determined in 101 women at the seventh month of pregnancy attending ante-natal clinics in Blackburn.

In the series seven women out of ninety-five tested (7 per cent.) were considered to be definitely anaemic, and eighteen (19 per cent.) probably slightly so. In thirty-seven out of ninety-six tested (39 per cent.) the calcium level was less than 9 mg. per 100 ml., which is believed to be abnormally low. The product calcium $\times$ phosphorus was 25 on the average. The blood of twenty-two women out of ninety-nine tested (22 per cent.) failed to inhibit the growth of streptococci, and, of these, one developed pyrexia during the puerperium; fever also occurred during the puerperium in a patient whose blood inhibited growth at the seventh month. A review of the literature indicates that the serum calcium and phosphorus fall and the serum phosphatase rises gradually as gestation advances.

In addition to the several individuals mentioned in the text who co-operated in this research and to whom our thanks are due we also wish to express our gratitude to the following: Dr. D. W. Auchinachie, for assistance and advice in biochemical methods; Dr. A. Bradford Hill, for assistance and advice in statistical analysis; Professors Dible and McLeod, for advice on bacteriological methods; and Dr. Colebrook, for supplying the culture of haemolytic streptococci.

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The Council of the Royal Society of Arts gives notice that the next award of the Swiney Prize will be made in January, 1939, the ninety-fifth anniversary of the testator's death. Dr. Swiney died in 1844, and in his will he left a sum of money to the Royal Society of Arts for the purpose of presenting a prize, on every fifth anniversary of his death, to the author of the best published work on jurisprudence. The prize is a cup of a value of £100, and money to the same amount. The award is made by a joint committee of the Royal Society of Arts and the Royal College of Physicians of London, which appoints special adjudicators. The prize is offered alternately for medical and general jurisprudence, but if at any time the committee is unable to find a work of sufficient merit in the class whose turn it is to receive the award, it is at liberty to recommend a book belonging to the other class. On the last occasion (1934) the prize was awarded for general jurisprudence. It will, therefore, be offered on the present occasion for medical jurisprudence. Any person desiring to submit a work in competition, or to recommend any work for the consideration of the judges, should do so by letter, addressed to the Secretary of the Royal Society of Arts, John Street, Adelphi, London, W.C.2, not later than November 30, 1938.

CHANGES IN BLOOD PRESSURE AND RESPIRATORY VOLUME FOLLOWING A SPINAL ANAESTHETIC

BY

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AND

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There is always a fall of blood pressure following the administration of a spinal anaesthetic. This has been attributed to (1) vasomotor paralysis of the legs and trunk, causing vasodilatation and loss of blood in effective circulation; and (2) diminution of respiratory excursion due to intercostal paralysis causing a decline in negative intrathoracic pressure during inspiration and a decrease of the venous return to the heart. The occurrence of a fall in respiratory volume has been ascribed to abdominal and intercostal paralysis and to medullary anaemia following the fall in blood pressure.

Observations on the changes in systolic and diastolic blood pressure and in respiratory volume after the administration of a spinal anaesthetic were carried out in twenty-three cases, using the following technique: the anaesthetic was crystalline novocain, in amounts varying between 0.100 and 0.150 gramme (average 0.126 gramme) in solution in cerebrospinal fluid (average 1.88 c.cm.) injected fairly slowly (four seconds) into the third lumbar space. This anaesthetic is completely absorbed in five to ten minutes by the spinal nerves near the site of injection; thus there are no secondary changes due to spread of the anaesthetic to higher regions during the progress of the operation. Repeated observations, commencing four to ten minutes before injection of the anaesthetic, were made of brachial systolic and diastolic blood pressure and also of the volume of expired air. For the latter purpose a simple airtight mask of elastoplast was devised, adherent to the patient's face and attached to the valve apparatus of a nitrous oxide apparatus, which was in turn connected to a meter, read every two minutes. The following readings obtained by these methods give some information on the relation of the fall in blood pressure to the changes in respiratory volume.

Relation of Blood-pressure Fall to Respiratory Changes

It was found that there is a sharp fall amounting on an average to 40 per cent. of the initial systolic and 36 per cent. of the initial diastolic blood pressure, the mean time of onset being 2.6 and 2.2 minutes after the administration of the spinal anaesthetic. The variation in this fall in blood pressure, considered as a percentage of the original value, while not very great, is proportional to the level of anaesthesia attained. The average level was up to the seventh rib, the highest and lowest being up to the third and tenth ribs respectively. There is also a fall in respiration, which occurs on an average one minute later than the fall in blood pressure (in two cases slightly before, in two cases synchronously, and in nineteen cases after). This decline amounts to 41 per cent. of the initial respiratory volume. These falls are regular, with a tendency to be biphasic in the case of blood pressure and a similar less pronounced tendency in the case of respiration. The fall ceases after 13, 12½, and 13½ minutes in the cases of systolic and diastolic blood pressure and respiration respectively. There follows a recovery of systolic and diastolic blood pressure and

respiration of $7\frac{1}{2}$, $10\frac{1}{2}$, and 14 per cent. of their initial values respectively, which occupies about eight minutes.

