be the momentum of the projectile, the part and surface area of the vertebra which it strikes, and the region of the spine which is wounded.

Secondary Changes.

Finally, we must consider the secondary changes which may occur in the neighbourhood of the primary injury and in those portions of the cord which have suffered from concussion.

It has occasionally happened that when the wound is not severe the patient was at first able to perform some movements in his legs, but lost the power to do so within the following two or three days. Further, we have seen new symptoms develop or their level alter under observation. This may be due to a secondary haemorrhage into the affected tissues or to progressive softening, of both of which we found possible evidence in our sections.

But the most striking secondary change was the development of the cylindrical cavities we have described. Their exact pathogenesis is obscure, but certain features they present must be emphasized in attempting an explanation. In the first place, they seem to involve the destruction of very little tissue, but rather separate and compress the fibres around them; their contents must be consequently under much pressure. In the second place they evidently develop away from the lesion, as the material they contain is always less necrotic at their upper or lower end if they are respectively ascending or descending cavities; and finally they do not as a rule extend to the maximal lesion, but are generally connected with this by a track of oedematous or softened tissue, or by a narrow channel of softening or by a fissure (Fig. 1). It seems, therefore, probable that they originate from the accumulation under pressure of transuded fluid and degeneration products in a small projection of the primary lesion, which tracks upwards or downwards along the lines of least resistance through either normal or oedematous parts, destroying only a relatively small amount of tissue but increasing in size probably under the same principles as a retention cyst. The granule cells which frequently line their walls, or are contained within them, must be due to a reactionary proliferation of the neuroglia in the tissue through which they track.

Finally, it must be emphasized that they are not due to infection, as in several cases in which they occurred the theca had not been lacerated, and there was no sign of infection in either the cord or the meninges.

They are obviously not produced by haemorrhages, though a certain number of red blood cells may be found within them, nor by vascular lesions, as there has been no evidence of these, and the position of the cavities does not correspond with the distribution of any spinal vessel. The frequency with which they occupy the ventral portion of one or both dorsal columns is striking, but its significance is not clear. This region is, however, a watershed area between the distribution of the anterior spinal arteries and of the small arteries that supply the dorsal columns, and as such may have a relatively poorer blood supply than other parts of the cord. In many cases, too, the dorsal columns seem to suffer more severely with oedema and softening than the ventro-lateral columns.

It is obvious that these irregular and diffuse changes which are found in various types of spinal injury must be taken into account in interpreting and estimating the significance of the clinical symptoms that are observed in these cases. The following conclusions at least can be drawn:

1. The structural lesions in the spinal injuries of warfare are rarely sharply limited or circumscribed, and cannot be compared to those produced experimentally in a physiological laboratory. The level of the lesion, as indicated by the clinical symptoms, for instance, often does not correspond with the level of maximal damage.

2. The lesions are so irregular in distribution and severity when the spinal injury is not complete that much care is necessary in drawing conclusions from the clinical symptoms alone on the functions of parts which it may be assumed have been involved.

3. Secondary changes may occur later in the cord which can alter or modify the clinical symptoms.

MALIGNANT TUMOUR OF THE KIDNEY.

AN ANALYSIS OF SOME SYMPTOMS AND SIGNS OF A SERIES OF CASES.

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THIS article, written from rough notes made some time ago, is divided into four portions. Part A contains an analysis of age, sex, side, and the onset symptom. Part B deals with the association of pain, haematuria, and a palpable renal tumour to each other during the illness. Part C mentions some complications, and Part D includes illustrative clinical cases. The material is extracted from my own case notes; I am also indebted to my colleagues on the staff of the Royal Victoria Infirmary, Newcastle-on-Tyne, for the use of their records.

A.—AN ANALYSIS OF AGE, SEX, SIDE, AND THE ONSET SYMPTOM.

1. Age.

Ten out of the series occurred in children under the age of 10; in each case the condition was sarcoma. No case occurred between the ages of 10 and 29 inclusive—that is, the second and third decades of life; 31 out of the 59 cases occurred between the ages of 45 and 65; or, if children are excluded, and only the 49 adults reckoned, 31 out of the 49 occurred between these ages—that is, 63.2 per cent.

