times greater than normal values (Rechenberger and Schairer, 1947). Spectrochemical analysis of four samples of lung ash was kindly carried out by the Bragg Laboratory, Sheffield, with the results shown in the Table.

Discussion

Arc-welders' lung arises because of inhalation of the smoke and fume of iron oxide. It is the high temperature of the arc which produces the oxidation of the iron. After the inhalation of these tiny particles, $1\ \mu$ in size, into the lung alveoli they are arrested in the peribronchial and perivascular lymphatics, and in lymph nodules, and it is this deposition of tiny radio-opaque iron particles which gives the characteristic x-ray appearance.

Our patient, though suffering from only cough and shortness of breath, showed evidence of considerable focal and lobular emphysema, a marked loss of lung elasticity on thoracotomy, and a maximum voluntary ventilation and a timed vital capacity of about 70% of their predicted values.

In the past the general consensus of opinion has been that the condition of arc-welders' lung is benign and innocent. This view has been based on the frequent clearing of miliary radiological shadows in the chest x-ray picture, and on the absence of major pulmonary symptoms. Indeed, this also has been our own experience in the past. However, it may well be that prolonged exposure to iron fume (in this case over 25 years) in an enclosed space with little or no protection from the fumes does produce secondary emphysematous changes which are considerable and permanent, and are responsible for the irreversible lung damage reported in this patient.

Summary

A case is recorded of arc-welders' lung in association with a tuberculoma, in a man engaged in arc welding for over 25 years.

Radiologically an increase in the pulmonary vascular pattern, with micro-nodular shadows, mainly concentrated in the lower two-thirds of the lung fields, was observed.

At operation a distinct loss of lung elasticity was noted, and this was confirmed by respiratory physiological investigation. The pathological appearances of the excised lobe, in addition to the deposition of iron, revealed a considerable degree of emphysema. Chemical and spectrochemical analyses show the lung to have an iron content at least 100 times greater than normal values. Evidence strongly suggests that arc-welders' lung is not always the innocent or reversible condition which has been suggested by all previous workers.

We wish to record our grateful appreciation to Professor J. Gough for his kindness in cutting and preparing the sections, and for his advice in reporting on the histological specimens; also to Dr. Nagelschmidt for the chemical and petrological analysis of the sections.

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FRACTURE OF NECK OF FEMUR SURVIVAL AND CONTRALATERAL FRACTURE

BY

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As a consequence of the increased proportion of aged in the population fractures in the elderly are more frequent. The classical example, fracture of the neck of the femur, continues to pose new problems. The following survey indicates fresh implications of this common injury.

During the four years from 1952 388 patients have been studied. The initial two-year period has already been reported (Stewart, 1955). In that paper the first absolute incidence was recorded. The present report is a sequel occasioned by a fresh problem—namely, the readmission of significant numbers of patients with a second fracture of the same variety on the opposite side.

Present Series

The series represents the total unselected incidence of fractures of the neck of the femur in one area. No patient was refused admission. A standard routine of management was practised throughout. Surgical treatment was given to 95% of the cases. After internal fixation the patients were encouraged in immediate mobilization, but weight-bearing was prohibited until there was evidence of bony union.

In the period under review 27 patients sustained the fracture, first on one side and then on the other (see Table). The contralateral fracture followed return to activity and, with one exception, did not occur spontaneously during confinement to bed or chair. It seemed to be a consequence of non-weight-bearing, and occurred only when weight was again borne freely. The interval between fractures in 24 patients varied from a few months to ten years, with the majority close to the average of two years and a few months. This is also about the time taken to regain the degree of activity which determined the original fracture. Reactive remodelling of bone declines with age (Lacroix, 1951), and the elderly patient may not respond rapidly enough to the stimulus of resuming walking. As with stress fractures in general, this particular fracture results from the repeated application of a strain with a rapidity which outstrips the capacity for reactive remodelling by the bone. Characteristically, force is absent from the production of the injury.

