zoster virus appeared to show a marked predilection for segments having a sympathetic-nerve connexion.

The peripheral lesion of zoster is an inflammation and vesiculation of skin or mucosa associated with degenerative changes in underlying nerve endings, and one might expect any lung complication to be due primarily to such changes, plus oedema, in the bronchial mucosa resulting in pulmonary atelectasis. Personal communication with several thoracic surgeons suggests that bronchial vesiculation is an unusual finding, and it seems reasonable to associate it with the zoster in this case—coinciding as it did with the typical skin lesion.

It is less reasonable, however, to consider that the pulmonary consolidation was a specific manifestation of zoster because it affected the middle and lower lobes whereas the vesiculation was in the upper lobe bronchus; moreover, the onset of the pulmonary episode did not coincide with that of the eruption but preceded it by over a month. The incubation period of herpes zoster is said to vary from 7 to 24 days.

Possibly the pneumonia was a predisposing factor in the manner suggested by Spillane and White (1939), who noted a tendency for patients with angina of effort to develop zoster in the distribution of their cardiac pain—the supposition being that irritation of posterior root ganglion cells by stimuli from a diseased organ might result in trophic changes resembling zoster or, alternatively, in these cells becoming devitalized and susceptible to attack by the zoster virus. This might be compared with anterior poliomyelitis affecting a previously injured limb. Parsonnet and Bernstein (1939) also discussed the association of heart disease and zoster. Wilson considers that all zoster, even those apparently secondary to another disease, are due to an infection with the specific virus—that is, not in some cases to a purely trophic change.

Conclusion

Admitting that both pneumonia and zoster are common and could easily coincide, earlier reports do suggest—and this case would support the suggestion—that visceral disease can be directly connected with zoster; and the practical implication, as stressed by Loiseau (1953), is that one should always question the state of any organ in the same neural segment as the eruption.

In most cases it might be practicable to make only a brief physical examination and inquiry regarding symptoms, but with an upper thoracic or vagus nerve zoster it would be a simple precaution to have the chest x-rayed to exclude an unsuspected carcinoma or tuberculous lesion of the lung.

Summary

A case is described in which pneumonia was followed by intercostal herpes zoster and bronchial vesiculation, and the possible connexion between these lesions is discussed.

Visceral disease in association with herpes zoster has been reported on various occasions, being sometimes probably itself a specific manifestation of the virus infection but at other times perhaps a predisposing factor.

One should consider the health of organs having the same nerve root supply as the superficial eruption.

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PROLONGED LABOUR

A CLINICAL TRIAL OF CONTINUOUS CAUDAL ANALGESIA

BY

G. TREVOR JOHNSON, M.D., F.F.A.R.C.S.
M.R.C.O.G.

Consultant Obstetrician and Gynaecologist, Park Hospital, Davyhulme, Manchester; formerly First Assistant, Department of Obstetrics and Gynaecology, King's College, University of Durham

A first stage of labour exceeding 48 hours in duration due to discoordinate action of the uterus and cervix has a sinister reputation for both mother and foetus. The stillbirth rate attributed to this condition is more than four times that encountered in uncomplicated vaginal delivery. The major causes are foetal injury from ill-advised attempts to expedite vaginal delivery, intrauterine infection (McCredie-Smith *et al.*, 1956) by organisms within the upper vagina, and foetal anoxia from placental failure (Johnson and Clayton, 1955). The potentially anoxic foetus, in such labours, is sometimes further endangered by post-maturity (Stewart and Bernard, 1954) and pre-eclampsia, both of which depress placental efficiency (Walker and Turnbull, 1953).

There is no general agreement about the management of prolonged labours of this type, and treatment largely depends upon the judicious use of sedatives to ease the pains of labour and assist dilatation of the cervix, intravenous fluids to control maternal dehydration and ketosis, and, more recently, antibiotics (McCredie-Smith *et al.*, 1956) to prevent intrauterine infection. Some authorities have advocated uterine stimulants (Theobald *et al.*, 1956), and others claim that certain drugs have a relaxing effect upon the cervix (Gill and Farrar, 1951). In some instances, however, these latter techniques may exaggerate the abnormal uterine behaviour (Jeffcoate, *et al.*, 1952; Embrey and Garrett, 1955).

