comparatively common, particularly in relation to emotional stress, that they are distinguishable electromyographically from those associated with muscular degeneration, and that patients displaying them can also be differentiated clinically from patients with progressive muscular atrophy at a reasonably early stage. Attention is drawn to the liability of medically trained people to suffer considerable avoidable anxiety in the absence of such distinction being clearly made.

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REFERENCES

- Ayer, J. B., Means, J. H., and Lerman, J. (1934). *Endocrinology*, **18**, 701.
 Bartels, E. C., and Pizer, E. (1944). *Bull. Lahey Clin.*, **4**, 52.
 Denny-Brown, D., and Foley, J. M. (1948). *Trans. Ass. Amer. Phys.*, **61**, 88.
 — and Pennybacker, J. B. (1938). *Brain*, **61**, 311.
 Duchenne, G. B. A. (1855). *L'Electrisation Localisée. Selections from the Clinical Works of Duchenne*, p. 486, edited by G. V. Poore. London, 1883.
 Ford, F. R. (1939). *Bull. Johns Hopk. Hosp.*, **64**, 114.
 Kny, E. (1888). *Arch. Psychiat. Nervenkr.*, **19**, 577.
 Nielsen, J. M. (1946). *Textbook of Clinical Neurology*, 2nd ed. Hoeber, New York.
 Odum, G., Russel, C. K., and McEachern, D. (1943). *Brain*, **66**, 1.
 Schultze, F. (1894). *Dtsch. Z. Nervenheilk.*, **6**, 65, 167.
 Starling, H. J., Darke, C. S., and Hunt, B. W. (1938). *Guy's Hosp. Rep.*, **88**, 117.
 Stone, Simon (1950). *J. nerv. ment. Dis.*, **3**, 139.
 Wechsler, I. S. (1940a). *J. Amer. med. Ass.*, **114**, 948.
 — (1940b). *Amer. J. med. Sci.*, **200**, 765.

ACUTE SUPRARENAL INSUFFICIENCY IN PREGNANCY

BY

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Death in the puerperium may be due to many causes, but one of the main "obstetrical" factors is shock occurring at the time of delivery. Death may be immediate but is often delayed, and in these cases it is generally accepted that the cause is either a pituitary necrosis or uraemia due to acute renal damage. From time to time, however, cases occur in which no sign of necrosis can be found in the pituitary and the patients show no evidence of uraemia. Also, there are some patients who die during pregnancy apparently without sufficient cause.

Nine such cases have come under our notice, and in our opinion death was due to acute adrenal insufficiency. Suprarenal haemorrhages are not confined to obstetric practice. They are found in the newborn, and in cases of the Waterhouse-Friderichsen syndrome, which occurs in older children and also in adults. This syndrome consists of fulminating meningococcal septicaemia with massive purpura and bilateral suprarenal haemorrhages. They have also been reported in cases of spontaneous thrombosis of suprarenal veins apart from pregnancy. This, according to Hall and Hemken (1936), is the commonest cause of suprarenal haemorrhage in adults. They also occur in any generalized "haemorrhagic" condition.

In view of the remarkable advances being made in the synthesis of suprarenal hormones it is important

that these cases of suprarenal deficiency in pregnancy should be recognized, especially as the damage to the glands does not appear to be irreparable in all cases.

Features of the Syndrome

Although the symptomatology tended to vary, certain features were common to most cases. The syndrome commonly manifested itself by the onset of sudden collapse, the patient exhibiting all the signs of severe shock. Details of the nine cases are shown in Tables I and II, and a description of Case 1 is given below. Three groups of cases could be distinguished by the clinical features preceding the onset of the syndrome: (A) those who developed the syndrome following obstetric shock (Cases 2, 3, and 7); (B) those in whom the illness was ushered in by an attack of late vomiting (Cases 1, 4, 6, and 8); and (C) those in whom pre-eclamptic toxæmia was present before the onset of the syndrome (Cases 5 and 9).

