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SYMMETRICAL NECROSIS OF THE CORTEX OF THE KIDNEYS

ASSOCIATED WITH SUPPRESSION OF URINE IN WOMEN SHORTLY AFTER DELIVERY.

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SYMMETRICAL necrosis of the cortex of the kidneys is rare and is almost only seen in women directly after childbirth, in whom ten cases have been reported (Bradford and Lawrence,[1] Griffith and Herringham,[2] Lloyd,[10] Klotz,[9] Jardine and Teacher[6] (2 cases), Torrens,[12] and Jardine and Kennedy[7] (3 cases)). The one recorded below brings the total up to 11. (See Table I.)

The ages of these 11 patients varied between 22 and 48 years. Nine were multigravidæ, one was a primipara, and in one case there was not any statement. In one case only was there a live birth (Jardine and Kennedy, Case 2) and in that instance there were live twins. The exception to the statement that symmetrical necrosis of the renal cortex is a puerperal manifestation is that in very rare instances embolic infarction may be so extensive as to produce this anatomical lesion. Juhel-Rénoy[8] described symmetrical necrosis of the renal cortex in a girl, aged 16 years, after scarlet fever, due to microscopic emboli in the interlobular arteries.

The *clinical features* are remarkable in resembling in the main those of calculous obstruction of both ureters rather than those usually regarded as characteristic of non-obstructive anuria. Although uræmic manifestations were absent in some of the reported cases and when present were usually comparatively slight, analysis of the 11 collected cases does not justify the statement sometimes made that uræmia is constantly and entirely absent. Dyspnœa occurred in 3 cases (in Jardine and Kennedy's first case, in Klotz's case, and in my case); Jardine and Kennedy's second patient vomited and for 24 hours before death was semicomatose; their third patient vomited and had hiccough; Griffith and Herringham's patient vomited frequently and had headache during the earlier days of the illness, but

TABLE I.—*Giving Particulars of the 11 Reported Cases.*

Authors.	Age of patient.	Condition of child.	Duration of anuria.	Uræmic symptoms.	Condition of kidneys, &c.
Thrombosis of Interlobular Arteries.					
Bradford and Lawrence.	36 7-gravida.	Dead child.	7 days.	Absent.	Endarteritis of interlobular arteries. Veins healthy. No fibrosis of kidneys.
Griffith and Herringham.	35 multigravida.	,,	6 days.	Almost absent.	Chronic nephritis. Retino-papillitis.
Lloyd.	39 multigravida.	Stillborn.	11 oz. in 11 days.	Convulsions after delivery.	Chronic interstitial nephritis.
Jardine and Teacher, Case 2.	22	,,	About 9 oz. in last 7 days.	Convulsions before and coma after delivery.	Very slight endarteritis only.
Klotz.	25 1-gravida.	Cæsarean section.	Not complete.	Two convulsions 7 days after Cæsarean section; occasional dyspnœa.	Some old change.
Jardine and Kennedy, Case 3.	23 2-gravida.	4-months pregnancy.	1½ days.	Several fits before uterus was emptied. Vomiting; semi-coma; and hiccough before death.	No old change. Scanty thrombosis in arterioles and capillaries.
Thrombosis of both Interlobular Arteries and Veins.					
Jardine and Kennedy, Case 1.	34 9-gravida.	Dead fœtus, 7-month.	4½ days.	Occasional dyspnœa; no coma; no fits.	No old change.
Jardine and Kennedy, Case 2.	36 2-gravida.	Live twins at eighth month.	2½ days.	Persistent vomiting; fit before death only; semi-coma 24 hours.	,,
Jardine and Teacher, Case 1.	36 7-gravida.	Dead fœtus.	5½ days.	Fits before and after delivery.	Slight subacute interstitial nephritis and arterio-sclerosis.
Rolleston.	48 14-gravida.	Macerated fœtus, 14 days overdue.	8 days.	Dyspnœa; drowsiness and vomiting in early stages; twitched before death.	No old change. Thrombosis of ovarian and renal veins.
Thrombosis of Interlobular Veins.					
Torrens.	29 multigravida.	Abortion at fourth month.	8 days.	Absent.	No old change. Thrombosis of renal veins.