A curious fact, which may only be a coincidence, is that in the fourth, fifth, sixth, and seventh decades the preponderance of cases occurred in the first half of the decade, for 5 cases were between 30 and 35 years old, 7 of the cases were between 40 and 45, 10 of the 17 cases were between 50 and 55, while 9 of the 12 cases were between 60 and 65.

Of the 49 adult cases, 14 occurred between the ages of 45 and 55, a percentage of 28.5.

TABLE I.

Under 9.	10-19	20-29	30-39	40-49	50-59	60-69	70-79	Not Stated.
10	—	—	5	11	17	12	1	3

Total, 59.

2. Sex.

63.8 per cent. of the series were males, there being 36 against 23 females. Of the 10 children, 6 were boys.

3. Side.

In 31 instances the malignant growth affected the left side and in 26 the right side. In 2 cases the side affected was not stated.

4. Onset Symptom.

In 7 cases of the series the actual onset symptom is not stated; these will therefore not be taken into account in calculating percentages. Of the remaining 52 cases, the commonest initial evidence was painless haematuria. This was observed in 14 cases.

In 10 cases the illness was ushered in by acute renal colic, while in 10 other cases a painless swelling found in the flank was the first evidence of anything wrong; 9 cases began with chronic pain in the flank, while 5 patients suffered from cachexia before any sign of malignant growth of the kidney became manifest. In 2 cases there was increased frequency of micturition at onset, another went to his doctor for a varicocele, while the remaining one had "swelling of the bowels."

Therefore the separate symptoms of (1) painless haematuria, (2) symptomless flank swelling, (3) acute renal colic, and (4) chronic renal pain, account for the onset symptoms in 43 cases, a percentage of 82 per cent.

Of the 7 children included in the above, in 3 cases a painless tumour was found in the flank, in 2 cases there was painless haematuria, in 1 case a chronic aching pain, in 1 case cachexia; while in the 3 further cases there was no statement.

TABLE II.

	Cases.	Per Cent.
Painless haematuria ...	14	26.9
Acute renal colic ...	10	19.2
Painless swelling in side ...	10	19.2
Chronic pain in side ...	9	17.3
Cachexia ...	5	9.6
Increased frequency of micturition	2	3.8
Swelling of bowels ...	1	1.9
Varicocele ...	1	1.9
	52	

B.—THE ASSOCIATION OF PAIN, HAEMATURIA, AND PALPABLE RENAL TUMOUR TO EACH OTHER DURING THE ILLNESS.

TABLE III.—Showing Number of Cases in which Pain, Haematuria, and Palpable Tumour were Present.

	Cases.
Pain, haematuria, and a palpable tumour ...	32
Pain and haematuria ...	3
Pain and a palpable tumour ...	6
Haematuria and a palpable tumour ...	5
Haematuria only ...	1
A palpable tumour only ...	6
Records not sufficiently complete ...	6

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1. Pain.

In 11 instances there had never been any pain before the case came under the observation of a doctor. Either painless haematuria or the accidental discovery of a flank swelling, separately or in combination, led the patient to think there was something amiss. This absence of pain bears out the well-known fact that "cancer" anywhere is by no means necessarily associated with pain, especially in the early stages of the condition. Fortunate is the patient with any malignant growth who has pain in the early stages; such pain may be regarded as protective, and is a warning to go to a doctor for investigation, when the chances of a cure after operation would be still greater than they are. Renal pain may be acute or chronic; although both may be present, the causes are different.

Acute renal pain shows itself in the form of colic, which is only present when there is bleeding, but furthermore when the blood becomes clotted in the higher urinary passages. Rarely, it may follow the detachment of a piece of the malignant growth. The colicky pains are due to the muscular contractions of the renal pelvis trying to empty this blood-distended organ, together with similar contractions in the ureter during the downward passage of the blood clot on its way to the bladder. Therefore, although bleeding is the real initial symptom, it may be preceded by acute pain before the haematuria is apparent.