In group A the shock was of haemorrhagic type in all three cases, the causes being accidental haemorrhage (Case 2), post-partum haemorrhage (Case 3), and incomplete abortion (Case 7). The duration of shock varied from 5 to 12 hours, and averaged 9 hours. Prior to the onset of shock two patients (Cases 3 and 7) had been quite well, but one (Case 2) had suffered from bronchitis and debility. These patients recovered from the state of obstetric shock but later collapsed again.

In group B three cases had late vomiting (Cases 4, 6, and 8). The duration of the vomiting before the development of the syndrome varied from 4 to 14 days and averaged 11 days. In Case 4 the vomiting was associated with epigastric pain, and there was a previous history of gastric ulcer. There was associated pyelitis in Case 8, and pre-eclamptic toxæmia was doubtfully present in Cases 6 and 8. The vomiting in Case 1 was slight, but had been continuous throughout pregnancy.

In group C there was definite evidence of pre-eclamptic toxæmia in Cases 5 and 9, and the duration was six and eight weeks respectively. There was no other illness in the antenatal period in Case 6, but in Case 8 there was evidence of pyelonephritis at necropsy.

The syndrome was ushered in by abdominal pain in Cases 1 and 2, and by lumbar pain in Case 4. In Cases 3, 4, and 8 the presenting sign was a rigor. Exhaustion was present just before the onset of the syndrome in Case 1.

During the phase of collapse the condition of the patient was indistinguishable from that of severe shock: the pulse was rapid and weak and at times almost imperceptible; the skin was cold and clammy and the blood pressure low. In Cases 1, 3, 5, and 8 the patient was markedly cyanosed. In their subsequent progress the cases could be divided into two groups.

1. Five patients (Cases 2, 4, 5, 7, and 8) failed to rally from this stage of collapse, and their survival times varied from $\frac{1}{2}$ to 12 hours. During the whole of this period they remained in the same shocked condition, gradually lapsing into coma. In Cases 2, 4, and 7 vomiting developed during the stage of collapse. These five patients did not belong to any single one of the aforementioned groups. In three of these cases there was extensive haemorrhagic destruction of the gland, the central vein was thrombosed in Case 2, and Case 5 showed numerous petechial haemorrhages and marked cellular degeneration.

TABLE I

Case No.	Age	Previous Obstetric History	History and Duration of Present Pregnancy	Condition	Duration of Labour and Delivery	Haemorrhage	Shock	Drugs	Anaesthetics	Transfusions
1	39	11 full-time normal	Vomiting, slight vaginal bleeding. 40 weeks	Retained placenta	13½ hours. Spontaneous	Nil	—	Pituitrin 2 ml.	Nil	Glucose-saline
2	32	4 full-time normal	Bronchitis. 30 weeks	Mixed accidental haem.	2 hours. Spontaneous	+	12 hours	—	—	—
3	23	—	Well. 40 weeks	Post-partum haem.	12 hours. Spontaneous	+	+	Pituitrin 0.5 ml Ergometrine 0.5 ml.	Nitrous oxide, trilene	Blood, plasma, 20% glucose-saline
4	37	5 full-time normal	Late vomiting. 30 weeks	Late vomiting	—	—	—	—	—	20% dextrose
5	22	—	Pre-eclamptic toxæmia. 38 weeks	—	8 hours. Forceps	—	—	Pituitrin 0.5 ml.	Chloroform	—
6	29	2 full-time normal	Late vomiting. Hypertension. 37 weeks	Late vomiting	—	—	—	—	—	—
7	24	1 full-time normal	Well. 17 weeks	Incomplete abortion	—	+	10 hours	—	Nitrous oxide, ether	Blood, plasma, dextrose
8	?	?	Pyelitis, hypertension, vomiting. 40 weeks	Late vomiting	—	—	—	—	—	—
9	43	4 full-time normal; 4 abortions	Pre-eclamptic toxæmia. 38 weeks	Post-operative vomiting	Caesarean section	—	—	Pituitrin 3 ml.	Spinal procaine	10% glucose-saline

