conservative treatment of placenta praevia, stated: "At the lower segment operation the cord may be cut through or pulled off, causing anaemia in the child." He quoted two such cases, one of which was very similar to Case 5, in which large placental vessels on the foetal surface were incised very close to the insertion of the cord. To avoid the danger of bleeding from the child Macafee recommended a stab incision into the lower segment and careful stretching of the incision with the fingers, thus avoiding damage to the placenta. This seems the best approach in the majority of cases, although it may often be equally effective to make the incision in the uterine wall a little higher than usual. If palpation suggests that injury to the placenta is inevitable or if, as sometimes happens, the lower segment is poorly formed, the classical approach may be justified in the interests of the child, but on no account should the placenta be removed before the child.

The differential diagnosis of the clinical picture following foetal haemorrhage is that of birth anoxia and birth trauma. Pallor and lack of tone may occur in all three conditions, but, while delayed onset of respiration is always present in birth anoxia, three out of five of the babies with post-haemorrhagic anaemia in the present series breathed spontaneously at birth. Further, babies with post-haemorrhagic anaemia remain pale, whereas normal colour returns after successful resuscitation of anoxic babies. Babies suffering from cerebral birth trauma may show other signs such as irritability, high-pitched cry, full fontanelle, increased tone in the limbs, and even convulsions. Post-haemorrhagic anaemia has also to be differentiated from haemolytic anaemia following blood-group incompatibility. Antenatal rhesus blood grouping and routine tests for agglutinins in rhesus-negative mothers will reveal in advance nearly all cases of rhesus-blood-group incompatibility, while the direct Coombs test is positive on the infant's cord blood. Post-haemorrhagic anaemia may occur shortly after birth from a slipped ligature of the umbilical cord, but the source will be evident.

In conclusion, in all cases with placenta praevia delivered by caesarean section arrangements should be made for haemoglobin determinations on the cord or infant's blood. As haemodilution may not occur for several hours after haemorrhage, serial haemoglobin estimations may be necessary after birth, taking into account that the normal haemoglobin level in the baby's peripheral blood is usually about 20% higher than the cord level. In every case preparations should be made for immediate transfusion of the child.

Summary

Five cases of post-haemorrhagic anaemia of the newborn are described following lower-segment caesarean section for placenta praevia and occurring in every case after incision of the placenta. In two other instances the placenta was incised without anaemia in the infant. In 235 caesarean sections carried out for other reasons in the same period there were no cases of anaemia in the infant; neither was the baby affected in seven cases of placenta praevia delivered by the vaginal route.

Methods for avoiding damage or incision of the placenta during delivery are discussed. The need for prompt recognition and treatment of post-haemorrhagic anaemia in the newborn is stressed.

We are indebted to Professor W. C. W. Nixon and the consultant obstetric staff of University College Hospital for their permission to publish these cases.

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ACIDAEMIC COMA AFTER BILATERAL TRANSPLANTATION OF URETERS

BY

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The frequency with which a chronic acidaemia with hyperchloraemia and raised blood urea occurs after bilateral transplantation of the ureters has been appreciated only since Ferris and Odel's (1950) review. In the last four years over 25 papers have been written on this topic, but the majority have appeared in the urological literature, and many physicians may be unaware of a characteristic clinical syndrome and its correct management. The case reported below is the first in which serial measurements of arterial blood pH have been made during recovery from acidaemic coma precipitated by acute pyelonephritis.

Case Report

A 66-year-old retired wood-sawyer was readmitted to Chase Farm Hospital on September 29, 1953. In October, 1949, bilateral uretero-sigmoid anastomosis and total cystectomy was performed for carcinoma of the bladder. He remained in moderate health but complained of easy fatigability, muscular weakness, dyspnoea on exertion, central chest pain of anginal character, increased thirst, and frequent attacks of malaise, fever, shivering, and anorexia suggestive of recurrent acute pyelitis. His weight fell from 10 st. 6 lb. to 8 st. 10 lb. (66.2 to 55.3 kg.).

Two weeks before admission he developed a further attack of malaise, shivering, and headache. On September 26 he felt well enough to get up, but after walking in the garden developed central chest pain and a feeling of extreme weakness, and retired to bed. On the following day he vomited once. On the 28th he became drowsy and subsequently unrousable. No urine had been passed for twelve hours prior to admission.