It would appear from these observations that the fall in blood pressure is, at least in part, independent of changes in respiratory volume. It was found that if the respiration volume was maintained at the initial level—for example, by CO_2 inhalation—the decrease in blood pressure occurs, but it takes longer (average eighteen minutes) and is more markedly biphasic. Recovery of blood pressure follows as before.

The effect of maintaining respiration was subsequently demonstrated by the induction of hyperpnoea by CO_2 inhalation. If a flow of $1\frac{1}{2}$ litre per minute is administered (of which about $1\frac{1}{4}$ litre per minute is inhaled) respiration is increased by about 45 per cent. of its initial volume, the rise being regular and rapid, of almost instantaneous

$6\frac{1}{2}$ per cent. and 6 per cent. of their initial values. The suggestion that medullary anaemia is the cause of the fall in respiratory volume is not borne out by the finding that the Trendelenburg position, while raising the brachial and to a greater extent the cranial blood pressure, does not result in an increase of respiratory volume.

It was noted that in cases of hypertension with arteriosclerosis the initial high systolic blood pressure fell very rapidly, the fall being a greater percentage of the initial blood pressure, and the final blood pressure being as low as or lower than in normal cases. In these cases the Trendelenburg position has the effect described above, bringing the blood pressure up to about the normal low level; subsequent induction of hyperpnoea by CO_2 inhalation has less than the usual effect in raising blood pressure. This increased decompensation occurring in cases of hypertension is shown by comparing the initial systolic blood pressure with the initial and final values of the function $S/2D-20$. On an

CHART 1.

CHART 2.

CHART 3.

CHART 1.—Average variation of blood pressure and respiration following the administration of a spinal anaesthetic.

CHART 2.—Variation of blood pressure and respiration following the administration of a spinal anaesthetic in a case of hyperpiesis.

CHART 3.—Variation of blood pressure and respiration following the administration of a spinal anaesthetic in a case with normal initial blood pressure.

onset, and attaining its maximum in three to four minutes. About 3.6 minutes after the beginning of CO_2 inhalation there is a rise (completed in another four minutes) of $3\frac{1}{2}$ per cent. and 5 per cent. of the initial systolic and diastolic blood pressure. At the same time the radial pulse volume is appreciably increased.

These effects of either maintaining or subsequently raising the respiratory volume suggest that there is a relation between the maintenance of respiratory volume and the blood pressure, but, also, that another result of administering a spinal anaesthetic is independent of respiration and much more potent in causing a fall of blood pressure, and that of the total fall in blood pressure only a small percentage can be counteracted by maintaining a normal or hypernormal respiratory volume.

The result of loss of blood in effective circulation was shown by placing the patient in the partial Trendelenburg position, the feet being raised not more than one foot above the level of the head. This brings about an immediate rise in systolic and diastolic blood pressure of

average, in those cases whose initial blood pressure was 130 mm. Hg or below, decompensation is slight, while in those cases in which initial blood pressure was in the neighbourhood of 180 mm. Hg decompensation amounts to a 25 per cent. decrease in the initial and final values of $S/2D-20$. The abnormally low blood pressure in these cases will, however, respond to some extent to ephedrine. The majority of the subjects of these observations had received premedication with $1\frac{1}{4}$ grain of morphine and $1/150$ grain of hyoscine.

The cause of the biphasic type of fall of blood pressure is not clear; it might be suggested that this temporary check in fall of blood pressure may indicate the normal compensation to lowered blood pressure by contraction of the spleen, visceral ischaemia, etc. The observations demonstrate that CO_2 is of immediate assistance during the administration of a spinal anaesthetic, as well as for prophylaxis against post-operative pulmonary collapse. The diagrams show the average response of the twenty-three cases to the various conditions imposed upon them,

and the response of a typical case of hypertension and of a case with normal blood pressure.

Conclusions

1. The greater part of the fall in blood pressure is due to vasomotor paralysis.
2. A minor cause is the diminished respiratory excursion, which is due to abdominal and intercostal paralysis rather than medullary ischaemia.
3. The Trendelenburg position has an immediate definite effect in increasing the blood pressure but not the respiratory volume.
4. The induction of hyperpnoea has a small delayed effect in increasing the blood pressure.

