

ACCIDENTAL ACUTE IRRADIATION FROM COBALT-60

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The accidental exposure of a traffic policeman in the Transvaal to a radio-active cobalt-60 source during December 1959 received considerable publicity in the press. As far as I am aware this is the first case of its type in South Africa and as the clinician in charge of the case from the fifth day after exposure I write this note on the management of such cases in general and on the management of this case in particular.

CASE HISTORY

On Tuesday 1 December 1959 at about 3.30 p.m., a car carrying a capsule of cobalt-60, which was to be used for metallurgical purposes, was involved in an accident 40 miles from Johannesburg. The lead container in which the capsule had been placed apparently broke open in the accident.

A traffic policeman, aged 32, arrived on the scene of the accident shortly after its occurrence. He stated that, in the process of carrying out his routine duties, which included the disposal of the injured and a search for the third-party-insurance disc of the crashed car, he came across a small capsule of about 6 by 2 cm., which he thought looked like a 'condenser'. He said that he picked it up and for about 5 minutes was playing with it from one hand to the other whilst proceeding about his duties at the scene of the accident; that he then placed it in the left thigh pocket of his motor cyclist's raincoat, where to the best of his memory it remained for about 20 minutes; and that then he placed it in the car and for the next hour or so was within 5 - 15 feet of the capsule whilst walking about the scene of the accident. Up to this stage, he said, he was not aware of the radio-active nature of the capsule.

The raincoat was double-breasted, buttoned down to the bottom, which was at knee level, and with the belt fastened. It

seemed likely therefore that the coat pocket would have been retained at a fairly fixed distance from the skin of the left thigh. The pocket was over the upper anterior and lateral part of his left thigh extending down to a distance of about 10-12 inches from the iliac crest, the bottom of the pocket being between 10 and 15 cm. from the gonads. The distance of any object in the pocket from the skin would have been between 1 and 3 cm.

He continued at work for the next few days, during which period there was no nausea or vomiting or loss of appetite. He felt somewhat fatigued but he did not emphasize this feeling. The press reported the incident widely.

On Friday 4 December he received an instruction to proceed to Johannesburg to visit a radiologist for an examination. He stated that whilst bathing before leaving for Johannesburg he noticed, at a place later measured to be 12 inches below the left iliac crest, a symptomless red patch of skin about $1\frac{1}{2}$ inches in diameter, and that on the way to Johannesburg he felt a burning sensation in this area but at that time there was no itch.

After his visit to the radiologist, when blood was taken for testing and photographs were taken, he returned home and the red spot began to itch. He noticed then that there were two other spots which began to itch above and lateral to the original point and in close proximity to it. He also noticed a spot of redness and itching on the right thigh symmetrically opposite to the original spot on the left thigh.

Later in the evening of 4 December, the itch at these spots became worse and a generalized intolerable itchiness appeared on the trunk and limbs. At about 10 p.m. he went to see his doctor, who diagnosed an urticaria-like eruption. It was not a flat erythema. In the course of the afternoon and evening he had no unusual food or drink.

He was given 40 mg. of cortin intramuscularly but the itch became so intolerable and he felt so unwell in general that he was admitted to the local hospital and was given 200 mg. of solucortef intravenously in 2 litres of fluid, and anthisan and meticortin by mouth. He was afterwards given chlortrimetron.

Transfer to Johannesburg General Hospital

On Saturday 5 December the itch continued, and he was transferred to the Johannesburg General Hospital for observation and investigation. At the time of admission no information was available about the amount of radio-activity of the cobalt-60 source. Cobalt-60 is a beta and gamma emitter, the gamma rays with their long pathlength are the significant ones under the circumstances of this case.

The patient's only complaint at the time of admission was of persisting itch. His general condition was normal apart from some concealed anxiety, due, it was considered, to what he had read of his case in the newspapers and to the chatter of his acquaintances concerning the frightful things that might happen to him. His temperature and pulse were normal.