The serious wastage of foetal life attributed to prolonged labour has resulted in the more frequent use of caesarean section (Baird, 1955) as a speedy and less traumatic means of salvaging these infants, but unfortunately the maternal risk of this procedure increases steadily with the preceding length of labour, especially when this has lasted for more than 48 hours (Marshall, 1949).

More recently, claims have been made for the therapeutic application of continuous caudal analgesia to this problem (Arthur and Johnson, 1952; Johnson, 1954; Ball and Chambers, 1956; Youngman and Lloyd, 1956). This technique interrupts the autonomic visceromotor nerves of the cervix, and allows the dilating powers of the body of the uterus to have unopposed action upon a paralysed cervix and pelvic floor musculature. At the same time it has been pointed out that this method

restores the impoverished placental circulation which is encountered in a long first stage of labour by a vasodilatation effect upon the decidual vessels, following the interruption of their vasomotor nerves (Johnson and Clayton, 1955).

Although well-documented series of cases have been reported in which continuous caudal analgesia has accelerated the course of labour, there is a need for more convincing evidence that this technique speeds dilatation of the cervix and reduces the need for caesarean section, to which ends this study has been devised.

Design of Investigation and the Clinical Material

The clinical trial has been planned to draw a comparison between the therapeutic effect of two distinct methods of treatment upon the course of a prolonged first stage of labour. Sustained paralysis of the visceral autonomic nerve supply of the cervix and the mixed somatic nerve supply of the pelvic floor musculature by continuous caudal analgesia has been compared with an orthodox method of sedation with morphine and intravenous glucose-saline to control dehydration and ketosis.

The patients admitted to the clinical trial are shown in Table I. There was reliable evidence that all these had been in labour for at least 48 hours, from discoordinate action of the uterus or cervix, and without evidence of cephalopelvic disproportion.

TABLE I.—*Clinical Material (A Comparison of the Two Groups of Patients)*

	Caudal Series	Control Series
Average age (years)	27.8	25.2
Primigravidae	20	18
Multigravidae	3	3
Average duration of pregnancy (weeks) ..	40.7	40.7
Pre-eclampsia	7	6
Eclampsia	1	0
Epilepsy	0	1
Genital infection	1	2
Hypotonia	15	9
Hypertonia	2	4
Cervical dystocia	6	8
Maternal distress	5	9
Foetal	11	6
Multiple pregnancy	0	2
Position of presenting part:		
Occipito-anterior	4	8
" lateral	10	7
" posterior	8	6
Breech	1	0
Cervix less than half dilated on admission to trial ..	19	18
Cervix more than half dilated on admission to trial ..	4	3
Total cases studied	23	21

Pre-eclampsia: Blood pressure exceeding 140/90 mm. Hg at the onset of labour.

Genital infection: Maternal temperature rise of 1° F. on one or more occasions during the course of labour.

Maternal distress: A pulse rate of 100 a minute, sustained or recurring, during the course of labour.

Foetal distress: A pulse rate of 160 or more or 100 or less at any time during labour, with or without meconium staining of the liquor amni.

The precise state and dilatation of the cervix were determined by vaginal examination when the patient was admitted to the investigation. No patient was admitted unless the cervix had reached at least one-third dilatation by 48 hours without significant progress in the preceding 12 hours. A clinical assessment of the predominant pattern of uterine dysfunction was made when the patient was admitted to the clinical trial, together with a note of any concurrent maternal or foetal complication.

The treatment adopted for individual cases depended upon a random method of selection, modified by equalizing the two groups according to maternal age, parity, and the presence or absence of such complicating factors as maternal or foetal distress, genital infection, or pre-eclampsia. A table was prepared at the beginning of this investigation, and the allocation of a patient to one or other method of treatment was read from it, after each patient had been admitted to the trial.

Patients designated for the first method of treatment were known as the "caudal series" and those for the other the "control series."

The final comments and conclusions are based on the duration of treatment required to effect delivery in 44 prolonged labours, by one or other method, the progress of labour after six hours of treatment, and the need for caesarean section.

Management

Caudal Series.—Continuous caudal analgesia was induced with 40 ml. of 1.5% piperocaine hydrochloride ("metycaine") injected into the sacral canal with a sterile malleable needle. The technical minutiae have been described by Hingson and Edwards (1943), with a more specific account of its application to the problem of prolonged labour by Johnson (1954). Analgesia was maintained for approximately six hours, with intermittent half-hour injections of 15 ml. of piperocaine hydrochloride. Each patient was nursed lying on her side, and bilateral analgesia was maintained by turning the mother on to her opposite side after each injection.