There is further evidence, as shown by the symmetry of the bilateral cases, that the final dissolution of the bone has simply occurred at its weakest point. The two exceptions (Cases 5 and 8) may merely prove the rule. Less obvious is the reason why the right hip was the first to prove unequal to demands in a similar proportion. It has been said, in relation to other mechanical failings of the weight-bearing skeleton, that this is a "right-footed world" (Goff, 1954). The precedence of right before left may be no more than the result of "best foot foremost" in the conflict with gravity. The femoral neck becomes so vulnerable that the most trivial factor may tip the balance to either side.

Discussion

Solution of continuity in the neck of the femur can certainly follow disuse. Restrictions imposed by the first fracture, and ageing physique, deprive the weight-bearing bones of the stresses normally expressed by the cancellous architecture of the femoral neck in accordance with Wolff's law. Fractures of the neck of the femur are a not infrequent spontaneous occurrence in bedfast or paralytic patients. This is exemplified in the case of a male who complained of hip pain while incompletely confined to bed in hospital

Bilateral Fracture of Neck of Femur in 27 Cases, in Chronological Order of Second Fracture

Case No.	Side Affected	Cervical or Trochanteric	Age	Treatment	Result
1	1 L	C	84	Nail	} Survival
	2 R	C	84	"	
2	1 L	C	46	" Missed "	} "
	2 R	C	50	" Missed." Excision both	
3	1 R	C	71	Nail	} "
	2 L	C	71	"	
4	1 L	T	53	Traction	} Death
	2 R	T	60	Nail-plate	
5	1 L	C	75	Traction	} Survival
	2 R	T	81	Nail-plate	
6	1 R	T	77	"	} Death
	2 L	T	77	"	
7	1 R	T	79	"	} Survival
	2 L	T	81	"	
8	1 R	T	80	"	} "
	2 L	C	82	Nail	
9	1 R	C	56	Nail-Osteotomy	} "
	2 L	C	60	" "	
10	1 R	T	84	Nail-plate	} Death
	2 L	T	84	"	
11	1 R	C	72	Calliper	} Survival
	2 L	C	82	Nail	
12	1 R	C	63	Plaster spica	} "
	2 L	C	81	Nail	
13	1 R	T	72	Nail-plate	} Death
	2 L	T	75	Traction	
14	1 R	T	63	?	} "
	2 L	T	81	Nail-plate	
15	1 R	T	81	"	} Survival
	2 L	T	83	"	
16	1 R	T	73	"	} Death
	2 L	T	73	"	
17	1 R	T	87	"	} Survival
	2 L	T	88	"	
18	1 R	T	76	"	} "
	2 L	T	78	"	
19	1 R	C	72	Nail	} "
	2 L	C	73	"	
20	1 R	C	85	"	} "
	2 L	C	88	"	
21	1 R	T	66	Nail-plate	} "
	2 L	T	69	"	
22	1 R	C	68	Nail	} "
	2 L	C	77	"	
23	1 R	C	81	" Missed "	} Death
	2 L	C	88	Nail	
24	1 R	T	97	Nail-plate	} Survival
	2 L	T	97	"	
25	1 R	T	76	"	} "
	2 L	T	78	"	
26	1 ?	C	41	Spontaneous	} "
	2 ?	C	41	" (male)	
27	1 R	T	84	Nail-plate	} "
	2 L	T	85	"	

with pulmonary tuberculosis: bilateral fractures of the neck of the femur had occurred without any incident being recognized. Two other bilateral cases also sustained supracondylar fractures of the femur during non-weight-bearing mobilization. Since it has been shown that the incidence of the injury is related to the senile state of the bone (Stewart, 1955), the inference is that the inactivity enforced by the first fracture leads to more rapid degenerative changes.

The misfortune of the first fracture is responsible for the vulnerability to the second. A higher incidence of second fracture among survivors of the first, as compared with the incidence of the first in the population at risk, indicates the degree of relevance. The exact incidence of second fracture is not yet known. Even the estimation of survival becomes problematical in these age groups; it is impossible in the individual. When the appropriate bilateral cases are related to the survivors from the known population the incidence is approximately twenty times that of the first fracture.

A second fracture on the same side is rare. The final healing of any fracture can only follow the principles of Wolff's law: the healed neck of the femur, having thus

once more become adapted to stress, is the less likely to undergo classical fracture again.