On the left anterior and upper part of the left thigh there were 3 excoriations caused by scratching, each one the size of a half-crown. There were also extensive scratch marks and rubbings over his limbs and trunk and over his face and forehead. There was a single patch of excoriation at the site of the area of redness which he had described on the right thigh symmetrically opposite the original patch on the left.

In the absence of information concerning the amount of radio-activity of the source to which he had been exposed, and in spite of the absence of the nausea and vomiting immediately after exposure which would have accompanied a considerable total body dose of ionizing radiation, it was considered wise to manage the case as if he had been exposed both locally and generally to a dose that might be followed by pathological effects.

As I entered the ward to see the patient I noticed a copy of a newspaper with a headline stretching across 4 columns COBALT BOMB VICTIM IN HOSPITAL. In the report appeared a photograph of the patient and immediately under the photograph was an account of a press interview with an un-named radiotherapist who had indicated the effects—local and general, immediate and remote—that might be produced in a person exposed to ionizing radiations. Bleedings and leukaemia were mentioned. It was natural for the reader to infer that what was mentioned in the report might happen to the person whose portrait appeared above the report. I therefore tried to assess the patient's reactions to the publicity which his case had received. He was a man of extrovert temperament and he stated that he took no notice at

all of what was being published about him in the newspapers. He later said that his wife was very worried about what might happen to him. I asked him to ignore any unpleasant reports he might read and any gloomy and hair-raising stories his friends and acquaintances might tell him, and to trust us to keep him informed of the true state of affairs. I told him that leukaemia has not been shown to be a long-term hazard of single-dose total body irradiation.

The white-cell count showed 18,000 white cells per c.mm., with a differential count of 69% neutrophil polymorphs, 23.5% lymphocytes and 7.5% monocytes. The sternal marrow was counted and stained with Jenner-Giemsa; the cell count was 216,000 per c.mm., the differential count was normal, and no abnormal marrow cells were seen.

On Sunday 6 December provisional information was received that the cobalt-60 source was about 1 curie. Cobalt-60 emits radio-activity at the rate of 13.3 roentgen per millicurie per hour measured at 1 cm. distance. At 1 cm., the dose from 1 curie in $\frac{1}{3}$ rd of an hour would be $\frac{1000 \times 13.3}{1 \times 3}$ roentgen, namely 440

roentgen skin dose at 1 cm. from source. At 15 cm., applying the inverse square law, the dose would be $\frac{1000 \times 13.3}{15^2 \times 3}$ roentgen,

which is about 20 roentgen. One could conclude that the total body dose under the described circumstances was insignificant. Nevertheless, pending receipt of an official report from the physicists of the Council for Scientific and Industrial Research and the Atomic Energy Board it was decided to carry on observing the patient as if he had been subjected to a significant body dose, i.e. significant in the sense that it might at least temporarily affect his bone marrow.

Daily white-cell, platelet and reticulocyte counts, haemoglobin and haematocrit estimations, and erythrocyte sedimentation rate estimations were instituted for 14 days, the period then to be lengthened if no abnormalities were found. Apart from a transient initial leucocytosis no abnormalities were found. The total white-cell count after the initial rise remained at 7,000-12,000 per c.mm., the differential count apart from a transient increase of eosinophils to 4-6% for a few days remained normal, the platelets never fell below 375,000 per c.mm., and the reticulocytes remained at 0.2-0.9%, the haemoglobin at 14.5-15.5 g.%, the haematocrit at 43-46%, and the ESR at 2-8 mm. in the first hour. All these estimations were normal at the end of the 8-weeks period of observations.

On 7 December photographs were taken of the thigh, pubic region and feet to serve as a base line for the observation of any later epilation or change in the growth of toenails and fingernails.

On 8 December Dr. T. H. Bothwell carried out an iron-turn-over study using ^{59}Fe and reported the results as normal. Normal bone-marrow function on this the 8th day after exposure led to the inference that the marrow had permanently escaped any significant effect of ionizing radiation.

