A NOTE ON THE CAUSATION OF SUDDEN DEATH

BY

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One of the duties of a procurator-fiscal in Scotland is to investigate all cases of death from any form of violence, as well as all sudden deaths and deaths from unknown or suspicious causes. In most cases this is done by private inquiry—though provision is made by statute for fuller inquiry into certain deaths from industrial accidents and other causes—a procedure possessing certain advantages over the coroner's inquest. Part of the procedure initiated by the procurator-fiscal is an examination of the body by the casualty police surgeon, with or without a necropsy, and this note is based on an investigation to elucidate the cause of 1,694 cases of sudden, violent, and suspicious death from 1931 to 1945.

These cases fall into two groups—those in which the actual cause was definitely ascertained post mortem (572) and those in which external examination alone was carried out (1,122). From the former I have deducted 45 cases of newly born children, many of them stillbirths, or non-viable foetuses. On the other hand, many cases of suicide were not subjected to post-mortem examination because the cause of death was obvious—hanging, gunshot wound, cut throat, etc. In suicide, wherever there was doubt as to the cause, a necropsy was done; so all suicides are added to the number of cases where the cause was definitely ascertained. This gives a total of 823 (post-mortem cases (572 less 45), 527; cases of suicide not coming to necropsy, 296), or nearly one-half the total cases, over a period of 14 years. An analysis of these is detailed below.

Non-violent Group

Of the 823 cases 200 were due to non-violent causes, with the addition of 24 cases of infants under 2 years which have been considered separately because of a tendency to certain special types of death they exhibit. The remaining 599 were due to external agencies, suicide accounting for 365 cases and other external causes (accidental or intentional) for 234. The non-violent group consisted of:

	Cases	Infants
Deaths due to cardiovascular degeneration	104 (52%)	
Deaths due to diseases of the respiratory system ..	26 (13%)	17
Deaths due to diseases of the nervous system	33 (16·5%)	2
Deaths due to diseases of the gastro-intestinal system	15 (7·5%)	
Deaths associated with pregnancy	9 (4·5%)	
Other causes	13 (6·5%)	5
	200	24

Diseases of the Cardiovascular System.—The cardiovascular cases—104 (52% of the total)—form much the largest group, though not so large as in some previously reported lists of causes of sudden deaths. They were grouped as follows:

Coronary atheroma and thrombosis	51	39·5% of total
Rupture of heart	3	
Myocarditis—fibrous or fatty	25	
V.D.H.	4	
Intracerebral haemorrhage	13	
Ruptured aortic aneurysms	6	
Pulmonary embolism	2	

The first three groups may be considered together. Many cases showed gross atheromatous changes of the coronary arteries, so that these could only with difficulty be cut with a knife; others showed localized atheromatous changes in the arteries, and still others only small isolated plaques—in all causing such narrowing of the lumen that in some an acute cardiac ischaemia and death, probably from ventricular fibrillation, resulted and in others the narrowed area formed a nidus for thrombus formation and cardiac infarction. If death did not occur at once it might follow in a few days from rupture of the heart through the softened area supplied by the thrombosed vessel, as in the three cases mentioned. Cases showing temporary recovery resulted in myocardial changes, diffuse or localized, with impaired cardiac function. In four cases this fibrosis resulted in a cardiac aneurysm, but in no instance did this rupture. Included in this group are four cases of gross enlargement of the heart which on section showed fatty degeneration of the muscles. One case of coronary embolism was seen in which there were many vegetations on the aortic cusps and a raw area where one of these had become detached; it was found plugged in the right coronary artery, and was about the size of a grain of rice. In four others the main lesion was valvular—two mitral stenosis and two aortic stenosis and incompetence. These also showed evidence of fibrosis of the myocardium. There were 13 cases of cerebral haemorrhage (apart from subarachnoid haemorrhage), and all of them gave evidence of arteriosclerosis with concomitant enlargement of the heart. Eight showed that the haemorrhage arose in the neighbourhood of the internal capsule and five were cases of pontine haemorrhage. Possibly the more rapid termination in cases of pontine haemorrhage resulted in a greater proportion of those being investigated as sudden deaths than in the ordinary cases, which are usually seen by a doctor before death occurs. Of the six cases of ruptured aneurysm three were saccular aneurysms of the aorta; the other three were dissecting aneurysms arising from atheromatous ulceration. Of two cases of pulmonary embolism which came to necropsy one resulted from a thrombosis of varicose veins extending into the iliac veins; the other followed 10 days after a confinement.