Chronic renal pain is usually present as a localized dull ache referred either to the front or to the back of the affected kidney. Its causes include the stretching of the renal capsule by the increasing size of the tumour, by the dragging weight of the tumour, by involvement of the renal nerves, and by infiltration of the surrounding parts.

Absence of all pain is due to the escaped blood remaining fluid, to lack of tension of the growth owing to a perforation of the renal capsule, through the anchoring of the kidney by local inflammatory adhesions, and to the temperament of the patient.

2. Haematuria.

Apart from the renal sarcomata of children, there are probably few cases which do not present this symptom at some stage.

Haematuria may be painful or painless; this is very often determined by the circumstance whether the blood undergoes clotting or not, especially in the higher urinary passages. It is difficult to say exactly the factor which determines such clotting; it is certainly influenced by the degree of urine concentration.

The bleeding is due to erosion of a blood passage—a normal vessel or one recently formed—by the advancing growth. In one case (mentioned later) the onset of haematuria followed the vigorous massage of a huge malignant kidney. The blood may be either intimately mixed with the urine or in the form of long worm-like casts, due to its coagulation in the lumen of the ureter.

Haematuria is an important link in the chain when making a diagnosis of malignant disease of the kidney; this symptom was definitely present in 24 cases out of 52—that is, in 46 per cent.

3. Tumour.

A renal swelling was present in 49 cases of the series; in 4 cases it was definitely stated that no tumour could be palpated, while in 6 cases the records are incomplete.

The presence of an enlarged kidney greatly facilitates diagnosis of suspected malignancy, but it is the surgeon's aim to make a diagnosis before the organ has attained a palpable size. I have operated upon two cases in which obesity quite prevented a malignant kidney from being palpated even under an anaesthetic; in each case the patient weighed over 18 st. Fortunately special aid is now available for helping the surgeon to arrive at a correct diagnosis in these diagnostic puzzles—that is, pyelography.

4. Cachexia.

The fact that this was an onset symptom in 5 cases emphasizes the urgent need for a thorough general overhaul by the doctor when an adult patient complains to him of the effects of this symptom.

C.—SOME COMPLICATIONS.

1. Varicocele.

In 3 cases of the series it is noted that there was a left-sided varicocele, in addition to a malignant renal tumour on the same side.

The presence of a varicocele, especially on the left side, may of course be only a coincidence. The wise surgeon, however, always satisfies himself that it is a coincidence before he decides to remove a malignant kidney. If the two signs of varicocele and renal tumour are associated, it indicates the spread of the malignant growth along the renal vein towards the inferior vena cava, thereby blocking the exit of the spermatic vein, the resulting back pressure forming the varicocele. Owing to its position the termination of the left spermatic vein is much more readily blocked by growth than the right.

It is almost superfluous to add that it is not justifiable to operate upon either the varicocele or the kidney in such a case. Many of these secondary varicoceles have been operated upon without the malignant kidney condition, the primary cause of that varicocele, having been detected. It is a golden rule to submit no case of varicocele, and especially in a middle-aged man, to operation until the absence of a renal tumour and of haematuria have been established.

2. Clot Retention.

Two of the patients had retention of urine due to clotting following painless haematuria, and in each case the doctor was only called in when the patient had complete retention.

3. Diabetes Mellitus.

One case of sarcoma was complicated by persistent glycosuria; he did well after nephrectomy, but I cannot say what happened to him after he left hospital.

4. Chronic Nephritis.

Several of the cases had this.

D.—REMARKS AND ILLUSTRATIVE CLINICAL CASES.

A routine investigation of the case should include the physical examination, analysis of the urine, cystoscopy, an estimation of the renal function, and pyelography.

Both flanks must be examined for the presence of a renal tumour, and, if there be one, the surgeon must note its consistence; the condition of its surface; if its margins are well defined or not; and its relation to the surrounding structures—that is, if it is fixed or not. A pelvic examination will show any thickening of the palpable lower portion of the ureters, and the existence or not of a varicocele must be verified by examining the spermatic cords.

All urine voided should be carefully collected for three consecutive periods of twenty-four hours. The specific gravity, the estimation of urea output, and a microscopic examination are the most important items of each analysis of the urine.