On 7 and 8 December the patient complained of a burning sensation in his testicles but there was nothing abnormal to observe. This was not complained of again.

Apart from platelet counts, clotting mechanisms were not examined. In the latest literature these have been generally reported to be normal after even severe total body irradiation with effects on the marrow.

By 8 December the itch had ceased and the patient felt normal.

On 10 December the official report of the radio-activity of the source and the estimated local skin, gonadal and total body doses were received from the CSIR and the Atomic Energy Board. The source had been measured as 1.75 curie. On the data available to the physicists, the local skin dosage was considered to be 900 roentgen, the gonadal dose 37 roentgen, and the total body dose 2.5 roentgen. The dosage was expressed in roentgen, applicable only to X-rays and gamma rays. The dose could have been expressed in rads (the tissue dose unit applicable to all forms of ionizing radiations). However, 1 roentgen is approximately the same as 1 rad under the circumstances of this incident.

The insignificance of this skin dose was explained to the patient on the lines that a local 'erythema' dose (600 to 1,000 r) produced an effect comparable to a patch of sunburn erythema. The estimated gonadal dose was explained on the basis that it was less than half of the mutation doubling dose, generally accepted as being between 50 and 80 r whether given in a single

exposure or over a life-span. The possible effect of such a dose on an individual's progeny was insignificant enough to be ignored. It was also explained that his potency would be unaffected, and that the male sterilizing dose is at least 20 times the maximum possible dose that he could have received with the capsule in his coat pocket. He was unwilling to have a sperm count done.

Out-patient Follow-up

The patient was discharged on 15 December 1959 feeling perfectly well, and arrangements were made to have regular blood and platelet counts done for another two weeks. No physical treatment had been indicated or given.

On 17 December, the patient was referred as an out-patient. He stated that on the evening of 15 December he noticed some red blood in his stool on one occasion. On the night of 16 December more 'rash' appeared on the left thigh, and a small blister developed on the back of the left hand. He said that he felt ill at the time but on 17 December was feeling perfectly well again. The patient was examined, and on the front of the left thigh about 10 inches from the iliac crest 3 superficial graze marks were seen, each the size of a half-crown, with a strange vertical lining which appeared due to a scratching process. On the back of the left hand there was a small blister about $\frac{1}{4}$ inch in diameter without surrounding erythema, comparable in appearance to a local thermal burn. The patient's general appearance and condition were normal. (The platelet count on 15 December, the day on which, as he stated, there had been blood in the stool, was reported as normal—475,000 per c.mm.)

I informed him that the lesions on the thigh and hand could not possibly be physically related to the effects of the ionizing radiations of 1 December. I hoped that this very positive line would prevent recurrence.

On 23 December he came as an out-patient once more, looking extremely well and feeling well. He had driven to Johannesburg on his motor cycle. There were no new eruptions and no local epilation on the thigh or elsewhere. Platelet count performed at his local hospital was reported as normal.

On 8 March 1960 he visited us again as an out-patient with a view to having a blood and sperm count done. He had no complaints. The blood picture was normal, with haemoglobin of 16.6 g.%, haematocrit 48%, white cells 11,400 per c.mm. and a differential count of 57% neutrophils, 29% lymphocytes, 6% monocytes, 7% eosinophils and 1% basophils. The ESR was 3 mm. in the first hour and reticulocytes 0.4%. The platelets were reported as normal in number and appearance. The sperm count by Dr. L. Schrire, of the South African Institute for Medical Research, showed a total count of 12 million per c.c., of which 40% were motile and 20% abnormal; volume 1 c.c. pH 7.2. After 24 hours there were 17% motile forms. The report read, 'This specimen of seminal fluid shows a marked reduction in the number of spermatozoa and a reduced proportion of motile forms. These findings could be compatible with a radiation effect but could equally well be due to a number of other causes'.