Diseases of the Respiratory System (26 Cases).—Of these deaths 19 resulted from pneumonia, mainly of the fulminant influenzal haemorrhagic type, which in two cases caused death within four hours of apparent onset; two were due to bronchiolitis and one to status asthmaticus. Four were the result of haemorrhage from tuberculosis, death being due to asphyxia from intrabronchial clotting rather than to the actual blood loss.

Diseases of the Nervous System (33 Cases).—Cases of subarachnoid haemorrhage form more than one-third of this group. In only a few was it possible to demonstrate the actual congenital aneurysmal dilatation of the vessel—though it is interesting to note the finding of an unruptured aneurysm the size of a hazel-nut in a case in which death was due to violence. The youngest subject in this series was 10 years and the oldest 59. The following table shows the usual age distribution of cases of this type.

	Present Cases	Magee's 150 Cases
Under 20 years	3	9
20–30 ,, ...	1	76
30–40 ,, ...	2	56
40–50 ,, ...	5	9
Over 50 ,, ...	2	—

Six cases occurred in asylum inmates and were due to exhaustion from acute mania, five were cases of cerebral softening from cerebral thrombosis, and three were brain tumours with acute oedema of the brain. There were three cases of fulminant cerebrospinal meningitis—two in brothers who took ill within two days of each other, each dying after less than one night's illness. The third died after eight hours' illness and showed the typical

Waterhouse-Friderichsen syndrome with gross haemorrhage into both adrenals. Of the others, one was a case of general paralysis of the insane in which death was due to idiosyncrasy to arsenical drugs, one of status epilepticus, and one of hydrocephalus.

Diseases of the Gastro-intestinal System (15 Cases).—Acute perforations accounted for nine cases, intestinal obstruction for four cases. One case resulted from haemorrhage from a gastric ulcer, and one from colitis which suggested mercurial poisoning, but all analyses were negative.

Diseases Associated with Pregnancy (9 Cases).—Four of these resulted from toxaemias of pregnancy; four were the result of abortions—three from sepsis and one from air embolism; and one was an ectopic gestation.

Other Causes (13 Cases).—The only interest of these 13 cases lies in one case of Addison's disease, two where starvation was the cause, and two others where in the presence of lymphatism and absence of any other apparent cause the deaths were attributed to status lymphaticus.

Infant Cases.—In addition to the 200 cases above listed there were 24 post-mortem examinations on infants. These have been kept separate because the majority of these are of one type. The usual history is that a young child is put to bed after a feed, either apparently quite well or with only a mild catarrhal cold, and in the morning is found dead in its cot. These infants are frequently proved to have died from pneumonia. A dramatic occurrence was in twins 4 months old. Twin A had a very mild cold the previous day, and there was no history of any further illness. Twin B had no history of illness at all. At 8.30 a.m. the mother tucked both children in their cot, apparently well, and went to her washing-house to soak-in her clothes. On her return at 9.30 both twins were dead. At necropsy both were found to have had pneumonia, Twin A in a more advanced stage than Twin B. Of the 24 cases in this group 12 had pneumonia: four were due to asphyxia, probably overlaying; two to cerebrospinal meningitis; one to a hepatoma, and one to total infarct of the kidney. The other four were one case each due to cerebral haemorrhage (from labour), colitis, bronchitis, and status lymphaticus.

Deaths due to External Agencies

This group of deaths, numbering 599, occurred from the following causes:

Suicides (necropsy)	69
Suicides—examined externally only	296
Injuries, wounds, and burns	150
Associated with anaesthetics	32
Asphyxias, drowning, strangulation, etc.	20
Poisonings	21
Other causes	11

Suicides (365 Cases).—It will be seen that suicides form a large proportion of the total. The interest of this group lies in the method chosen and in the evidence of imitation in the recurrence of similar methods of self-destruction about the same time, especially noticeable in the coal-gas and precipitation groups. "How oft the sight of means to do ill deeds makes ill deeds done." The following is an analysis of the methods adopted:

Coal-gas	144 (40%)	Hanging	14 (3·8%)
Drowning	123 (33·6%)	Cut throat	14 (3·8%)
Poisoning	37 (10%)	Gunshot wounds	12 (3·2%)
Precipitation	18 (4·9%)	Trains	3 (0·8%)

As is usually seen, coal-gas provides the majority of cases, though cases of drowning approach the same figure, perhaps from the proximity of harbour, sea, and rivers in the area. Of the 37 cases of poisoning, lysol caused 18, again illustrating the usual habit, 11 were due to narcotics (barbiturates, chloral, bromides, and chloroform), three to prussic acid (occurring in two chemists and a laboratory attendant), two to corrosive sublimate, and one each to arsenic, strychnine, and aspirin. The other types of suicide call for no comment.