TABLE II

Case No.	Collapse after Delivery		Pain	Vomiting	Cyanosis	Rigors	Oliguria	Paresis	Survival Time	Lesion in Suprarenals
	First	Second								
1	10½ hours	30½ hours	Abdominal	—	+	—	+	—	31½ hours	Massive haemorrhage and necrosis
2	4 days	—	"	+	—	—	+	—	3 "	Central vein thrombosis
3	6 hours	15 hours	—	+	+	+	+	+	21 "	Massive haemorrhage and necrosis
4	?	—	Lumbar	+	—	+	—	—	12 "	Petechial haemorrhages
5	5 minutes	—	—	—	+	—	—	Opisthotonos	½ hour	"
6	?	—	—	—	—	—	—	—	7 hours	"
7	17 hours	—	Headache	+	—	—	—	—	2½ "	Massive haemorrhage and necrosis
8	?	—	—	+	+	+	—	—	?	"
9	?	—	—	+	—	—	—	—	?	Central vein thrombosis

2. Two patients (Cases 1 and 3) made a partial recovery from this stage of collapse. The quality of the pulse improved, cyanosis diminished, and the patient appeared to be relatively comfortable. The duration of this stage was two and four hours respectively, and it was followed by a second and final period of collapse. The terminal phase was of relatively short duration—70 minutes in Case 1 and 5½ hours in Case 3. The condition of the patient at this stage was similar to that in the previous phase of collapse and was indistinguishable from severe shock. There were no prodromal symptoms such as occurred before the first phase of collapse. In Case 3, however, there were additional features which differentiated this patient from all others. During the final phase of collapse she became comatose. In the earlier stages she could be awakened, but her speech was slurred and twitching of the face muscles was noted. Later she became deeply comatose and exhibited spastic movements of the limbs. These movements gradually subsided, and she developed a left-sided flaccid paralysis. It may be mentioned here that in Case 5 of the previous group there was opisthotonos following delivery of the placenta.

In Cases 1 and 3 oliguria was present throughout the illness. This may have been of reflex type and related to the pronounced degree of "obstetric" shock occurring at delivery in Case 3, but in Case 1 there was no "obstetric" shock, and it seems to have been directly related to the condition of the patient in the terminal phase. There was oliguria in Case 2 also, but this was associated with the initial "obstetric" shock and preceded the collapse due to the suprarenal lesion. It is noteworthy that in both Cases 1 and 3 the degree of suprarenal damage was severe.

The remaining two patients could not be grouped as above. In Case 6 the history was deficient, and the patient died shortly after admission to hospital, but there was no evidence of marked shock at any time. In Case 9 the illness was of relatively long duration, and began with vomiting and abdominal distension following caesarean section. This continued until death on the ninth day. During the course of the illness "pituitrin" was given repeatedly. In both Cases 6 and 9 the suprarenal lesions were not gross but were easily distinguishable on microscopical examination.

Additional Factors

Age and Parity.—These did not appear to play any part in the illness. The average age was 31, but individual ages varied from 22 to 43 years. Two were primigravidae (Cases 3 and 5) and six multiparae (Cases 1, 2, 4, 6, 7, and 9). The duration of pregnancy varied from 17 to 40 weeks, the average being 34 weeks.

Duration of Labour and Delivery.—Three patients (Cases 4, 6, and 8) died undelivered, and one (Case 7) had an incomplete abortion which was completed by digital removal. The duration of labour in the three (Cases 1, 2, and 3) who delivered spontaneously varied from 2 to 13½ hours and averaged 9 hours. Case 5 was delivered with forceps after a labour lasting eight hours, and Case 9 was terminated by caesarean section. There was nothing to indicate that the mode of delivery or the length of labour had anything to do with the subsequent illness, except perhaps in Case 9.

Drugs.—Apart from morphine the only drug administered was pituitrin, which was given in Cases 1, 3, 5, and 9; Cases 1 and 9 received large doses.

Anaesthetics.—Nitrous oxide, oxygen, and "trilene" were administered in Case 3, nitrous oxide, oxygen, and ether in Case 7, chloroform in Case 5, and spinal procaine hydrochloride in Case 9.

Transfusions.—Intravenous transfusions of glucose-saline were administered in Cases 1 and 9; 20% glucose-saline or dextrose, plasma, and blood in Cases 3 and 7; and 20% dextrose in Case 4.