On examination he was comatose, with Kussmaul breathing. T. 99.2° F. (37.3° C.); R. 9-12; P. 110. There was moderate dehydration, but the extremities were warm, and blood from the antecubital vein was arterial in colour. Intermittent twitching of facial muscles, platysma, and arms occurred. B.P. 140/70 (usual level 170/105). Deep reflexes were all increased, with sustained clonus of right ankle.

Arterial blood analysis showed severe acidaemia with hyperchloraemia and raised blood urea—pH 7.08; plasma CO₂ content, 4.5 mEq (10 vols.); pCO₂, 13 mm.; sodium, 145 mEq; potassium, 4.3 mEq; chloride, 114 mEq; blood urea, 231 mg. per 100 ml. The acidaemia was treated by rapid infusion of 3.8% sodium citrate. After twenty to thirty minutes the level of coma lightened and extreme restlessness necessitated sedation with paraldehyde. After 1.7 litres of sodium citrate in three hours, the arterial pH had risen to 7.48, but clinical hyperventilation was still present with an arterial CO₂ tension reduced to 20.9 mm. and a plasma CO₂ content of 15.8 mEq. Rehydration was continued with 5% glucose and the presumed pyelonephritis treated with chlortetracycline ("aureomycin"), 500 mg. twice daily, added to the intravenous drip (total 14 g.). On October 1 he was fully conscious and replied slowly but rationally to questioning; the blood urea had risen to 297 mg. He complained of profound anorexia and lethargy, and was found to have developed moderate hypokalaemia (K 2.4 mEq). Potassium deficiency was repaired by the intravenous administration of a potassium phosphate solution (60 mEq per litre) and subsequently by potassium citrate orally.

The serum level returned to normal on the tenth day after 1,000 mEq of potassium. Balance studies proved

impossible because of rectal incontinence. Despite the administration of sufficient alkali to maintain the arterial pH on the alkaline side of normal (pH 7.42-7.52), mild hyperventilation persisted and the plasma CO₂ content and pCO₂ did not become normal till two weeks after admission. On recovery slight urea retention persisted (54-80 mg.), but the patient remained in good health (April, 1954) with normal blood electrolytes on a daily supplement of 20 g. of sodium bicarbonate and 10 g. of potassium citrate. Full details of blood electrolytes, pH, fluid intake, etc., are given in the Chart.

Arterial pH, carbon dioxide tension, and electrolytes during recovery from acidaemic coma in a patient with bilateral uretero-sigmoid anastomosis.

Discussion

The biochemical abnormalities that follow uretero-colic anastomosis are acidaemia with lowered plasma CO₂, raised blood urea and chloride levels, and, less frequently, hypokalaemia. Plasma sodium and total base are usually within normal limits. In the 141 patients studied by Ferris and Odel (1950) the alkali reserve was reduced in 80% and 55% showed hyperchloraemia (Cl>107 mEq). The frequency of electrolyte disturbance has been confirmed in the larger series of 201 cases collected by the British Association of Urological Surgeons (Jacobs and Stirling, 1952)—a lowered alkali reserve was present in 78% and the full syndrome of hyperchloraemic acidosis with raised blood urea in 31%. In only 6% were the levels of blood urea, chloride, and CO₂ content all normal. Hypokalaemia was present in more than a third of the cases.

Although electrolyte disturbances occur in most patients, symptoms attributable to them appear in only a minority. These symptoms include general weakness and fatigue, hyperventilation and exertional dyspnoea, anorexia with progressive weight loss, an unpleasant or salty taste in the mouth, increasing thirst, and bone pains. Muscular weakness can occasionally be attributed directly to hypokalaemia: Diefenbach *et al.* (1951) describe the case of a patient with a complete flaccid quadriplegia and serum potassium of 2.1 mEq who was able to walk within 50 minutes of the infusion of 4 g. of potassium chloride. Osteomalacia due to the chronic acidaemia with consequent renal loss of calcium may occur, and cases with bone pains and multiple fractures have been reported by Pines and

Mudge (1951), Badenoch (1952), and Moore (1952), and vitamin-D resistant "rickets" in a child by Boyd (1931).