A BRIEF REVIEW OF 426 CONSECUTIVE CASES OF URINARY CALCULUS

BY

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The investigation of a large number of cases of a disease such as lithiasis, chiefly because of the wide distribution of that condition throughout the urinary tract, reveals some interesting data. First of all is the fact that the male is invariably more prone to urinary lithiasis than the female: there are approximately two cases in the former to every one in the latter. My figures are as follows: male, 278; female, 148. Lett's (1936) figures from the London Hospital are in the same proportion; these cover the period 1905-34. The next important fact to note is the high proportion of cases which occur in the upper urinary tract (79 per cent.) in comparison with the lower. The London Hospital figures (74 per cent.) are not far removed from mine on this point. The following table shows the general distribution throughout the urinary tract in my cases:

Kidney, 220	}	337 = 79.10% upper urinary tract
Ureter, 117		
Bladder, 80	}	89 = 20.90% lower urinary tract
Urethra, 9		
426		

Staphylococcal Foci of Infection in Renal Calculus

Several Continental writers, notably Hellström (1936) of Stockholm and Hryntschak (1935) of Vienna, have called attention to the importance of chronic staphylococcal foci of infection as predisposing factors in the aetiology of renal calculus. Hellström found the staphylococcus in the structure of the stones in a large number of his cases. At the same time he has identified chronic infective foci in the genitalia of many of his patients. In 115 cases of stone in the upper urinary tract which I have examined in the same way I observed similar foci in 72 per cent. These were noted in the prostate, seminal vesicles, urethra, epididymides, the cervix uteri, and at the bladder neck. The importance of treating such foci is obvious, particularly in the hope of removing a cause for further stone formation. One other aetiological factor I found important in this series—namely, a dilatation in the urinary tract which pre-existed the calculus. This was noted in

15 per cent. of my cases, and had its maximum incidence among children, concerning whom the dilatation appeared to be the principal aetiological factor with regard to stone. Parathyroid or deficiency disease, diseases of the bone, excess of vitamin D, and hypercalcaemia from various causes are all known to encourage stone formation, but they have certainly played an insignificant part in the cases forming the subject of this article.

Age Incidence

The average age incidence in 220 cases of renal calculus was 39.5 and in 117 cases of stone in the ureter 39.7. The disease is slightly more common on the left side than on the right. The percentage figures of my cases are as follows: left, 50.55; right, 36.40; bilateral, 13.05. In the kidney, calculus is of equal incidence in both sexes.

When we come to consider the ureter, however, there is a remarkable change in the sex incidence. Indeed, ureteric calculus is about twice as common in the male as in the female: eighty-two of my cases were in males and thirty-five in females. The London Hospital figures are roughly in the same proportion. Here is offered an opportunity for an interesting speculation as to anatomical differences, which might supply the explanation. When we come to vesical calculus there is a still greater disparity in the sex incidence, the male greatly predominating, actually to over 90 per cent. There is nothing new about this relationship, it being practically the same as in ancient times.

Recurrence and Mortality of Renal Calculus

I have no figures to put forward at present as to recurrence of renal calculus following operations on the kidney for stone. The literature offers a wide range of results according, I should imagine, to the way the investigations have been conducted. Although I have not yet undertaken a systematic investigation on this matter I have come across a few of my patients who have had a recurrence. In some cases this occurred in the kidney from which stone was removed; in others the stone has subsequently appeared for the first time in the opposite organ. With regard to the latter group, I would like to emphasize the fact that, in those cases in which after full investigation I have thought it proper to do nephrectomy, I have no knowledge of any in which stone has ultimately appeared in the remaining kidney. I call attention to this matter because I am of the opinion that when a kidney which is badly damaged by stone is left behind it is likely to encourage the formation of stone on the opposite side. The percentage of recurrence is quoted by some authorities as being no more than two to three after nephrectomy. My mortality for operations for renal calculus in 135 cases is 2.9 per cent.

Stone in the Ureter

Treatment of stone in the ureter presents an interesting problem. The outstanding fact about these cases is that the great majority of stones pass spontaneously without any assistance. This was so in 67 per cent. of the cases that I was able to trace. If the stones do not pass in due course they can usually be made to do so by some minor measures carried out through the cystoscope, such as passing ureteric catheters and slitting the ureteric orifice. Sometimes several weeks elapse between the instrumentation and the passage of the stone. The longest interval in my cases was nine months. As a rule there is no appreciable damage to the renal function from the lodgment of a small stone in the pelvic portion of the