CARDIAC IRREGULARITIES DURING LABOUR IN PARAPLEGIC WOMEN

By Drs. H. L. FRANKEL, L. GUTTMANN and V. PAESLACK

National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, England

(Paper presented by Dr. FRANKEL)

PARAPLEGIC women with complete lesions of the spinal cord above the splanchnic outflow develop, during the final stages of labour, in particular just before and during labour, the classical symptoms of reflex hyperactivity of autonomic mechanisms (hyperextension, bradycardia, outbursts of vasodilatation of the face, headaches, and sweating), as described by Guttmann and Whitteridge, 1947, due to detrusor activity of the bladder. These symptoms are closely related to the uterine contractions and disappear or are greatly diminished during the free intervals. Moreover, they disappear completely after delivery of the placenta.

A case of a woman with a complete transverse lesion below T₅ is described, who, during the uterine contractions in the later stages of labour and especially during delivery, developed profound disturbances of the cardiac rhythm which were studied in detail electromyographically. Deformities of A-V conduction, varying from simple prolongation of the P-R interval to second degree block with A-V nodal escape beats, disappearance of the P-waves and, during the actual delivery of the child, ventricular extrasystoles occurred in different directions and were of different shape.

A full account of this case has been published in Vol. 3, No. 2, p. 144, of this journal.

PREGNANCY AND LABOUR IN COMPLETE TETRAPLEGIA

By A. G. HARDY, M.B.E., F.R.C.S., and D. W. WARRELL, M.D., M.R.C.O.G.

Spinal Injuries Unit, Lodge Moor Hospital, Sheffield, England

(Paper presented by Dr. HARDY)

THE occurrence of pregnancy in patients with paralytic disorders must give rise to anxiety on a number of counts. The increased incidence and greatly improved chances of survival in traumatic paraplegia in women have provided increased opportunities for observation on this comparatively uncommon combination of circumstances. Reports of 17 cases of pregnancy and labour in traumatic paraplegia were made by Guttmann (1963) and a further case was detailed by Jackson (1964). These reports clearly indicate that there are definite hazards to mother and unborn child. They also indicate that successful spontaneous delivery can occur after a full-term pregnancy in certain circumstances.

This paper reports a pregnancy and labour in a case of traumatic tetraplegia arising from a fracture dislocation of the 5th and 6th cervical vertebrae sustained as a result of a motor-car accident.

Case Report. The patient was a young woman of 21 years old who had already had three children. She was the front-seat passenger in a car which overturned. She was dazed but not unconscious and aware of severe pain in her neck, and that she could not feel or move her arms or legs. On admission to hospital she was found to have a total motor paralysis of her arms, trunk and legs and a total loss of all superficial and deep sensations below and including the 5th cervical dermatome on both sides. The fracture-dislocation was realigned and held in position by skeletal skull traction and a routine of two-hourly changes of nursing position organised immediately. Special attention was paid to assistance in coughing and in the encouragement of respiratory movement. The paralysed bladder was drained by an indwelling urethral catheter attached to a closed drainage system.

The immediate post-accidental period was eventful mainly because of respiratory difficulties and troublesome nausea and vomiting. At the time of the accident the patient was thought to be about 10 weeks pregnant and had had morning sickness during the previous month. The diagnosis was confirmed by the serum and urine pregnancy tests and subsequently by vaginal examination.

Six weeks after injury radiographs showed that the bony spine was healing in good position but clinical examination demonstrated that the neurological status was unchanged except for the appearance of some reflex activity in the parts of the body below the level of the spinal cord injury. The general condition was only fair. Anorexia, nausea and vomiting were marked and morale was low. The problems of complete and permanent tetraplegia were facing us coupled with a pregnancy now of approximately 16 weeks' duration. Would the added burdens of a pregnancy adversely affect the life of the mother already struggling to compensate for a high and severe degree of cervical spinal cord injury? Would the effects of the tetraplegia hazard the life of the foetus? Would the pregnancy more readily predispose the patient to the ordinary complications of tetraplegia such as bed sores, urinary tract infections, disturbances of vaso-motor control and somatic reflex activity? Would the respiratory difficulties associated with diaphragmatic breathing be increased by the ever enlarging uterus? Would skeletal muscle spasticity be a hazard in labour?