Control Series.—A subcutaneous injection of morphine, $\frac{1}{4}$ gr. (16 mg.), was given at the onset of treatment, together with 1 litre of 5% glucose-saline, given by slow intravenous drip. Response to treatment was assessed in both series of patients by comparing alterations in dilatation of the cervix after a period of six hours of treatment.

Results of Caudal Series

Twenty-three patients were treated with continuous caudal analgesia, and the final conduct of delivery depended upon its effective aid in dilating the cervix after an initial six-hour period of treatment (Table II).

TABLE II.—*Response to Approximately Six Hours of Treatment*

	Complete Dilatation of Cervix in 6 Hours	Progressing Dilatation of Cervix in 6 Hours	Non-dilatation of Cervix in 6 Hours	No. of Patients
Caudal series ..	11	9	3	23
Control ..	3	10	8	21
Total ..	14	19	11	44

χ^2 for linear trend of proportions = 6.69. $n = 1$. $P < 0.01$.

Eleven of the patients achieved full dilatation of the cervix within this time, all being delivered with the aid of forceps in the manner enumerated in Table III. One infant was lost from intrauterine asphyxia and infection. Nine patients showed sufficient progress to justify prolonging treatment

TABLE III.—*Duration of Labour and Mode of Delivery*

	Full Dilatation in 6 Hours		Progressing Dilatation in 6 Hours		Non-dilatation in 6 Hours	
	Caudal	Control	Caudal	Control	Caudal	Control
Spontaneous ..	—	1	—	3	—	—
Low forceps (occipito-anterior) ..	6	1	2	3	—	—
Low forceps (occipito-posterior) ..	1	—	3	1	—	—
Mid-cavity forceps (after correcting any malpresentation) ..	3	1	4	3	—	—
Breech extraction ..	1	—	—	1 (second twin)	—	—
Caesarean section ..	—	—	—	—	3	8
Total ..	11	3	9	10	3	8
Average treatment-delivery interval (hours) ..	5.0	3.7	9.5	18.7	13	15.4
Stillbirth or neonatal death ..	1	—	—	1	—	—

in anticipation of vaginal delivery, and all these were delivered in an average of 9.5 hours from the onset of treatment without loss of foetal life. The three remaining patients proved refractory, and were delivered by caesarean section, all the infants surviving. Analgesia was continued

for a further six hours in this particular group, to prove its inability to dilate the cervix, and to justify a more radical approach to caesarean section in this type of case in the future.

Results of Control Series

In this category there were 21 patients, who were collectively similar to patients in the caudal series, and the results are compared in Tables II and III.

Three patients were delivered within the six-hour period of starting treatment compared with 11 in the caudal series. One patient delivered herself spontaneously, and the other two required delivery by forceps.

Ten more patients displayed sufficient progress to continue sedative treatment. This consisted of morphine, or its derivative, the total dose and frequency of administration depending upon individual response to the discomforts of labour and the clinical judgment of the individual obstetrician. The final method of delivering these 10 patients is shown in Table III and compared with similar cases in the caudal series. Three patients delivered themselves spontaneously, and the remainder required assistance. These 10 patients were delivered in an average of 18.7 hours from the onset of treatment. The longest treatment-delivery interval was 43.5 hours, and this infant was lost from intrauterine infection.

The third group of eight patients were all delivered by caesarean section, performed for progressive non-dilatation of the cervix after at least six hours of treatment, but the optimum time for intervention was always decided by the individual obstetrician concerned. The average treatment-delivery interval in this group was 15.4 hours.

Comparison of the Two Series

Progress of Labour.—The ability with which continuous caudal analgesia facilitated dilatation of the cervix compared with traditional methods of treatment is demonstrated by Table II. The cervix became fully dilated in 11 of the patients in the caudal series during the first six hours of treatment, and nine more patients showed sufficient progress to justify persisting with the treatment. All of the latter became fully dilated within an average of $3\frac{1}{2}$ hours of supplementary treatment, the longest caudal block in the whole series being 13 hours from the onset of treatment. Only three patients became fully dilated during the first six hours of treatment in the control series, and 10 more showed progressing dilatation of the cervix in the same time interval. The latter required a mean of 12.7 hours of supplementary treatment to achieve complete dilatation of the cervix, with a range of 3 to 40 hours. Continuous caudal analgesia failed completely in three further patients, all of whom were delivered by caesarean section, but the progress of labour became arrested in eight of the control series and caesarean section was eventually required to complete delivery. The difference between the two series is statistically significant.