General Survey of Features of Syndrome

The onset of the syndrome is sudden and is typified by collapse with a rapid pulse of poor volume and sighing respirations, and may be accompanied or preceded by abdominal or lumbar pain, exhaustion, vomiting, cyanosis, or rigors. Coma, muscle-twitching, and paralysis may occur, but these are unusual features.

The state of collapse may continue for a varying period up to 12 hours until death occurs. In other cases there is recovery from the collapse and the patient is apparently well for a period up to 24 hours, when she once more becomes suddenly collapsed, with rapid feeble pulse, sighing respirations, and increasing cyanosis; this attack proves fatal in a few hours. In the cases that recover from the initial state of collapse there is oliguria during the "lucid" interval.

Arnaud (1900), in his classification of suprarenal haemorrhage in adults, described three clinical types: (1) the peritoneal type with vomiting and abdominal pain; (2) the asthenic type, characterized by asthenia alone, leading to death; and (3) the nervous type in which the patient is found in coma or delirium, and is seen at necropsy to have no cerebral lesion but bilateral suprarenal haemorrhages. Lavenson (1908) and Simpson (1937) add the type in which sudden death occurs from no ascertainable cause and suprarenal haemorrhages are found *post mortem*. These four types were represented in the present series. Cases 1, 2, and 4 were examples of Arnaud's type 1, and Cases 6, 8, and 9 were representative of Arnaud's type 2, while type 3 was exemplified by Cases 3 and 5. Case 7 corresponded with Lavenson and Simpson's type.

The differentiation of the condition from other causes of "acute abdomen" may lead to some difficulty, but from a perusal of Cope's (1940) book it was concluded that the condition most likely to lead to real difficulty in differential diagnosis is acute pancreatitis. Even in this condition there are some differentiating features which will make the diagnosis possible.

Some complicating factor was present during pregnancy or labour in all cases. The associated conditions which occurred during pregnancy were vomiting, pre-eclamptic toxæmia, or pyelitis. The other two patients who were well during pregnancy, however, developed haemorrhagic shock due to some abnormality at parturition. It is possible that large doses of posterior pituitary extract, which is a known vasoconstrictor, may have been a contributory factor in the production of the lesions. Although Cases 4 and 7 developed symptoms during the administration of dextrose it is difficult to imagine that this substance could cause suprarenal thrombosis or haemorrhages.

The syndrome may occur at any age in the reproductive period and in both primigravidae and multiparae. Usually it occurs in the later weeks of pregnancy, but may appear earlier, and either before or after delivery. Blood or plasma transfusion does not seem to play any part in the production of the syndrome.

Post-mortem Findings

The only organs in which significant lesions were detected were the suprarenal glands and the kidneys. The lesions were bilateral in all cases. There were three types of lesion in the suprarenal gland:

Massive Haemorrhage and Necrosis.—This occurred in five cases (No. 1, 3, 4, 7, and 8). There were thromboses in the smaller vessels in all cases, and in two cases (Nos. 1 and 4) there was also thrombosis in the central veins.

Thrombosis of the Central Vein Without Haemorrhage or Necrosis.—This occurred in Cases 2 and 9, although in Case 9 there were a few petechial haemorrhages and the cortical cells were degenerate although not necrotic.

Petechial Haemorrhages in Cortex.—This lesion occurred in Cases 5 and 6: there was no evidence of thrombosis or gross necrosis.

The lesions in the kidneys also varied, but were not gross. In Cases 5, 6, and 9 the changes were those associated with pre-eclamptic toxæmia. In Case 3 there was degeneration of the proximal tubules only, and in Cases 1, 2, and 4 necrosis or degeneration of the proximal and distal convoluted tubules with cytoplasmic debris in the lumina.

The following record is that of a case illustrative of this series.

Case 1

This patient, aged 39, had had 11 previous full-time pregnancies. During each pregnancy she suffered from general debility and sickness. She had no difficult or abnormal deliveries. Throughout the present pregnancy she had slight vomiting and suffered from insomnia. For the four months before admission she had slight intermittent painless vaginal bleeding. She had another slight painless vaginal haemorrhage when 40 weeks pregnant, and was admitted to hospital.

On admission the pulse rate was 98 a minute, respiratory rate 20 a minute, temperature 98° F. (36.7° C.), and the blood pressure 130/70 mm. Hg. There was no albumin in the urine.