RELATIONS WITH PRESS

Reference is made above to the sensational newspaper reporting with which the patient and his family were confronted.

On 8 December I was asked to make a statement to the press, which was still reporting the case extensively, and through the Medical Superintendent of the hospital I arranged to meet representatives of two Afrikaans and two English papers and the South African Broadcasting Corporation to give them a factual account. Three of the press representatives were regular science-writer journalists. This procedure I considered to be of great importance in order to have as accurate reporting of the incident as possible both from the point of view of public information and from the point of view of the patient and his family.

A description was given of the manner in which ionizing radiations arise from fall-out, from reactor accidents, from radio-active spills, sealed and unsealed, from X-ray therapy and high-energy therapy machines such as 'cobalt bombs',

and from background and cosmosphere. The physical effects on individuals following a total body dose below the lethal dose were described, and it was explained that these effects had not to date been observed in the present case. It was explained that it was impossible to forecast whether or not effects would develop within the next 10 days without a knowledge of exposure dose, and it was further pointed out that it would be undesirable to report dosage estimates even when known, because the public might easily get confused between local skin dose, gonadal dose, specific organ sensitivity, and total body dose. The difficulty of assessing the dose to which a subject of an accident has been exposed, even with the most modern facilities available, was also pointed out. The unhappy situation that arose in the present case from the publishing of the patient's photograph over the report of an interview describing the possible after-effects of total body irradiation was explained and appreciated.

After this press interview the subsequent reporting of the case by the newspapers, whose representatives attended the conference, was both accurate and sympathetic.

On 13 December a newspaper that had not been represented at the press conference published a report of an interview with an 'internationally known nuclear physicist' in which report the 'cobalt bomb victim' was advised 'not to be a father yet'. The unhappy effect of this report on the subject and his wife was anticipated and managed reassuringly.

DISCUSSION

The estimation of the local, gonadal and total body dose of irradiation in a radio-active spill or other accident is of the utmost importance from the point of view of diagnosing or anticipating the somatic and genetic effects. The difficulties of accurate assessment of dose are exemplified by the fact that at a uranium accident at Oakridge in 1958, reported by Marshall Brucer,¹ the assessment of total body dose by two groups of physicists working from the same data was a mean total body dose (for the 5 subjects exposed) of 200 rad from one group and 300 rad from the other.

In the present case, the absence of nausea and vomiting in the first few hours and days after exposure pointed to a very low body dose whilst the presence of skin erythema locally, if due to irradiation, pointed to a local skin dose of at least 600 r, the obsolete 'skin erythema dose' (for calculated doses see above).

Genetic Effects

The gonadal effect of ionizing radiation includes gene mutation, and reduced spermatogenesis up to a permanent sterility where the dose is 600 r or more. The effect of a 'gene mutation doubling dose', i.e. the dose that doubles the gene mutation rate that normally occurs during the 30 years of active reproductive life as the result of normal background radiation and other factors, is, according to geneticists' opinion, insignificant both as regards the effect on the progeny of an individual and as regards the effect on the population in general when the whole population is exposed to such doubling dose. The doubling dose is roughly estimated at between 30 r and 80 r, and it is agreed that the effect is the same whether this dose is given in 30 years or in one single exposure.²

What in fact is the estimated effect of the doubling dose genetically on an individual and on the population as a

whole? Various estimates have been made. Many are hazardous guesses rather than mathematical calculations. In 1958 the United Nations Scientific Committee on the Effects of Atomic Radiation³ reported as follows: 'The Committee considers that the human race has sufficient reserve capacity for breeding to make the possibility of its slow extinction by reduced fertility of genetic origin due to doubling of the normal mutation rate by any mutagenic agent seem very remote.

In regard to the effect on the individual, the Medical Research Council's (Great Britain) 1956 report² states:

'If a gene defect-transmitted disease has a normal incidence of 1 in 500 births, the incidence of that defect on the progeny of someone exposed to a doubling dose will be 1 in 493'.