these may have been due to chronic nephritis ; in my case drowsiness and vomiting occurred in the early stages ; and convulsions are recorded in six cases. But in 2 out of these 6 cases the convulsions occurred only before the uterus was emptied (Jardine and Teacher, Case 2, Jardine and Kennedy, Case 3), and therefore cannot be so distinctly correlated with the anuria as in the other 4 cases. In 2 cases (Lloyd, Klotz) convulsions occurred after delivery ; in 1 case (Jardine and Kennedy, Case 2) just before death, and in 1 case (Jardine and Teacher, Case 1) both before and after delivery. It is interesting to inquire if the occurrence of convulsions can be correlated with the presence of old-standing renal disease, and the absence of convulsions with a previously healthy state of the kidneys. (Table II.) Of the

TABLE II.—*The Pre-existing Renal Condition in Relation to the Occurrence of Convulsions.*

Cases without Convulsions.

Authors.	Condition of kidneys.
Bradford and Lawrence	Endarteritis.
Griffith and Herringham	Chronic nephritis.
Jardine and Kennedy (Case 1)	No old change.
Torrens	No old change.
Rolleston...	No old change.

Cases with Convulsions.

Authors.	When convulsions occurred.	Condition of kidneys.
Lloyd.	After delivery.	Chronic interstitial nephritis.
Jardine and Teacher.	Case 1.—Eight fits before and one fit after delivery.	Slight subacute interstitial nephritis.
	Case 2.—Woman, aged 22; 12 fits before delivery.	Very slight endarteritis.
Klotz.	Two fits after Cæsarean section.	Some old change.
Jardine and Kennedy.	Case 2.—Convulsions before death only.	No old change.
	Case 3.—Several fits before the uterus was emptied.	,, ,,

5 cases in which convulsions did not occur the kidneys were previously healthy in 3, showed endarteritis without renal fibrosis in 1 (Bradford and Lawrence), and chronic nephritis in 1 (Griffith and Herringham). Of the 6 causes in which convulsions occurred the kidneys were previously healthy in 2 ; in 1 case—a woman of 22, in whom 12 fits occurred before delivery—there was very slight endarteritis only, and in the remaining 3 cases there was old change. There is, therefore, some, but not overwhelming, evidence in favour

of the view that pre-existing renal change favours the occurrence of convulsions.

Although anuria was not absolutely complete in Lloyd's case (11 oz. in 11 days) and in Jardine and Teacher's second case (9 oz. in 7 days), it is a striking feature in nearly all these cases. In Bradford and Lawrence's case anuria lasted 7 days, in Griffith and Herringham's 6 (only 10 oz. being passed in the last 10 days), in Jardine and Teacher's first case 5½, in Jardine and Kennedy's first case 4½, second case 2½, third case 1½, in Torrens's case 8, and in my case 8 days. Klotz's case is peculiar in the comparatively large amount of urine passed; in the last 15 days of life the patient passed more than 76 oz. of urine and voided as much as 16 oz. two days before death.

The *morbid lesions* are remarkable in showing symmetrical necrosis of the renal cortex with thrombosis of the renal vessels supplying the cortex, usually of the interlobular arteries in the middle zone of the cortex. In some of the cases (Jardine and Teacher (Case 1), Klotz, Jardine and Kennedy (Cases 1 and 2), and my case) there was a narrow rim of unaltered cortex immediately under the capsule. Its escape appears to depend on the anastomosis between the arteries in the capsule of the kidney and those supplying the perirenal fat, and resembles the condition often seen in ordinary embolic infarction of the kidney.