The patient remained moderately well, and on the sixth day in hospital the membranes were ruptured artificially. Next day pituitrin was given in doses of 0.5 ml. at half-hourly intervals until a total of 2 ml. had been administered. Two days later a stillborn child was delivered spontaneously after a labour lasting 13½ hours. The placenta was retained for three hours, but there was no excessive blood loss. The diagnosis of partial placenta praevia was confirmed by examination of the placenta and membranes.

Ten and a half hours after delivery the patient's colour became very poor. She felt exhausted and complained of abdominal pain. The pulse was soft and of poor quality and the rate was 120 a minute. Continuous intravenous saline and glucose was given.

Twenty-eight and a half hours after delivery the patient appeared to be improved, the pulse volume was good, and the intravenous saline was discontinued. Two hours later, however, she suddenly collapsed, the respirations were sighing, and there was increasing cyanosis. She died 70 minutes later. In the first 24 hours after delivery 12 oz. (340 ml.) of urine was obtained from the bladder. There was a terminal rise of temperature to 99° F. (37.2° C.).

Post-mortem Examination

The suprarenal glands were very large and congested and were firmly adherent to the kidneys. There appeared to be haemorrhages into the medulla. The cortices of the kidneys were rather broad and pale. The medullae were also pale, with a few dark streaks in them. In the uterus there was a ring of petechial haemorrhages round the attachments of the Fallopian tubes. There was much gelatinous para-

metrial oedema, and the endometrium was black and foul-smelling. The other organs appeared healthy.

Microscopical examination of the suprarenal glands revealed thrombosis of the central vein, with thrombosis of the smaller vessels and complete necrosis of most of the suprarenal cortex. There were haemorrhages in the cortex, especially in the subcapsular region. In the kidney the glomeruli appeared normal, but there was necrosis of the first and second convoluted tubules and loops of Henle in many areas with altered staining of the cytoplasm and absence of nuclei. In other cases the cytoplasm of the tubular epithelium was degenerate, but the nuclei remained. There was debris in some of the tubules. A few of the collecting ducts showed degeneration and contained debris, but none was necrotic. The afferent arterioles and some of the interlobular vessels were dilated and engorged. There was no significant microscopical change in any of the other organs.

Correlation of Pathological Lesions and Clinical Features

Although all the cases showed a varying degree of adrenal damage this could not be related to a progressive increase in the severity of the symptomatology. The aetiological conditions also varied, but here again no correlation could be found with the degree of pathological change in the suprarenal cortex, except perhaps in Cases 1 and 3, in which the lesions of the suprarenal glands were marked and there was partial recovery from the collapse followed by a second fatal collapse.

The oliguria which occurred in Cases 1 and 3 seems to have been due to necrosis or degeneration in the renal tubules. Whether the necrosis or degeneration of the renal tubules was due to the suprarenal lesions is not clear. In Case 2 the oliguria occurred before the probable onset of the suprarenal lesion; in Case 4 oliguria did not occur even though there was degeneration of both proximal and distal convoluted tubules. It is worthy of note, however, that degenerative changes in the renal tubules have been found in adrenalectomized animals (Simpson and Korenchevsky, 1935), and in many cases of Addison's disease (Barker, 1929). In addition, Marangoni and D'Agati (1944) have reported two cases of Waterhouse-Friderichsen syndrome associated with hepato-renal failure. It has been shown that inulin clearance and diodone clearance are reduced in Addison's disease, and that treatment with deoxycortone acetate partially corrected these deficiencies (Sanderson, 1946-8; Talbott *et al.*, 1942). This is a purely functional derangement, as the azotaemia found in these cases is not to be explained on the basis of structural changes in the kidneys. It is possible that where there is a sudden withdrawal of suprarenal hormones, as in the present series of cases, not only functional but also structural damage to the kidneys is produced.

Literature

Although suprarenal haemorrhages have been fairly often reported with acute infective conditions and a general haemorrhagic state, and in the newborn, there are few cases on record in which suprarenal haemorrhage or infarction has been associated with pregnancy, and in most of them a full account of the pathology has not been given.