TABLE IV.—Mean Duration of Treatment for All Patients Achieving Vaginal Delivery

	No. of Patients	Treatment-Delivery Interval
Caudal series	20	7.7 hours
Control "	13	15.1 "

Difference of means = 7.4 hours. $t=3.5$; $m=42$; $P<0.002$.

The individual variations in the length of labour, to the last complete hour, from the time of admission to the clinical trial to delivery, were as follows: Caudal series: 6, 5, 9, 1, 5, 8, 4, 11, 6, 8, 10, 9, 6, 6, 7, 13, 9, 3, 6, 6. Control series: 6, 2, 3, 43, 9, 17, 15, 13, 17, 14, 24, 12, 20.

Duration of Labour (Table IV).—The accelerating effect of continuous caudal analgesia is summarized above. All the patients in the caudal series who achieved vaginal delivery did so in a mean of 7.7 hours of treatment, compared with 15.1 hours for a similar group in the control series. The difference between these means is 7.4 hours, and this is a highly significant figure.

Caesarean Section.—The need for caesarean section arose in three patients in the caudal series compared with eight in

the control series. The difference between these figures gives a value, $P<0.08$ (by an exact method), which is not significant in itself, although suggestive. When considered with the other findings, however, this result may well be interpreted as anticipating a clear difference in a larger series.

Discussion

There are many complicating factors in a prolonged labour, such as age, parity, maturity, pre-eclampsia, foetal distress, and the general maternal condition, all exerting their individual effect on uterine behaviour or the planning of treatment. This is especially true of foetal and maternal distress, which are common deciding factors leading to caesarean section. As this paper draws a comparison between two methods of treating a prolonged labour, every effort has been made to distribute these factors as equally as possible between the caudal and the control series (Table I). The chief failure is in the caudal series, which is loaded unfavourably by a larger number of distressed infants at the onset of treatment who might have been delivered by caesarean section but for the favourable influence of caudal analgesia upon placental action (Johnson and Clayton, 1955). There was also a preponderance of patients with hypotonic inertia in the caudal group, but it is likely that these would have lengthened rather than shortened the average duration of labour in the caudal series.

The major object of this investigation has been to decide whether the duration of the first stage of a prolonged labour can be significantly shortened by interrupting the autonomic nerve supply of the cervix, in support of the previous tocodynamometric studies by Reynolds (1954), who showed that the normal dominating influence of fundal contractions was undisturbed and frequently enhanced by this technique, especially when uterine action had been deficient.

One additional, and important, effect is the complete obliteration of the pains of labour. This allays maternal anxiety and the production of adrenaline, with its depressant effect upon uterine action.

Upon this basis continuous caudal analgesia is a desirable means to expedite the course of a delayed first stage of labour, with a favourable effect upon the disturbed placental function encountered.

The preponderance of forceps deliveries and malrotation of the foetal skull in the mid-cavity of the pelvis has always been one of the criticisms levelled against caudal analgesia. This is attributed to the complete motor and sensory paralysis of the birth canal and the interruption of the stimuli which initiate maternal expulsive efforts. This criticism is borne out by the results achieved in the present study, but, so far as prolonged labour is concerned, this relative disadvantage is heavily outweighed by an increased need for caesarean section in patients treated conservatively.

Although it is wise to point out the possible difficulties of caudal analgesia, the frequently favourable outcome following its therapeutic application to discoordinate uterine action amply justifies a method which is simpler and considerably safer than performing a caesarean section upon a patient who has been in labour for several days.

With scrupulous attention to details of technique, and avoiding overdilatation of the bladder in the early days of the puerperium, we have not experienced any serious post-analgesic sequelae attributable to caudal analgesia, which has been induced satisfactorily in the large majority of patients upon whom it has been attempted in the past six years.

Summary and Conclusions

The use of continuous caudal analgesia for the primary relief of labour pains has justifiably been received with little enthusiasm by British obstetricians owing to the technical difficulties and possible complications of the method. On the other hand, its therapeutic application to the problem of discoordinate uterine

action is a sound application of regional anaesthesia which is based upon the existing knowledge of the autonomic nerve supply of the genital tract.