The *vascular changes* are not absolutely identical in all the cases. Bradford and Lawrence's case showed old end-arteritis with recent thrombosis; thrombosis of the interlobular arteries was reported in four other cases (Griffith and Herringham, Lloyd, Jardine and Teacher (Case 2), and Klotz); thrombosis of both the interlobular arteries and veins in four cases (Jardine and Kennedy (Cases 1 and 2), Jardine and Teacher (Case 1), my case); scanty thrombosis of the arterioles and capillaries in Jardine and Kennedy's third case; and thrombosis of the veins alone in Torrens's case. Torrens's case and my case differ from the other nine cases in the presence of thrombosis in the main renal and ovarian veins in addition. In these two cases three possibilities arise: (1) that the thrombosis in the intrarenal veins spread to, or caused the thrombosis in, the extrarenal vessels; (2) that the thrombosis in the two situations was simultaneous and independent; or (3) that the thrombosis spread from the large veins into the interlobular vessels. In the first instance the last view seemed probable in Torrens's case, but the absence of thrombosis of the extrarenal veins in the other published cases, which are in other respects similar, naturally causes some hesitation in adopting this explanation. In my case the left renal vein contained some loose granular clot, but the right renal vein was free from clot, although both the ovarian veins were thrombosed; extension of thrombosis from the extrarenal to the intrarenal vessels therefore appears less probable than in Torrens's case.

Cause of the thrombosis.—In the first recorded case (Bradford and Lawrence) endarteritis of the renal arteries was regarded as the cause of the thrombosis, but this appears to be almost the only instance in which this sequence is at all probable. In Jardine and Teacher's second case, in which there was slight endarteritis, the face and arms presented a lividity resembling that of the stage of local asphyxia in Raynaud's disease. This suggested the hypothesis that spasm of the renal arteries determined the thrombosis. But as the Raynaud phenomenon was not noted in the other ten cases this explanation cannot be adopted. Klotz, who described the thrombi as finely granular and due to hæmolysis of red blood corpuscles, believes that the thrombosis occurred simultaneously in all the renal vessels, as a result of certain metabolic disturbances of secretion in pregnancy. Kennedy, like Parkes Weber,[13] considers that the thrombosis is secondary to the necrosis, which may be assumed to be due to toxæmia. In favour of his view that the necrosis is due to the poison of eclampsia Kennedy points out that focal necroses were present in the liver in two out of his three cases. But Klotz, who compares the thrombi in the renal arteries to those in an eclamptic liver, definitely states that there was no focal necrosis in the liver in his case. As Dr. R. S. Trevor points out in his report on my case, there is an obvious objection to the view that the thrombosis is secondary to the necrotic changes in the cortex—namely, that a similar thrombosis does not occur in other forms of toxic nephritis however severe. I am not aware of any evidence that the blood of healthy parturient women is prone to coagulate. The phlebo-thrombosis seen in this state is due to infection; and there does not appear from the 11 recorded cases of symmetrical necrosis of the renal cortex, especially Klotz's, in which this point was considered, to be convincing evidence of a primary local infection of the kidney. Possibly the thrombosis is in the first instance due to the same toxæmia which causes degeneration of the renal cells, and that the thrombosis then causes complete necrosis of the cortex.

Remarks on the symptoms.—It is not at first sight obvious why the symptoms differ so markedly from those of anuria due to extremely acute nephritis. Herringham [4] has recently pointed out that "we do not in our ordinary views allow enough for the effect upon the general system which is produced by the diseased cells of the kidney," and he suspects that products are absorbed from them which are very hurtful. A possible explanation of the difference between the symptoms in the two conditions is that when the renal vessels become thrombosed the circulation is so interfered with that little or no absorption of toxic products from the necrotic renal cortex can occur. In connexion with

this suggestion reference may again be made to Juhel-Rénoy's case of multiple microscopic embolism of the interlobular arteries with necrosis of the cortex in which there was anuria for 6 days, but with such freedom from uræmic symptoms that hysterical anuria was at first suspected; subsequently œdema of the feet appeared. In some of the 11 collected cases the uræmic symptoms were more obvious in the early days of the suppression of urine, and it might be urged that this was before thrombosis had supervened and brought the renal circulation to a standstill, and so prevented absorption of toxins from the damaged kidneys.