Hall and Hemken (1936) reported a case of bilateral suprarenal haemorrhages with thrombi in the veins of the medulla in a young girl who had severe hyperemesis gravidarum. Keele and Keele (1942) gave a very good

description of the clinical findings in a case in which thrombosis of the central veins of the suprarenal with infarction and haemorrhage occurred in a woman who was eight months pregnant. Their description agrees in all essentials with the syndrome presented by our first two cases. They also summarize the findings in non-pregnant cases reported in the literature, and there seems to be a similarity in these cases also. A case of massive bilateral suprarenal haemorrhage associated with necrosis of the liver during the puerperium was reported by Dodds (1945). The fourth case, that of Hurter (1946), was one of bilateral suprarenal haemorrhage without thrombosis occurring on the eighth day of the puerperium after a post-partum haemorrhage. In this case there was cloudy swelling in the tubules of the kidneys, and Dodds found degenerative changes in the second convoluted tubules and loops of Henle in her case.

Discussion

Although acute suprarenal insufficiency is a rare occurrence in obstetric practice it is none the less important to be able to diagnose such a condition, as it may now be possible to employ some form of active treatment.

Haemorrhage into the suprarenal glands destroys the tissues and thus prevents formation of the cortical hormones and adrenaline, while thrombosis of the suprarenal veins will prevent the secretion of these hormones. In the absence of these hormones a state of collapse will be easily induced. Hormones of the suprarenal cortex (such as "eschatin") have been used in cases of shock without much benefit, but it is conceivable that in these cases, in which the suprarenals have been damaged, injections of such an extract or some of the more recently isolated hormones would temporarily control the collapse until the suprarenal function was regained. This would apply especially to cases in which there is recovery from an initial collapse followed by a subsequent and fatal collapse. A possible explanation for the two stages of collapse may be that both suprarenal glands are not affected simultaneously in these cases.

The aetiology of the suprarenal lesions remains obscure. It is possible that shock can produce necrosis in the suprarenal glands similar to that produced in the pituitary gland. The vasospasm of pre-eclamptic toxæmia may also have an aetiological role, and a similar condition may be produced by large doses of posterior pituitary extract. Vomiting during pregnancy occurs in a sufficient number of cases to suggest that it is of aetiological significance, but it is not clear how the lesions are produced, though haemoconcentration due to dehydration may predispose to thrombosis.

It was suggested by Keele and Keele (1942) that some cases of Addison's disease might be caused by atrophy or calcification of the suprarenal glands due to old haemorrhage. As some of the cases of suprarenal haemorrhage or infarction were directly or indirectly associated with obstetric shock (Cases 2, 3, and 7, and Hurter's case) it was thought that a follow-up of cases of obstetric shock might produce some support for Keele's suggestion. So far 76 women who had been patients in the Glasgow Royal Maternity and Women's Hospital between the years 1938 and 1941 because of obstetric shock have therefore been followed up. None of the survivors has shown any evidence of suprarenal insufficiency, and none who had died had a history suggestive of Addison's disease.

Summary

Nine fatal cases of acute suprarenal insufficiency occurring in pregnancy are described in which death was apparently due to acute suprarenal insufficiency.

The history of these cases was similar to that described in similar conditions in non-pregnant patients by other authors.

The symptoms of these patients were classified into four groups as described by Arnaud (1900), Lavenson (1908), and Simpson (1937).

The predisposing factors in the cases described appeared to be obstetric shock, pre-eclamptic toxæmia, or late vomiting of pregnancy.

In some cases the pathological lesion was thrombosis of the central veins without destruction of the gland substance, and it is suggested that in these cases the lesion may not be irreparable.