If the patient has haematuria when the surgeon first sees the case (or on the first sign of such bleeding after it comes under his care), the opportunity must be seized to make a cystoscopic examination immediately. This more especially applies in the case of patients with symptomless haematuria; it may be an isolated bleeding, and the surgeon may not get another opportunity of ascertaining the source of the haemorrhage. Bleeding from a ureteric

orifice may be in the form of bright red blood, of smoky urine, or in the form of worm-like clots. I have on many occasions watched one of these bloody ureteric casts in process of extrusion from the ureter. So important is this piece of clinical evidence that I always mark the thigh of the same side as the bleeding ureter while the cystoscope is still in the bladder; unless some such routine is carried out, mistakes as to which ureter the blood is coming from can easily be, and have been, made.

An estimation of the renal function is a necessary part of the investigation of the case. To know the amount of work each kidney is capable of performing is to be able to compare the two organs, when it will be usually found that the malignant kidney is capable of doing less work than the sound organ.

The most certain method of collecting a specimen of urine from each kidney is to pass a ureter catheter into each renal pelvis. After the necessary amount of urine has been obtained pyelography can be done, so that the passage of the ureter catheter performs a double purpose. In the routine examination of this urine I place most reliance upon the amount of urea present, the specific gravity—if sufficient urine can be obtained—and the presence or absence of pus cells; the presence of red blood cells I disregard, as it is so easy to get a trace of blood from the mere passage of the ureter catheter.

Theoretically there are many other better tests for the estimation of the renal function, but for practical purposes I consider that a comparison of the percentage of urea excreted from each kidney is a good working guide, especially if the nitrogenous food intake is checked.

The advent of pyelography was a distinct advance as an aid in the diagnosis of a kidney tumour. When the renal pelvis takes part in a general enlargement of the organ, the point can be definitely ascertained by examination of the increased size of the "shadow" of the renal pelvis on the radiogram after the injection of the collargol solution.

Again, other tumours occupy one or other pole of a kidney, and in these cases a study of the radiogram (after collargol injection) will show changes in the normal angle formed by the junction of (a) the line of the lower margin of the renal pelvis, and (b) the line of the ureter. The growth makes that pole heavier than normal, and it tends to rotate upon its central axis. For example, if the growth is in the upper pole, the kidney will tend to rotate downwards and inwards; therefore the angle between (a) and (b) will become more obtuse—that is, it is widened. If, on the other hand, the growth is in the lower pole of the kidney, this rotates upwards and inwards, and the angle between (a) and (b) becomes more acute—that is, it is narrowed. To make an accurate observation collargol must be injected into both sides, so that the sound side can be used as a control; again, the "shadow" of each side should appear on the same negative.

CASE I.—*Pain and Haematuria with a Palpable Tumour.*

J. M., aged 65, was admitted to the Royal Victoria Infirmary, Newcastle-on-Tyne, two years ago, complaining of (1) attacks of acute left-sided renal pain, which radiated downwards to the left testicle, and which made him vomit; (2) profuse haematuria.

He was very anaemic. He had a large tumour in the left flank, which was rather tender and of hard consistence, irregular surface, well-defined rounded lower margin, and it freely moved upwards and downwards on respiration. On percussion it was dull (except anteriorly, where it was semi-resonant), and the dullness was continuous with the erector spinae dullness. Pressure of the tip of the index finger at the junction of the lower border of the last rib with the outer border of the erector spinae caused a mild edition of the acute pain he had been experiencing. Cystoscopy showed a long worm-like blood clot in process of extrusion from the left ureteric orifice; catheterization of the ureters showed that the right kidney was a normal one. A carcinomatous left kidney was removed, but his doctor informed me that he died some months later, probably from a recurrence.

The acute renal colic was due to the blood clotting in the ureter, which resulted in increased tension inside the kidney. After the blood clot had passed the urine became clear; his acute pain then disappeared.

CASE II.—*Haematuria with a Palpable Tumour.*

J. E. B., aged 60, was referred to me with a history of severe haematuria. For some weeks, his doctor informed me, the patient had not felt quite in his usual health, so he went to a noted London masseur for a course of massage. On the first two days the rubbing was confined to the limbs; on the third day his abdomen was vigorously massaged, and that night he

had a furious haematuria. Twenty-four hours later he had a rigor, followed by a second one at the end of a further twelve hours. He had had some difficulty in urination for a great many years owing to a spinal injury due to a hunting accident.