Dietary deficiency can be postulated as relevant to senile bone change; but in animal experiments bone has been found resistant to dietary restriction of calcium (Bell, Cuthbertson, and Orr, 1941). The second fractures arose after a period of hospital dietary likely to have corrected deficiencies.

Patients with fractures of the neck of the femur are usually thin; they are often described as emaciated. The weight-bearing requirements of the skeleton have thereby again been reduced to an inadequate level. Such fractures, however, do occur in the obese and entail particular technical difficulties, including comminution. It has been noted that heavy patients have not only applied their own weight to produce the fracture, but have also more frequently done so in some accident from which violence was not entirely absent.

A word or two may be said concerning the fate of the fracture. The local result is often undecided for about two years. This is also the time taken to produce a contralateral fracture if such is to occur. The final processes in repair depend on the very factors the absence of which determines the vulnerability of the other hip. The point is thus not surprising.

The foregoing comments cannot justify the taking of physical liberties with the first fracture. If, however, the incidence of contralateral fracture is proportional to the prohibition of walking until union, a warning is none the less implied. There is no ready alternative to the normal stimuli for maintenance of skeletal strength. Elderly people do not take kindly to the use of crutches even when the use of both legs is once more vouchsafed. They cannot reasonably be expected to use them with one sound leg. Meantime, reliance can only be placed on intensification of maintenance exercises.

Deterioration of skeletal strength must be borne in mind when decreased activity is prescribed for the ageing. The concept of occupational therapy has been developed to make exercises palatable, and, indeed, is popularly so understood. However, there is not yet popular understanding of the need to encourage activity in old age. This may be due to the lack of some comparable plan to make it as acceptable. Preventive medicine could contribute to this defect in prophylaxis.

Conclusions and Summary

Clinical investigation of the bilateral cases described appears to confirm that the incidence of fracture of the neck of the femur is determined by the senile state of the bone. Furthermore, the susceptibility of senile bone to this fracture is in particular related to a low level of physical activity. The patients who sustained fractures of the femoral neck first on one side and then on the other probably exhibit the highest degree of predisposition. The symmetry, timing, and production of these second fractures exemplify the failure of skeletal reactivity as determined by the ageing process. Such cases thus clarify the aetiology of fractures of the femoral neck. They indicate also the obstacles to their prevention.

Details are given of 27 cases of fracture of the neck of the femur where survival has already been followed by a similar fracture in the opposite hip; the exact incidence of such second fractures, however, is not yet known.

Certain inferences are drawn from the bilateral cases relating to aetiology and prophylaxis.

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Medical Memorandum

Fatal Outbreak of Botulism among Labrador Eskimos

This is an account of a fatal outbreak of botulin poisoning among a group of Eskimo hunters in Northern Labrador. The men concerned belonged to the township of Nain and moved out from there in the middle of November, 1956, to the autumn sealing station at Ungadlek. The party consisted of six men, two women, and some children. The sealing station was a hut which had not been used since the spring of that year.

A favourite Eskimo diet called *utjak* was asked for. This is prepared by placing seal flippers, complete with fur, in a container, and leaving this with a lid on it behind the stove for a variable period of several hours to several days. One of the women did not like the food and refused to make the meal. Her husband insisted, whereupon she said that the wooden cask was leaking and she could not use it. He then brought an empty gasoline cask, which had previously been used for tainting sealskins, and told her to use that to prepare the meal.

Sealskins are "tainted" by being left in a cask beside the stove until the hairs are removed from the skin. The gasoline cask had been used for that purpose a year previously. It was now used to prepare *utjak* without being cleaned. In this cask meat was "cooked" for ten days at a temperature that probably fluctuated between 20 and 40° C. The seals used for the meal were fresh, and other parts of the seals had been eaten at other times.