Whilst excessive reabsorption of chloride and urea from the colon forms the basis of the electrolyte disturbance, it is now generally agreed (Lapides, 1951; Parsons *et al.*, 1952; Pyrah, 1954) that this only becomes of clinical importance in the presence of renal impairment when the capacity of the distal tubules to acidify the urine is impaired by ascending pyelonephritis or back pressure from a hydro-nephrosis (Kekwick *et al.*, 1951). Any intercurrent illness associated with diarrhoea and vomiting, but especially an attack of acute pyelonephritis, may precipitate acute symptoms by causing dehydration with rising blood urea levels, increasing acidaemia, hyperventilation, stupor, and, finally, anuria and coma. The clinical picture may then be confused with terminal uraemic coma, but infusion of alkali, rehydration, repair of potassium deficiency, and treatment of the underlying infection will restore moribund patients to health.

Some authors (Harrison, 1943) maintain that the measurement of blood pH is technically difficult and clinically unhelpful. This is not true. With a closed glass electrode (see Appendix) measurement of the pH takes twenty to thirty minutes, and with careful standardization duplicates agreeing within 0.02 pH unit can be obtained routinely. Brachial-artery puncture is a safe and painless procedure even when samples are taken from the same arm daily. I have not encountered any serious sequelae (embolism, thrombosis, or aneurysm formation) in over 300 punctures. Haematoma formation can usually be prevented by firm compression of the artery for two to three minutes. If arterial puncture proves impossible, venous blood of arterial character can be obtained from the back of the hand after immersing the forearm in warm water for fifteen minutes.

It is well known that the alkali reserve is frequently a completely misleading guide to the degree of acidaemia, especially when the acid-base disturbance is due to a combination of metabolic and respiratory factors. Low levels of serum bicarbonate may be accompanied by little change in pH and comparatively high levels with severe acidaemia (Natelson and Barbour, 1952; Yeomans and Stueck, 1952). Direct measurement of arterial pH is the only method of assessing the severity of acidaemia and of controlling therapy accurately. During the infusion of alkali, measurements should be made at intervals of thirty minutes to one hour until the pH has risen to the desired level. The correction of acidaemia by formulas based on serum bicarbonate or alkali reserve is unreliable and the technique of *in vivo* titration makes their use unnecessary.

In this patient the arterial pH rose from 7.08 to 7.48 after 65 g. of sodium citrate had been administered over a three-hour period. Despite correction of pH to the alkaline side of normal, hyperventilation persisted with reduction of plasma CO₂ content to 15.8 mEq and pCO₂ to 20.9 mm. If therapy had been based either on the clinical appearance or on the level of serum bicarbonate, it would have been assumed erroneously that the acidaemia was still uncorrected. Further infusion of alkali would have caused severe alkalaemia and tetany, since the serum calcium was reduced to 6.4 mg. The persistence of hyperventilation for hours or days after the correction of acidosis was first recorded by Stillman *et al.* (1917) in diabetic coma, and is due to the fact that the respiratory centre in chronic acidaemia becomes adapted to a low level of CO₂ tension and takes time to readapt to the normal level of 40 mm. In diabetic coma it is unnecessary to do more than partially correct an initial severe acidaemia. Spontaneous restoration of pH to normal will occur as soon as the level of blood keto-acids begins to fall with the administration of insulin and intravenous saline.

I attribute coma in this patient to acidaemia rather than uraemia, since an arterial blood pH below 7.1 is known to cause coma in patients suffering from carbon dioxide narcosis (Westlake, 1953) and recovery of consciousness occurred with restoration of the blood pH to normal while the blood

urea was continuing to rise. Lange *et al.* (1951) have shown that severe acidaemia (pH 6.8-7.2) causes a large increase in cardiac output with fall in peripheral resistance: this may account for the fact that, on admission, blood from the antecubital vein was arterial in colour despite considerable dehydration.

Summary

A case of acidaemic coma with hypokalaemia, precipitated by acute pyelonephritis, four years after bilateral uretero-sigmoid anastomosis, is described.

Recovery occurred following the infusion of alkali, rehydration, intravenous and oral potassium, and a course of chlortetracycline.