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REFERENCES

- Arnaud, F. (1900). *Arch. gén. Méd.*, **186**, 5.
 Barker, N. W. (1929). *Arch. Path.*, **8**, 432.
 Cope, Z. (1940). *Early Diagnosis of the Acute Abdomen*. Oxford Univ. Press, London.
 Dodds, G. H. (1945). *British Medical Journal*, **1**, 769.
 Hall, E. M., and Hemken, L. (1936). *Arch. intern. Med.*, **58**, 448.
 Hurter, L. E. (1946). *Proc. roy. Soc. Med.*, **39**, 581.
 Keele, D. V., and Keele, K. D. (1942). *British Medical Journal*, **2**, 687.
 Lavenson, R. S. (1908). *Arch. intern. Med.*, **2**, 62.
 Marangoni, B. A., and D'Agati, V. C. (1944). *Amer. J. med. Sci.*, **207**, 385.
 Sanderson, P. H. (1946-8). *Clin. Sci.*, **6**, 197.
 Simpson, C. K. (1937). *Lancet*, **1**, 851.
 Simpson, S. L., and Korenchevsky, V. (1935). *J. Path. Bact.*, **40**, 483.
 Talbott, J. H., Pecora, L. J., Melville, R. S., and Consolazio, W. V. (1942). *J. clin. Invest.*, **21**, 107.

TREATMENT OF PLANTAR WARTS WITH ELASTOPLAST AND PODOPHYLLIN

BY

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We believe that in recent years there has been a considerable increase in the incidence of plantar warts, though we have no certain evidence of it. Table I shows the increasing numbers of cases seen at the skin department of Edinburgh Royal Infirmary in certain years.

TABLE I.—Cases of Plantar Warts Seen at the Skin Department, Royal Infirmary of Edinburgh, in 1936-8 and 1948-50

Year	Cases	Year	Cases
1936	58	1948	168
1937	68	1949	205
1938	105	1950	209

Over 200 cases were seen in 1950, and undoubtedly considerable numbers were also treated by chiropodists, medical practitioners, and consultants in private. Plantar warts are thus common enough to present a problem to every practitioner. They may produce considerable disability, the pain giving rise to a limp and bad posture.

If they are left untreated other members of the household may contract the infection, the spread taking place, presumably, from the bathroom floor. Most of the juvenile patients are regular attenders at swimming-baths, which appear to be the main disseminators of the infection.

Since the war much has been written on the dangers or the advantages of the usual methods of treatment of plantar warts. These are in the main radiotherapy, curettage, diathermy, and chemical methods. Their multiplicity indicates that they all have their limitations or shortcomings.

The reports of plastic surgeons (McLaughlin, 1948; Shaw, 1948) on the dreadful sequelae following improper treatment with x rays may have aroused prejudice against radiotherapy. This method should be reserved for the solitary wart or for one which is a reasonable distance from others. The mosaic wart—that is, many small warts grouped closely together—should not be treated with x rays, and multiple warts should be attacked preferably by other methods.

Diathermy and curettage, or curettage alone, may give good results in the hands of an expert, but the injection of the local analgesic may be rather painful, even with preliminary freezing with ethyl chloride, and there is usually much subsequent discomfort. It is therefore unsuitable for children, who comprise the majority of patients (Table II). The frequent use of general anaes-

TABLE II.—Distribution by Age Groups of 209 Patients With Plantar Warts Seen in 1950

Age	No.	Age	No.
0-4	6	15-19	32
5-9	34	20-24	18
10-14	97	25 and over	22

thesia is difficult to arrange in a busy out-patient department.

The surgical excision of plantar warts usually results in a painful scar, which is often the site of a recurrence. This method should be avoided as a routine procedure.

Various treatments with salicylic plasters and caustics have been described, and are applicable to solitary, multiple, or mosaic lesions. Such measures are often extremely painful, necessitate frequent visits over a long period, and are by no means uniformly successful.

With the introduction of the formalin method (Thomson, 1943) we have the first simple treatment for all types of plantar wart; this is particularly suitable for use in general practice. A fair number of cures can be obtained, but the disadvantage of the method is that the results depend entirely on the thoroughness with which the patient carries out the treatment.

Present Investigation

The treatment described here is equally simple, has proved in our hands more efficient than the formalin method, is applicable to all types of wart, and can be used after failure with x rays, surgery, or any other method. By successful treatment we mean here the removal of the substance of the wart followed by an examination three weeks after cessation of treatment to see that no trace remained. Patients were then instructed to report back in the event of any recurrence of symptoms. The "elastoplast" series was completed in October, 1950, and the elastoplast and podophyllin series in January, 1951.