Occlusion of the renal arteries supplying the glomeruli and the convoluted tubes of the kidney might thus be thought to put the patient in a condition analogous to that of double nephrectomy. There are few published accounts of cases in which a single or solitary kidney has been removed. Polk [11] recorded extirpation of a misplaced kidney in which the woman lived 11 days after removal of her only kidney, the clinical features being much the same as in calculous anuria, and I have had verbal information of a few similar cases. In 1898 Bradford and Lawrence [1] stated that there is no great difference in the phenomena between complete extirpation of both normal kidneys on the one hand and double ligature of the ureters on the other hand in animals. And more recently Jackson and Saiki [5] found that when all the conditions are constant animals after double nephrectomy survive operations longer than animals with ligature of both ureters.

Œdema is not produced by symmetrical necrosis of the renal cortex; when present it is due to pre-existing nephritis.

Summary.—Symmetrical necrosis of the renal cortex is almost invariably related to recent delivery, and the child is almost always stillborn. The symptoms resemble those of obstructive anuria, but uræmic manifestations are not entirely absent. The kidneys may have been previously either healthy or diseased. The necrosis of the cortex is a characteristic lesion, and is intimately connected with thrombosis of the interlobular renal vessels, but the exact relation between these two events is open to discussion.

The following case was under my observation :—

Thombosis of the ovarian and renal veins; symmetrical necrosis of the renal cortex; anuria.—A woman aged 48, who had had 13 children, 9 of whom are living, and 2 miscarriages, was delivered on March 6th, 1913, of a macerated fœtus which was 2 weeks overdue. The labour, which lasted 12 hours, did not require instrumental assistance. On March 8th she became rather drowsy, and on the following day had abdominal pain and ceased to pass urine. She vomited every day from the date of her confinement until March 12th, when she was admitted under my care at St. George's Hospital. She was then anæmic, rather

drowsy, but perfectly intelligent and alive to her surroundings. The heart, lungs, and abdomen appeared normal. The pulse, 100, had a systolic blood pressure of 115 mm. Hg. The temperature was subnormal. By catheter 1 c.c. of pale neutral fluid, containing blood, pus, and albumin, was drawn off from the bladder; on March 13th no urine could be obtained by catheterisation, but on the 14th and 15th a few c.c. with the same characters as before were drawn off. On the 13th a skiagram of the kidneys did not show any evidence of a calculus; before this was done Dr. J. A. Torrens, the medical registrar, had suggested that the condition was one of thrombosis of the renal veins, basing this on the resemblance to a case previously published by him.[1,2] On the 14th there was noticeable dyspnœa, and the blood pressure was 120 mm. Hg. On the 16th the blood pressure was 120 mm. Hg, dyspnœa was again very well marked, there was severe abdominal pain—mainly on the right side—and no urine was passed. The temperature ran up to 102° F. and the pulse to 136. On the 17th the temperature had fallen to 97°, and there was slight twitching of the face. At 2.30 P.M. the blood pressure had fallen to 60 mm. Hg; at 3.30 P.M. the face twitched slightly and the patient died quite suddenly. She was mentally alert to the end. There was no vomiting while in the hospital, and no œdema of the subcutaneous tissues.