The meal was consumed at about noon on December 10. One man thought it tasted bad, and vomited almost at once. He was the only man to survive. Between two and three hours later a girl aged 6 died. Her speech was peculiar, she seemed to be paralysed and unable to move her tongue. At this point the survivor left to get help, and further clinical details are scanty. In all cases there appeared to be difficulty in swallowing, regurgitation of fluids through the mouth, abdominal pain, and distension. The first man, aged 46, died at 4 p.m. (necropsy was carried out on his body); the second, aged 42, died soon after. Then next morning (December 11) the third man, aged 21, died, and the fourth man (aged 34) died a little later. The last man to die (aged 42) was the heaviest, weighing about 170 lb. (77 kg.)—in contrast to the others, who weighed 120–140 lb. (54.4–63.5 kg.). He died on December 13.

There was one other survivor—a girl of 8. She took the meal, and suffered from nausea, vomiting, diarrhoea, and headache. She arrived back at Nain on December 15 and was admitted to the nursing station early the following morning with diarrhoea (stool green and black), abdominal distension, nausea, abdominal cramps, and frontal headache. She vomited three times after admission, was kept on fluids by the nurse in charge, and recovered completely in a few days.

The two women did not eat the food and were unaffected.

The man who survived (aged 22) ate only one or two mouthfuls, and vomited almost at once. He walked nine miles to Black Island, where he was reported to have arrived covered with sweat and his abdomen so distended that his top trouser button and his jacket buttons would not fasten. The next day he travelled by dog sledge 25 miles to Nain. He felt better then and went to his home, complaining only of some stiffness in his throat. A few days later he felt pain

in his chest, was admitted to the nursing station, and then transferred by aeroplane to the hospital at North-West River with lobar pneumonia. He made a rapid and uneventful recovery. No other physical abnormality was discovered on examination.

As soon as news of the tragedy was received at Nain an aeroplane was summoned. It arrived at Nain, but was delayed thereafter for several days by bad weather. This aeroplane brought the body of one of the victims to North-West River, where necropsy was performed.

NECROPSY REPORT

The body was that of a well-built Eskimo male. Some discoloration of the skin of the abdomen was seen, and there was a notable dilatation of the superficial vessels over the whole body. No pathological changes had occurred within the mouth. The peritoneal cavity contained no free fluid. The stomach was filled with a paste-like material flecked with blood. There were petechial haemorrhages in the gastric mucosa, particularly towards the cardia, also a few haemorrhages in the duodenum. The rest of the gut was normal, as were all other abdominal viscera. The bladder was filled with cloudy urine. The bladder mucosa appeared normal. Signs of old tuberculosis were seen in the right lung and pleural cavity, otherwise the thoracic viscera showed nothing abnormal.

The brain was normal both macroscopically and microscopically. The meninges were normal to the naked eye, but histological examination showed multiple thromboses in small vessels. Otherwise the histology of all organs showed no abnormality apart from vascular congestion in the upper alimentary tract.

Samples of the seal flipper from the food consumed, together with samples of the gastric contents and urine from the body examined, were sent to the Public Health Laboratory at St. John's, Newfoundland. In direct smears from the seal flipper a Gram-positive bacillus with terminal spore, morphologically resembling *C. botulinum*, was demonstrated. Subsequent exhaustive bacteriological investigation failed to yield culture of this organism or its toxin. However, confirmatory bacteriological investigation of part of the sample of the flipper, carried out at the Department of Bacteriology in the University of British Columbia, demonstrated type E toxin of *Clostridium botulinum* in a concentration of roughly 1,000 m.l.d. per g. of flipper, and also a toxic strain of *Cl. botulinum* type E.

COMMENT

In the eyes of the Eskimos the cause of the tragedy lay in using a metal cask. Many Eskimos have said that to have used a gasoline tank showed *issumaki* (little thought). They have a definite superstition that metal should not be used for cooking seal meat. This dish is always made in a wooden cask.

In 1954 a similar tragedy occurred in the same region. Information concerning this is now scanty, but it seems to have followed the same pattern as the Ungadlek tragedy. The Eskimos were warned at that time of the dangers of eating rotted meat.

An incident is recounted by a Moravian missionary who was travelling in winter many years ago with Eskimos in the same region. They came to a house which had been derelict for many weeks. In a wooden cask, with a cotton cover, were rotting seal flippers. The delighted Eskimos put their arms into the cask, stirred them round, and ate the contents in handfuls. There were no ill effects.

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