When I saw him the bladder was distended to the level of the umbilicus. Although he had made constant efforts, he had not micturated for the greater part of the previous six hours. In the left flank was a tumour the size of a child's head; it was hard, nodular, had a well-defined lower margin, and moved upon respiration. The cystoscope showed a quantity of decomposing blood clot lying on the base of the bladder, also a ball valve intravesical enlargement of the prostate gland. The septic element being the dangerous factor of the case, I advised that the blood clot be removed at once. This was done by means of the apparatus used during the operation of litholapaxy—that is, a metal cannula and an indiarubber aspirator bag. The ureters were catheterized and the results showed that the right kidney was normal—moreover, that it was doing the great part of the patient's renal excretion. Three days later I excised a carcinomatous left kidney. He made an uneventful recovery, and three and a half years later he is in excellent health.

CASE III.—*Renal Pain with Haematuria.*

In August, 1912, I saw H.S., aged 55, in consultation with his doctor. The patient was very stout, and weighed over 18 st. He complained of periodical attacks of passing brownish-coloured urine, and on close questioning admitted that he had had some discomfort in the right flank; there had never been any acute pain. No flank tenderness or tumour could be found, but this was not surprising owing to his size. The cystoscope demonstrated smoky urine flowing through the right ureteric orifice. Catheterization of the ureters with collection of the urines showed that the left kidney was a normal one, and that it was doing twice the amount of work that the right one was doing. I excised the right kidney, and there was a large hypernephroma in its lower pole. He is now in excellent health.

The chronic flank discomfort was due to increased tension in the kidney, for the growth was of the variety which has a capsule, and this, to the naked eye at any rate, had not been perforated. There had never been any clotting of the blood, hence the absence of acute colic.

The success of the case, of course, is largely due to the practitioner who was so determined to get to the bottom of the small degree of haematuria, for the patient failed to regard the flank discomfort as anything worth mentioning until I questioned him.

The right renal discomfort, the cystoscopic demonstration of the bleeding from the right ureter, and the information gained by the ureter catheter, gave the diagnosis and the line of treatment to be pursued.

CASE IV.—*Haematuria Only.*

Miss L., aged 56, was seen in consultation with Professor Rutherford Morison in 1907. She was an enormously stout woman who complained of periodical attacks of painless haematuria when she passed thick bright red blood; at first her doctor thought this came from the vagina. No pain or discomfort had ever been experienced, and owing to the huge rolls of abdominal wall fat it was quite impossible to exclude any renal tumour.

Cystoscopy showed a normal bladder and the effluxes of urine through the ureteric orifices were clear. As there was no clue whatever to the origin of the bleeding she was instructed to proceed to a private hospital for immediate cystoscopy directly the next attack came on, no matter what the hour was, night or day. The desired opportunity came sometime later, and I was summoned to cystoscope her in the small hours of one morning. Bright red blood was seen to be pouring furiously from the right ureteric orifice, but the medium quickly became so turbid I was unable to catheterize the ureters. This was done a few days later when it was found that while the left kidney was functioning normally the right kidney failed to do its full share of the work. Professor Morison subsequently excised a right hypernephromatous kidney.

This case was entirely dependent upon the cystoscope for a diagnosis. No blood clots were seen and their absence accounted for the lack of any acute pain.

CONCLUSION.

Excluding children, 63.2 per cent. of the cases occurred between the ages of 45 and 65.

The commonest onset symptom was painless haematuria.

In 32 cases out of 52, pain, haematuria and a palpable renal tumour were associated at some stage during the illness.

In 3 cases a varicocele was a complication, that is, the condition was inoperable when first seen.

Two patients had clot retention of urine.

CAPTAIN ANGUS MCNAB, London Scottish, M.B., ophthalmic surgeon to King Edward VII Hospital, Windsor, who was killed in France on November 1st, 1914, left estate valued at £9,242.