The *necropsy* was performed by Mr. J. R. H. Turton. The right utero-ovarian plexus of veins was filled with dark blood-clot and produced a prominent swelling at the commencement of the right ovarian vein in the upper part of the broad ligament. There was not any extension of the clot into the iliac veins. The right ovarian vein was completely distended with clot and formed a conspicuous object on the posterior wall of the abdomen. The clot, about an inch in length and a quarter of an inch in diameter, projected into the inferior vena cava, lying free in the lumen of the vessel but not filling its cavity. The right ovarian vein opened into the inferior vena cava about one and a half inches below the renal vein which was free from clot. The left ovarian vein contained some granular clot adherent to its wall opposite the brim of the pelvis. There was a small pale clot, apparently detached from this, at the opening of the left ovarian vein into the left renal vein and lying free in the vein. The left renal vein in the hilum of the kidney contained a loose granular clot, extending from the hilum to within three-quarters of an inch of the entrance of the left ovarian vein. The vein wall was healthy. The kidneys, 8 oz. each, showed symmetrical necrosis of the cortex, which was dull yellow in colour; there was a thin rim of healthy cortex under the capsules. The remaining kidney substance appeared healthy, and the capsules stripped off normally. The arteries were healthy. Cultures from the spleen and the blood clot in the ovarian vein both showed *Streptococcus pyogenes*, pure in the blood clot, but with *Bacillus coli* in the spleen. The uterus was normally involuted.

I am indebted to Dr. Trevor for the following account of the microscopical examination :—

On microscopical examination the necrosis affects the cortex irregularly in both kidneys. For the most part the whole of the cortex from the medulla to the capsule is affected—a narrow zone only immediately under the capsule being free. The width of this zone even is variable and in one or two places, especially in the left kidney, the necrosis extends quite to the surface, which is slightly depressed. On the medullary side the necrosis reaches downwards in patches to the boundary zone, leaving unaffected areas of cortex in between. The latter, however, are not healthy, the tubal epithelium being degenerated, the cells vacuolated and broken up, whilst many of the tubules contain hyaline casts. There is a remarkable absence of any hæmorrhagic zone round the necrotic areas. On the medullary side there are scattered patches of congestion only, and even these are few. There is a well-marked zone of small-celled infiltration at the periphery of the enclosed portions, and collections of leucocytes are scattered irregularly throughout them. In the necrotic areas the outlines of the

tubules can be made out easily, but the epithelium and the glomeruliare completely necrotic and do not show any nuclear staining. The interstitial tissue is also necrotic and does not show any nuclear staining. The arteries and veins in and contiguous to the necrosed areas are thrombosed, but no thrombosis can be detected in any of the vessels lying farther away. The arteries are not thick-walled and are quite free from any proliferation of the subintimal connective tissue.

The liver did not present any areas suggesting focal necroses to the naked eye, and on microscopical examination no such areas can be seen. The softened central portion consists of liver cells much altered in shape and shrunken in size. Some are markedly degenerate and vacuolated, others still stain well and have well-preserved nuclei. The normal arrangement of the cells, however, is destroyed, and the capillaries can no longer be made out. Here and there remains of a portal space can be made out without any thrombosis in the vessels. The whole area suggests a post-mortem disintegration.

In the kidneys those portions of the cortex, which are not necrosed, still show well the normal arrangement, although the tubal epithelium shows the changes already described. These changes are indistinguishable from those met with in the so-called "nephritis of pregnancy"—a degenerative lesion of the tubal epithelium due to toxæmia. It has also been shown that hyaline or agglutinative thrombi are met with in the capillaries in many infective and toxic states (*vide* Welch [14]). On the other hand, cortical necrosis does not occur in the kidney of acute nephritis, however severe the lesion may be, nor in cases of corrosive sublimate poisoning in which the tubal epithelium may even show calcification. It seems probable, therefore, in this case (at all events) that the necrosis, involving as it does both epithelium and interstitial tissue, is the direct sequence of the extensive thrombosis present in the vessels. Apart from the lesions present in the renal epithelium, the rapid disintegration in the liver points to there having been a grave toxæmia, and it is to this toxin, whatever its nature, that both the degeneration of the tubal epithelium and the hyaline thrombosis are due. To the latter must be attributed the final necrosis of the cortex, which is in a state similar to that seen in anæmic infarction.

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