Deaths due to Injuries and Wounds (150 Cases).—These generally are of little pathological interest. Head injury was responsible for 90, rupture of organs for 28, multiple limb injuries for 12, and fracture of the spine for 6; nearly all the cases in these groups were caused by motor-car accidents.

Deaths Associated with Anaesthetics (32 Cases).—Of these cases 17 could be attributed directly to the disease which created the necessity for operation or to post-operative shock—for example, gangrene of leg, two cases (one with aortic thrombosis); cancer of breast and stomach, uterus, and prostate; toxaemia from pelvic abscess and gangrenous appendicitis; and post-operative haemorrhage, from a venous cyst and from gastrectomy. Of the cases where the anaesthetic played a major part in the cause of death three followed the inhalation of blood in throat and nose cases and two from the inhalation of vomit. One was a case of circumcision with status lymphaticus and one with hydrocephalus which collapsed on being given 1/2 oz. (14 ml.) of ether for the purpose of taking an encephalogram. In six cases—two of tonsillitis, one of mastoiditis, one of tuberculous nodes of the neck, one of antral suppuration, and one for the change of a plaster casing—the anaesthetic alone appeared to be responsible for the collapse. Two cases followed the application of a 2% amethocaine hydrochloride (decicain) spray—one a tumour of the lung and the other a case of bronchiectasis. The anaesthetic was given to permit of a bronchoscopy, and in both cases generalized convulsions set in within a few minutes and death occurred very shortly afterwards.

Deaths from Poisoning (21 Cases).—Six of these were accidental deaths from carbon monoxide from stoves or coal-gas: seven were the result of asphyxia in alcoholic coma; four were caused by drinking the synthetic methanol; and one each from phosphorus (rat paste used as an abortifacient), hydrocyanic gas (in a ship fumigator), quinine (also used as an abortifacient), and lysol applied externally as a dressing in mistake for eusol.

Asphyxias, Drowning, etc. (20 Cases).—These include 15 cases of accidental drowning, one accidental strangulation, and four cases of choking on foreign bodies—two in lunatics (a bun and an oatmeal pudding being the offending agents) and two in children from a bean and a particle of food.

Other Causes (11 Cases).—Of the 11 cases so classified two resulted from tetanus, two from pyaemia, and two from septic abortion. One case of oedema of the glottis occurred in a schoolboy who was kicked on the neck in a game of football and died within 20 minutes.

An interesting feature of this group is that in 16 of these cases of death from all classes of violence a charge of murder or culpable homicide followed. Three were in children murdered by an insane mother by coal-gas; three were head injuries; three resulted from strangulation—two manual and one with a handkerchief; two from cut throats; and one each from fracture of the spine, stabbing, shot-gun wound, and lysol—this last in a child murdered by its mother, who also committed suicide with lysol.

Cases Not Examined Post Mortem

Of the 1,122 cases in which external examination alone was carried out, 296 suicides have already been dealt with: 12 others related to newly born children and are discounted for reasons previously stated. This leaves 814 cases, of which 404 were cases of sudden death, 305 cases of injury, etc., and 105 infant cases. In a great number the cause of

death was not conclusive, so it is undesirable to base any conclusions on the figures ; but experience of large numbers of these cases allows an examiner to group the probable causes of death with reasonable accuracy for registration purposes.

Cases of sudden death		404 cases
Cardiovascular group	357	
Respiratory diseases	21	
Nervous system diseases	8	
Gastro-intestinal diseases	3	
Miscellaneous causes	15	

Here the outstanding feature is the proportion of deaths (85%) attributed to cardiovascular causes. This is not surprising when one considers that most of these were of people collapsing in the street or at work, or found dead in bed. In ordinary times many of these cases would have come to necropsy, but as nearly half occurred during the war years, when post-mortem examinations were reduced to a minimum, they were ascribed to the most likely cause as adjudged from the previous history and mode of death. In all, 318 deaths were thus considered to be due to coronary thrombosis and myocarditis ; 11 to valvular diseases ; 22 to cerebral haemorrhage ; one to ruptured aneurysm, and five to pulmonary embolism.