Many other reassuring estimates have been given by geneticists.

In the present cobalt-60 incident, the gonadal dose at the most was less than half the doubling dose and no effect on progeny need be anticipated.

The male sterilizing dose is about 600 r. Lesser doses will cause varying degrees of temporary lessened spermatogenesis, its duration being days, weeks or months, according to the dose. In the present case a sperm count was carried out 3 months after the incident, and showed a reduced count, for which any of a number of causes might have been responsible.

Potency is unaffected by radiation *per se*. Like any other general sickness, a total body dose large enough to cause general effects may be associated with impotence. Impotence of psychological origin may be induced iatrogenically or by the fears caused by alarming press reports and scare talk.

Somatic Effects

The effect of locally applied ionizing radiation must be carefully distinguished from the effect of total body irradiation.

It is a commonplace that 10,000 r can be locally applied radiotherapeutically to a limb and produce virtually no total body effects.

The generalized pruritus complained of in our case is not a feature of total body exposure to ionizing radiations unless, according to Cronkite *et al.*,⁴ that exposure be due to fall-out. Opinion seems to vary in regard to its incidence as a reaction to local radiotherapy of the skin.

In our case, the three discrete patches of erythema on the left thigh seem unlikely to have been an effect of radiation, unless scratching had obscured the true picture. The patch of itchy erythema that was stated to have appeared symmetrically on the right thigh, is consistent with a neurodermatitic type of lesion appearing symmetrically opposite the initial lesion (irrespective of its cause) in the corresponding neurodermal segment.

The total body dose is what determines the 'acute irradiation syndrome'. It is generally agreed that a total body dose of 1,000 r is almost always fatal in any period up to 4 or 5 weeks and shows its clinical effects at once by nausea and vomiting and skin erythema, with haematological and other effects following in a few days. It is generally agreed that a total body dose of 500 r carries about 50% mortality.

Five cases in the reactor accident at Oakridge in 1958¹ were exposed to between 200 and 300 rad total body dose. All 5 cases showed haematological effects and all recovered completely in periods of up to 5 months under treatment consisting of bed rest and reassurance. In the same accident, 2 other cases were exposed to 20-40 rad total body dose and showed no effects apart from a transient leukocytosis.

In Fig. 1 is shown a composite graph, compiled from Marshall Brucer's report,¹ indicating the clinical and haematological effects in the 5 cases exposed to 200-300 rad, but not effects on amino-acid excretion and serum proteins (there was early excessive urinary excretion of certain abnormal amino-acids, and an early rise and fall in serum albumin followed by a secondary temporary rise some weeks later).

Early nausea and vomiting were present in all cases, but erythema was absent. Epilation mostly in the scalp but also elsewhere, took place from about the 3rd week, and recovered within 6 months. The incidence of purpura coincided with the fall of the platelet count from about the 14th day. The platelet counts in all cases fell at a consistent rate and time after exposure, and returned to normal within 6 weeks. The white-cell counts in all 5 cases fell at about 4 weeks to about 2,000 per c.mm. The lymphocytes showed a drop within two or three days and then returned to normal in about 2 weeks.

The proliferative capacity of the marrow was estimated by the tritiated thymidine technique and was shown to be temporarily reduced during the early stages. The mitotic index of the marrow was also temporarily reduced. Both these tests indicated reduction of marrow function.

