tubarine" was injected into a superficial aberrant ulnar artery in the mid-third of the right forearm in the mistaken belief that it was a vein. The patient complained of an agonizing burning pain in his right hand. The needle was immediately withdrawn and the remainder of the syringe