Compared with orthodox methods of sedation, caudal analgesia can accelerate the course of a delayed first stage of labour and lessen the need for caesarean section or mutilating vaginal operations to expedite the course of labour. However skilfully these latter operations are performed, each imposes a greater maternal risk than caudal analgesia, the dangers of which have been unjustifiably exaggerated. A close collaboration between the anaesthetist and obstetrician is fully justified to substantiate the claims for its efficacy in these special circumstances.

It might reasonably be argued that the favourable outcome of labour in the caudal series arose from the omission of the morphine which was administered to the control series. The experiment was designed, however, to give an answer in terms of therapeutic expediency rather than exact physiological mechanisms, and its results in such terms are conclusive.

This paper is deliberately concerned with patients who have been in labour for more than two days, which is the accepted definition of prolonged labour; but experience has shown that in future practice the method should be given serious consideration before this time has elapsed, to avoid the increased hazard of uterine infection and placental failure, or the extra risks of a caesarean section performed late in labour, should this ultimately prove desirable.

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According to the 1956 annual report of Manchester's medical officer of health, Dr. C. METCALFE BROWN, the outbreak of poliomyelitis in Manchester last year produced the largest total of cases, 321, ever recorded there. Of the eight fatal cases, seven were adults. Special tests showed that two other virus infections were present at the same time, one of these being Coxsackie virus, so that it is impossible to say with certainty how many non-paralytic cases of poliomyelitis were correctly notified. The paralytic cases numbered 93. In 20 households more than one case of the disease occurred: in three houses three non-paralytic cases in each house, in a further 12 houses two non-paralytic cases, and in the five remaining houses one paralytic and one non-paralytic case.

INFLUENCE OF HIGH-PROTEIN DIETS ON LIVER-FUNCTION TESTS IN KWASHIORKOR

BY

A. A. KINNEAR, M.D.

AND

P. J. PRETORIUS, M.Med. (Paed.)

From the Departments of Chemical Pathology and
Paediatrics, University of Pretoria, Pretoria,
South Africa

In a previous publication (Kinnear and Pretorius, 1956) liver function was evaluated in 107 consecutive cases of kwashiorkor. Of the tests used, albumin levels were found to be constantly low while bromsulphthalein retention was significantly high in 84% of cases tested. Thymol turbidity, thymol flocculation, serum colloidal gold, serum colloidal red, total serum bilirubin, and van den Bergh reactions were shown to have no diagnostic or prognostic value. It was also found that bromsulphthalein retention was significantly higher on admission in those patients who later died.

The composition of the diets and assessment of the clinical findings have been discussed elsewhere (Brock *et al.*, 1955; Pretorius *et al.*, 1956).

The Chart shows no significant statistical difference in the ability of the various diets in increasing the speed of production of albumin. Similarly, no statistically significant differences in the return to normal of the other liver-function tests could be demonstrated between the diets.

For these reasons it is proposed to treat all the cases as one group, and we report here the influence of a high-protein diet on serial liver-function tests in 107 consecutive cases of kwashiorkor. Albumin and globulin were estimated in a further 84 cases, while bromsulphthalein retention was estimated in 51 cases.

Liver-function tests were performed on cases of kwashiorkor on admission. They were repeated twice weekly for variable periods up to three weeks.

The methods used have already been discussed (Kinnear and Pretorius, 1956).

Results

Serum Albumin.—Table I shows the changes in concentration of serum albumin over varying periods of time. There is a steady upward trend, which in the cases of the Borden mixture seems to be better than the other diets (see Chart). However, the Borden cases would appear to be less severe cases of the disease, as their initial albumin values were about 2 g. per 100 ml. as compared with ± 1.5 g. per 100 ml. for the other diets. The different high-protein diets showed strikingly similar improvement of the serum albumin concentration in the groups studied.

Serum Globulin.—The value of 2.29 g. per 100 ml. on admission (Table II) is within the normal range for American children given by Kagan and Stern (1955). The steady increase in globulin values during treatment with high-protein diets confirms the findings of Trowell *et al.* (1954). No one diet gave better production of globulin than another. The prognostic value of total serum globulin is limited because of the many factors which influence its concentration in the plasma. Its extrahepatic origin makes its value as a liver-function test doubtful, but it undoubtedly plays a part in the mechanism of some of the flocculation tests of liver function.