Although none of these questions could be answered with any certainty it was decided that events should be allowed to follow their natural course and as much information as possible be obtained from all subsequent happenings.

Special Observations. In addition to the ordinary clinical observations it was decided to make weekly clinical and laboratory estimations of certain features of possible special significance and interest.

1. A measurement of the lung vital capacity.
2. A clinical assessment of muscle tone in the abdominal wall, the pelvic floor and both legs.
3. Haematological and biochemical checks on the blood picture and blood urea.
4. Bacteriological and biochemical analysis of the urine.
5. Biochemical assay of urinary pregnandiol and oestriol on a 24-hour specimen.
6. Cystometric examination of bladder function.
7. Recordings of blood pressure, weight and fundal height.
8. Monitoring of foetal heart sounds in the later stages of pregnancy.

Progress and Treatment. The bony spine was held in good position and skeletal skull traction maintained for six weeks with complete comfort to the patient. Radiological evidence of consolidation at the fracture site was demonstrated at the time of removal of the traction at the end of the 6th week.

Recovery from the paralysis was only slight and improvement confined to weak voluntary contractions in the deltoid and biceps and brachialis muscle groups in both arms. Otherwise the upper limbs, the whole of the trunk and both legs remained completely paralysed. Weak reflex activity appeared in the lower limbs within one week and the knee and ankle tendon reflexes were present at four weeks. At no time was there any excessive

reflex activity in the skeletal musculature and muscle tone on the whole was diminished. The abdominal muscles remained remarkably flaccid throughout the whole period although there were weak intermittent involuntary movements usually associated with similar movements in the lower limbs.

Respiratory complications were present during the immediate post accident period (10th week of pregnancy) and again in the 16th week after the accident (26th week of pregnancy). On the second occasion there was a total atelectasis of the left lung, relief from which was only obtained after bronchoscopy and vigorous assistance to breathing and coughing. Infection was controlled with Tetracycline. The vital capacity fell to 450 millilitres during this second incident but at all other times the capacity recorded was between 1100 and 1450 millilitres.

Bladder control was by indwelling urethral catheter which was changed each week. The catheter was attached to a closed drainage system and the drainage controlled by a clip on the catheter. This was released at two-hourly intervals. There were three episodes of urinary tract infection with high fever and leucocyte counts. Two of these were controlled by Furadantin and Mandelamine respectively but the third required a course of kanamycin. Tablets of ammonium chloride were given simultaneously with the Mandelamine. Urine cultures produced heavy mixed bacterial growths with *B. Coli* predominating. The urine was more often infected than not.

Cystometry demonstrated the return of reflex activity in the detrusor muscles in the 13th week after accident but no attempt was made to get rid of the catheter. The basic pressure of the filling bladder was 18 cm. of water and at a capacity of 200 millilitres there were uninhibited pressure swings to 90 cm. of water at intermittent and irregular intervals. At the same time of the bladder contractions the blood pressure rose from a systolic of 90 mm. Hg. to 130 mm. Hg. and there were tingling sensations in the scalp. Headache did not occur, but the examinations were not continued beyond a point where the catheter was ejected during a reflex contraction of the bladder.

Bowel actions were obtained in response to the use of Dulcolax suppositories on alternate days. Good actions were the usual feature.

The general condition varied considerably. Anorexia was a problem in the early weeks and required a good deal of patience on the part of the nursing staff. Feeds were small, frequent and largely composed of Complan. Nausea and vomiting were controlled by Phenergan. The general malaise and anorexia were dramatically improved each time an infection was brought under control. Anaemia was an almost constant feature in spite of attempts at routine prophylactic therapy with iron and vitamin preparations. The best clinical and haematological response was obtained from a two-pint blood transfusion at the time of the 2nd respiratory episode (26th week of pregnancy).