Deaths from External Agencies (305 Cases).—These deaths were due to the following causes:

Injuries:	
Fractured skulls	101
Ruptured organs	25
Fractured limbs and spine	25
Burns	14
Exposure	2
Other causes	4
Drowning	70
Accidental carbon monoxide asphyxias	22
Associated with anaesthetics	36
Poisons	6

The first point of interest here is the comparison of the accidental deaths from inhalation of carbon monoxide—22 cases plus six that came to necropsy, 28 (16%) in all—with the 144 (84%) such cases due to suicide. The six poison cases were all due to alcohol. Nearly all of the 36 deaths associated with anaesthetics were due to the condition necessitating anaesthesia or to post-operative shock or haemorrhage—hence necropsy (especially in the war years) was not done. For example, 13 were cases of malignant disease and 7 were abdominal emergencies. Three special cases may be noted: one of tetanus which ended in death during a spasm while receiving chloroform ; another that of a child of 23 months with a tuberculous lesion of the skull who received 40 ml. of a 0.5% solution of "novocain," fcllowed by a nitrous oxide, oxygen, and ether anaesthesia, in which the local anaesthetic was certainly in excess of a safe dosage ; and a third case, that of a man suffering from a deflected septum who had this treated locally with a swab of adrenaline dipped in cocaine crystals and died in convulsions within a few minutes, presumably from poisoning by cocaine owing to idiosyncrasy to the drug.

Infant Cases.—The 105 infant cases show the same tendency as the post-mortem cases: 55 were regarded as due to respiratory causes—50 to pneumonia and 5 to bronchitis—21 were asphyxial deaths, mostly accidental overlaying ; 13 were due to convulsions, nine to prematurity, and five to acute infections—measles (three) and whooping-cough (two).

Conclusion

Exact inferences may not be drawn from the figures given, but there seem to be three points which deserve some emphasis: (1) the outstanding predominance of cases of cardiovascular degeneration as a cause of sudden death—461 (76%) out of 604 cases ; (2) the frequency of coal-gas as a suicidal agent ; and (3) the frequency of pneumonia (50%) as a cause of sudden death in young infants.

HEMIPLEGIA IN YOUNG ADULTS

BY

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Strokes in the elderly are usually regarded as a manifestation of cerebral vascular disease, while in the young adult they are usually thought to be due to some extraneous cause. The purpose of this paper is to emphasize both the obscurity of aetiology and the frequency of strokes in young adults.

The cases selected for study are all instances of unilateral pyramidal palsy seen in Service personnel between the ages of 20 and 40 at the E.M.S. Neurological Centre, Winwick, between 1940 and 1946, and also four civilians of the same age group admitted to the Warrington General Hospital between 1944 and 1946 ; in all 35. Nineteen of these patients had only minor degrees of hemiparesis, and in these a convincing cause was found. Thus, seven occurred among 30 consecutive cases of cerebral tumour, six among 30 consecutive cases of disseminated sclerosis, three cases of congenital hemiparesis had been accepted by the recruitment board, and two cases of hysteria and a hemiparesis due to syringomyelia completed the total. It so happened that the onset of the palsy in all these 19 patients was insidious.

The remaining 16 patients with more severe palsies all had a sudden stroke ; of these, two men suffered cerebral emboli during the course of rheumatic mitral stenosis with pulmonary infarcts (Case 20) and bacterial endocarditis (Case 21). Another in retrospect presumably had suffered a Herxheimer reaction during the treatment of secondary syphilis (Case 22) ; a fourth must have had a cerebral aneurysm, as his stroke occurred 10 days after a subarachnoid haemorrhage ; and a woman (Case 24) aged 29 developed a hemiplegia whenever an overdose of insulin was administered in treatment of her diabetes mellitus. A case similar to this last was described by Fischer and Florman (1943), though their patient eventually suffered from a cerebral embolus. It is of interest that Case 21 eventually recovered from the endocarditis after treatment with penicillin, though he was left with an almost useless left hand and spastic leg and auricular fibrillation ; while Case 22 recovered sufficiently to be conscripted three years after his stroke.

Eleven of the severely palsied cases were not so readily diagnosed. Of these, two convalescent Service men (Cases 25 and 26) who had no pyramidal signs were at first labelled hysteria ; however, they both claimed unilateral loss of sense of position and a field defect on the same side. An almost identical Service case was described by Stewart, Randall, and Riesenman (1943) and diagnosed by them as hysteria. However, in reconsidering these three patients it appeared remarkable that all of them should have mimicked so closely the symptomatology of a vascular lesion in the posterior portion of the internal capsule, and when Case 25 was re-examined two years later the signs were unaltered, except that he had developed choreiform athetotic movements of the affected shoulder and a pneumoencephalogram demonstrated localized cortical atrophy. Six months after his stroke Case 26 wrote that his condition was stationary. It seems possible that had the frequency of strokes in young adults been appreciated at the time both Cases 25 and 26 would have been differently labelled.

Three of the cases under review had sepsis in the jugular vascular bed on the same side as the brain was affected—namely, in Case 27 a tuberculous gland on the right side of the neck, in Case 28 a Vincent's ulcer on the left tonsil, and in Case 29 a right-sided chronic otitis media. Dowman