Hyperventilation with low levels of plasma bicarbonate and CO₂ tension persisted for two weeks after restoration of the blood pH to normal. Attention is drawn to the value of serial measurements of arterial pH as a rapid and accurate method of controlling alkali therapy.

I wish to thank Dr. Thomas Simpson and Mr. H. O. Blauvelt for permission to publish this case; and Mr. Ronald Smith for the estimations of sodium, potassium, chloride, and urea.

APPENDIX

Arterial blood samples were taken, under local analgesia, from the brachial artery into all-glass syringes lubricated with a few drops of heparin (5,000 units per ml.) only, using a No. 1 Luer needle. Beads of mercury were subsequently introduced to obtain even mixing of blood and heparin. The patient's temperature was taken while the artery was compressed firmly for three minutes. The blood was allowed to cool to room temperature and its pH measured within thirty minutes of sampling with a Cambridge pH meter and Stadie closed glass electrode. The meter was standardized with phosphate-citrate buffers of pH 7 and 7.4 (B.D.H. electrometrically tested). Correction of the observed pH to the patient's body temperature was made by Rosenthal's (1948) factor. Arterial pCO₂ can be calculated from pH and total plasma CO₂ content using the Henderson-Hasselbalch equation.

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Speaking at the opening of two villas for female patients at St. Crispin Hospital, Duston, the Minister of Health, Mr. IAIN MACLEOD, commended the growing practice of mental hospitals holding regular "at homes." "Throwing open the doors in this way and inviting local people to come and see for themselves is by far the best way to break down prejudice and remove misunderstanding about the life and atmosphere of these hospitals," he said. "As a result I hope more young men and women will be ready to help this great work forward by enrolling as nurses."

SMALLPOX IN A CHILD AGED 3 DAYS

BY

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Transplacental transmission of diseases from the mother to her offspring is well known, and is perhaps the only route of infection of a foetus *in utero*. Of the infectious diseases transmissible in this manner, smallpox is probably the most common. Bancroft (1904), Marsden and Greenfield (1934), and Dixon (1948) have all reported smallpox in newborn infants; but in most of the recorded cases the mother was suffering from the disease when the child was born. We have found only one record of an apparently healthy mother giving birth to a child who developed smallpox shortly after birth—that is, within the incubation period of nine days to call it an inherited infection—that of Bancroft (1904), who referred to a case without giving any details. In the following case of smallpox in a child aged 3 days the mother had not shown any of the symptoms of smallpox immediately before or after delivery. A discussion on the probable mechanism of infection in such cases is also presented.

Case Report

A healthy child born on January 27, 1950, was first noticed by the medical attendant to have a rash on January 31, 1950. On account of the atypical nature of the rash, the doctor delayed sending the infant to the Infectious Disease Hospital, Madras, until February 2.

The child was well nourished and its general condition was good. The eruptions were present all over the body, including the face and extremities. The lesions were discrete and in the vesicular stage. Smallpox was diagnosed. On February 11 the lesions had advanced and were in the scabbing stage. The scabs had begun to fall off and a few were collected in 50% glycerin water for laboratory investigation.

Other Relevant Data.—There had been no case of smallpox in the house, but there were some cases in the locality. The mother was healthy, and did not recollect any history of illness during the last few days of pregnancy. She bore marks of smallpox and gave a history of an attack 20 years before. She had not been vaccinated during pregnancy, but underwent vaccination when the child was admitted into hospital, the reaction being of the nature of that seen in partially immune individuals (accelerated or vaccinoid).

Laboratory Investigations.—The scabs collected from the child were ground up in normal saline and the following experiments were performed.

Using Monkeys.—(a) Scarification on to the skin of the monkey produced vesiculation characteristic of variola-vaccinia lesions. (b) Successful serial passages through the monkeys were performed for about four passages and discontinued afterwards. (c) The monkeys used in experiments *a* and *b* gave "immune reactions" when injected with routine calf lymph.

Using Eggs.—(a) The ground-up scab material, on inoculation on to chorioallantoic membrane, produced variola-like lesions. (b) Successful serial egg passages were made, and the strain is at present being maintained. (c) One of the monkeys inoculated with the egg-passed material developed generalized eruptions, which included the face, and died on the twelfth day after