In our case we did not have facilities for the tritiated thymidine technique, but the iron turnover estimated by

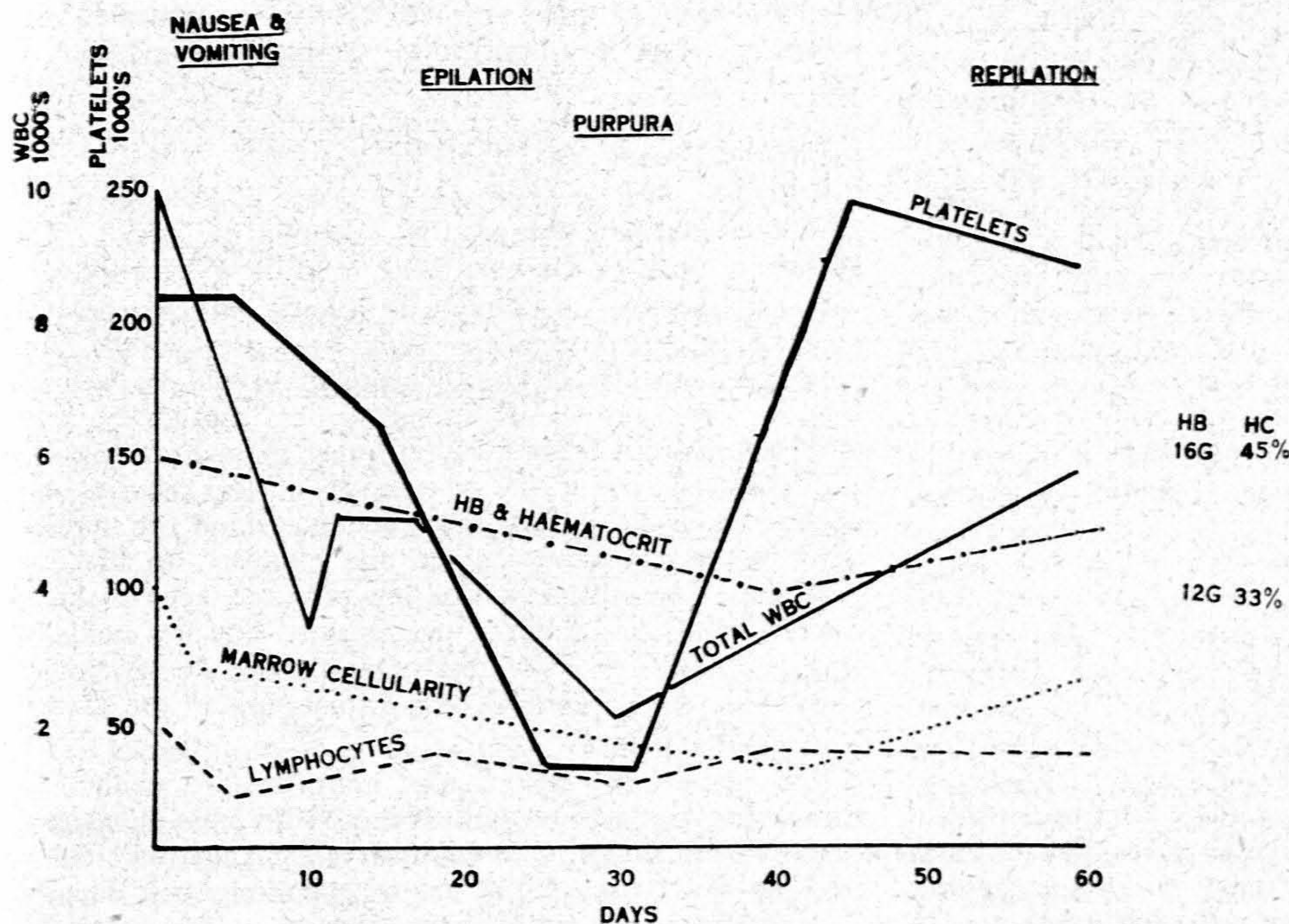


Fig. 1. Composite graph of mean haematological values and salient clinical features of 5 cases exposed to 200 to 300 rad total body dose. Compiled from data published by Marshall Brucer¹ in 1959.

the ^{59}Fe technique is an index of marrow function and this was normal on the 8th day after exposure. There was no change in the serum protein-pattern in our case on the 6th day; the haematological studies indicated that the marrow and peripheral blood remained structurally and functionally normal.