Autonomic hyperreflexia only occurred during the cystometric observations on bladder function and during labour itself. At no time did the blood pressure rise above 135 mm. Hg. systolic and 90 mm. Hg. diastolic. The general blood pressure level was 95/65 mm. Hg. and hypotension was a constant feature and also troublesome during the period of mobilisation from bed to chair routines.

The programme of mobilisation was started with elevation of the head of the bed as soon as the traction had been removed. In the 8th post-accident week the patient had a few minutes in a chair but syncope with marked hypotension occurred on this and subsequent occasions throughout the pregnancy. It was only effectively controlled by the application of abdominal binders and leg bandages, but even then it was never possible to have the patient sitting for longer than four hours for any one period right up to the time of onset of labour.

There were no skin problems at any time.

The ante-natal obstetric observations were remarkable in their normality. The foetus grew normally and the foetal heart sounds were always regular during the 20-minute weekly monitoring periods. The pregnandiol and oestriol estimations made each week gave above average levels throughout the pregnancy.

Labour. Labour began at term in the 29th week after the accident and was recognised by spontaneous rupture of the membranes. The catheter was pushed out of the bladder. For one hour the patient complained of frequent intermittent tingling in the scalp and there were also palpable uterine contractions. At no time was there any general physical distress. The blood pressure rose to 135/90 mm. Hg. Fifteen minutes after the head appeared on the perineum a female child was born without any difficulty. The child weighed 7 lb. 3 oz. The 3rd stage was normal.

In retrospect the patient remembered that for 12 hours prior to delivery she had felt tingling in the scalp and no doubt this feature corresponded to the first stage of labour.

Puerperium. This was uneventful. Skeletal muscle tone remained flaccid in both the abdomen and lower limbs. Blood pressure returned to the lower range of 100/65 mm. Hg. Lactation was inhibited by ethinyl oestradiol.

Catheter drainage of the bladder was continued and efforts now diverted into the aspects of physical rehabilitation with the aid of slings and other gadgets. Unfortunately there was no further recovery of voluntary movement in the arms except in the deltoid, biceps and brachialis muscles. The patient thus required very considerable assistance in all matters of daily living. She and her baby were eventually discharged to their home 44 weeks after the original accident and 15 weeks after the baby had been born. The general condition was good, morale was high and has remained so.

DISCUSSION

The foregoing account of events occurring throughout the pregnancy appear to show that our worst fears were unfounded. Forewarned is perhaps forearmed, and some of the risks were minimised by the special care and interest that went into the planning of the management of this case.

It does not seem that the spinal cord injury and total paralysis below the lesion in the mid cervical cord had any direct detrimental effect on the pregnancy and the child has subsequently developed in a perfectly normal manner. The pregnancy was maintained in spite of vigorous physical measures of treatment of the respiratory upsets which included heavy manual pressure on the abdomen in the assistance with coughing. As far as the child was concerned there were no adverse effects as a result of the relative anoxia occurring during the lung atelectasis and neither were there any adverse influences as a result of the urinary infections or vasomotor disturbances.

The pregnancy was apparently unaltered by the occurrence of spinal cord isolation below the level of bony injury or by the altered states of reflex activity. An interesting feature was the comparative lack of hypertonicity in the trunk and lower limb muscles at all times throughout the pregnancy, labour and puerperium. It is known that reflex activity varies widely from case to case in ordinary circumstances, but the quiescence in this case was certainly very striking.

The pregnancy undoubtedly influenced the handling of the problems of the tetraplegia, but apart from delays in general rehabilitation and difficulties in dealing with the symptomatic aspects of the constitutional upsets it cannot be said that the tetraplegia was adversely affected. It might be postulated that the pregnancy altered the pattern of returning reflex activity in the trunk and lower limbs, either through hormonal or vasomotor influences. It would also seem likely that the vascular hypotension in the early stages and absence of intermittent hypertension in the later ones were also related to the pregnancy. The syncope due to postural hypotension undoubtedly delayed the programme of physical rehabilitation.

The urinary tract infections might have occurred in any ordinary circum-

stances and would have been dealt with in a similar manner. Because of the pregnancy no attempt was made to achieve any form of habit or reflex control of micturition. The constitutional upsets arising from the infections were an added burden to the nausea and vomiting associated with the pregnancy and this made the dietetic regime more difficult to regulate and in turn influenced the haemoglobin levels. The anaemia would probably have been better improved by more transfusions with whole blood. The one transfusion given provided dramatic clinical improvement. It is also possible that the rather persistent urinary tract infections might have been more manageable on this account.

An important aspect of this case, certainly not to be overlooked, was the enormous improvement in morale coupled with an obvious sense of achievement on the part of the mother.

SUMMARY

This is a short report of a case of pregnancy in a patient with complete tetraplegia. Detailed clinical and laboratory observations were made with reference to the progress of both mother and foetus throughout the period of gestation. There is a short discussion on the problems which were considered in the initial instance and the measures which were taken to nullify adverse influences and to enhance beneficial ones.

The importance of a carefully planned programme of observation and treatment is stressed.

RÉSUMÉ

Il s'agit d'un bref rapport concernant la grossesse chez une tétraplégique complète. L'évolution clinique et biologique en a été étudiée. Une courte discussion des problèmes qui se sont présentés est présentée ainsi que l'importance d'un programme d'observation et de traitement.

ZUSAMMENFASSUNG

Ein Fall von Schwangerschaft einer kompletten Tetraplegikerin wird kurz beschrieben. Einzelheiten bezüglich Mutter und Foetus während der ganzen Gestationsperiode inklusive einer Diskussion der verschiedenen Probleme werden gegeben.

Die Wichtigkeit eines sorgfältigen Programms für Beobachtung und Behandlung wird betont.

REFERENCES

- GUTTMANN, L. (1963). *Proc. R. Soc. Med.* **56**, 383.
JACKSON, F. E. (1964). *Obstet. and Gynec.* **23**, 620.

Discussion

Jousse, A. (Canada), wondered if Dr. Hardy had any explanation why there were no autonomic disturbances in his patient, so manifestly evident in Dr. Frankel's case.

Hardy, A. G., replied that he had not. This had been very striking and although in his case the manifestations were there—she had tingling in the scalp, which Dr. Frankel also mentioned in his cases—this girl also had a rise in the level of blood pressure, but to within almost normal limits; most of the time she was hypotensive. Blood pressure throughout pregnancy and immediately before labour had been within the region 90-100/65-60 and then it only went up to a maximum of 135/90. So it was a relative rise but nothing

like the autonomic responses recorded by Dr. Frankel. One wondered whether the onset of pregnancy had any significance—in this case there was a pregnancy 10 weeks old in a case of injury and therefore the development of pregnancy was at a time of changing reflex activity—and whether the hormonal and vasomotor changes that were going on in both spheres at that time were such that no excessive activity became apparent in either. He really did not know.

Frankel, H. L., said the cases described who got severe hypertension in labour were all three several years after injury, all were having their first child. He was informed that it was much easier to have the third or fourth and the difficulty in dilatation may have been considerably less in Dr. Hardy's case. The thing that did strike him in Dr. Hardy's presentation were the three severe urinary flare-ups which the patient and foetus survived. They had always feared the possibility of this and had taken great precautions to try and avoid it, because they were told by the obstetrician that the foetus would not withstand high fevers for more than 24 hours. Apparently, it could.

Gingras, G. (Canada), said that Dr. Hardy had not mentioned the problem of abortion. It had been discussed and performed in a few of their cases. He did not want to start a controversy but he thought this was important and should be discussed if possible.

Hardy, A. G., said there were two answers here. There were the ethics and whether the mother and the father wished to have an abortion. This question was considered in this case. He thought they might have been persuaded but religious beliefs were actually against it, and he thought that they were glad when it had been decided that it should be allowed to continue. He thought also it had been decided to allow it to continue, if he could use these words, to acquire as much information as they could in the process of doing it. The feature that came out to them was that with careful handling these risks could be minimised, and there was this very question that Dr. Frankel had raised that abortion did not occur spontaneously anyway. Here was someone who was 10 weeks pregnant who got an injury which one might have thought would have precipitated a spontaneous abortion. He thought Dr. Gringras' question whether it should be artificially done should be considered, but in the light of what they had found one could not feel that it was an urgent thing, but one should have it at the back of one's mind.

Guttmann, L., said that the meeting would remember that he gave here a year or two ago a paper on 24 paraplegic women who had become pregnant and given birth to normal children, and from the medical point of view one could say that paraplegia as such was no contra-indication to pregnancy and to continuing the pregnancy to the very end. Pregnancy was quite normal, provided one took care about one thing: the anaemia which occurred in some of the patients, and Hardy had mentioned this also in his own case; the best and quickest method of overcoming anaemia, which was serious even in normal pregnant women, was by blood transfusions. Their first case had been a patient with a T4 lesion on the one side and T6 on the other and a suprapubic drainage, which could not be discontinued. This patient had started anaemia very soon and they had kept her going throughout the pregnancy by repeated blood transfusions. In this case, with a suprapubic drainage and contracted bladder, they had decided to have a caesarean section done. This was the only case in their series. There was another paraplegic woman—a former patient—who had gone to live in Rhodesia where the gynaecologist did a Caesarean, and he questioned whether this had been necessary. In all the other patients, pregnancy had been finished in the normal way. The only thing one had to do in high lesions—and that was the importance of continuous measuring of blood pressure—was to watch that the systolic blood pressure did not go up over 180/190. Then forceps had to be applied. What had struck him in Hardy's case was that there had been so little of the autonomic reaction one usually found in cases above T5. The explanation that Frankel had given that by the thirdgravidity the musculature of the pelvic floor was more adaptable to the uterus contraction might perhaps be the right one. Of course, there were variations in the intensity of these autonomic reactions, which he found already in 1944 and described in 1947. In particular, it depended largely on the size of the bladder. The smaller the bladder, the

more contracted the bladder, the more rigid the bladder, the more pronounced the autonomic distension syndromes which they had described.

The answer to the question of abortion he thought was now quite clear. From all the experience they had at Stoke Mandeville there was no indication as far as the paraplegia as such was concerned to do an abortion.

Araluze, F. (Spain), thought it would be very interesting to follow up the growth of the children born in these cases. Mainly because there was a possibility of minimal severe brain damage which was not easily detected within the first months but very easily detected in later life. He wondered if anyone had done so to see if there were any such brain damage or not.

Guttmann, L., said he could answer this. The children were absolutely normal in every aspect. The boy of the patient previously mentioned, with a high lesion and the suprapubic cystotomy, who had been pretty ill before with pressure sores, was 10 years old. He went to school with normal children and came with his mother every year to the Games. The same applied to all other children who had been borne by the Centre's paraplegic women.

ELECTRO-MYOGRAPHIC STUDY OF THE FLEXION REFLEX OF THE LOWER LIMB

By G. M. POOL

Zuider Ziekenhuis, Rotterdam

INTRODUCTION

NORMAL walking is an action, which, for the most part is involuntary and brought about by reflexes which are co-ordinated by a computer. The voluntary part of the action occurs through stimuli in motor fibres of a certain thickness in which there is a certain conduction velocity.

In view of this conduction velocity this system of fibres is called the alpha motor system. The conduction in this system is not continuous, but only present when a movement or working of a muscle or musclegroup is wanted.

Besides the alpha system we know the gamma system, which regulates the tone of the muscles. In this system there is a more or less constant inflow of stimuli from cerebral centres along thinner fibres with a lower conduction velocity (gamma). These stimuli are reflected via the muscle spindle. The gamma system could be compared with a radar: in the cerebral centre a tone image is formed from the reflected gamma stimuli and the centre becomes aware of the state of mobility of the muscles.

The regulation of tone in the muscle is monosynaptic and based on the stretch reflex. The p.t.r. is an example of this, passive stretching of the muscle elicits an increase in tone.

In the case of patients with a paraplegia normal walking is not possible because of a disturbance in the stimulus conduction whereby the computer can no longer, or not so well, regulate the reflexes and also the gamma radar system is more or less interrupted.