The induction of body radio-activity by neutron or very heavy gamma bombardment of the body's sodium, which can be measured during the few days it lasts by whole-body counter or serial linear scans,¹ did not arise in our case by reason of the minute total body dose concerned.

Discussion of the treatment of the acute radiation syndrome is beyond the scope of this case report.

The Press

In these cases good public relations are intimately interwoven with the whole subject of radio-activity. The attitude of the public to ionizing radiations and particularly to accidents in which people singly or in small or large groups are exposed to their action must be positively guided.

The atomic energy establishments of the USA and Great Britain which I visited under the auspices of the World Health Organization during 1958 - 59 all emphasize the need to have an effective public relations department through which information concerning their work and any accidents is presented to the press. Press reports are all handled by the public relations office, and no member of staff, medical or other, is permitted to make statements to the press. The result is the publication of scientifically accurate reports, which nevertheless can be mishandled by sensational headlining or by the omission of essential parts.

The press is the most important single influence in keeping the public informed on any matter. The World Health Organization⁵ has reported on an analysis of press reporting on atomic energy. In 504 press cuttings from 31 countries in 1 year (1956 - 57) in which the common factor was reference to the work of WHO, by far the most widely covered subject was atomic energy, and the emphasis was upon the dangers—the risk of harm to genetic and somatic health from fall-out, radio-active waste, food contamination, and the medical use of X-rays. One 'quality paper' of Great Britain gave an average of 1,500 words daily to atomic energy during that year. It was emphasized that a report prepared for the public by nuclear physicists, physicians and experienced public relations officers of atomic energy institutions, no matter how well balanced, accurate, and intelligible to the average layman, can be ruined in so far as its intended effect upon the public attitude is concerned by the headlines chosen to feature it. Such a report, for instance, appeared under a banner headline of ATOMIC SUICIDE.

In our cobalt-60 incident, one daily paper referred in its 4-column headline to COBALT BOMB ACCIDENT. This title appeared not long after the installation at the Pretoria General Hospital of the teletherapeutic 'cobalt bomb' of a radio-activity 1,000 times as great as that of the cobalt-60 capsule concerned in our case, when the power of ionizing radiations and the great precautions that had to be taken to prevent their damaging effects on man were reported in the press. The unhappy results of the publication of interviews with 'authorities' who are unaware of the features of the particular accident are also well exemplified by two other reports mentioned above. One was the interview with

a radiotherapist which was published under a photograph of the patient, and the other was an interview with an unnamed 'internationally known nuclear physicist' visiting Johannesburg, reported under the 3-column headline COBALT BOMB TRAFFIC COP TOLD: DON'T TRY TO BE A FATHER YET.

There is therefore good reason to support the view that reports, at least on accidents, should be accepted by the press only from authorities concerned to prevent both individual hurt and public alarm and panic. Whether the publicity given to ionizing radiations has in fact caused significant psychological damage is a difficult question to answer. The emotional reactions to reports of danger and risk from ionizing radiations are fear, resentment and anger. In my WHO tour I heard accounts of individuals, including medical practitioners, who refused to allow themselves or their families to be diagnostically X-rayed because of the dangers of ionizing radiations. But these were few. On the other hand, I met many practitioners and physicists who were nonchalantly exposing themselves to ionizing radiations in what appeared to be very considerable ignorance of their biological effects.

Dr. K. Soddy, psychiatrist at University College Hospital, London, who was rapporteur of the WHO Committee on the Mental Health Aspects of the Peaceful Use of Atomic Energy, informed me that his committee had received reports from psychiatrists of 8 countries to the effect that reference to atomic energy are absent from the expressed symptom-content of psychiatric patients, both psychoneurotic and psychotic. Occasionally, references were made to the fear of atomic-bomb explosions. This it was agreed was in striking contrast to the incorporation into the delusional systems of psychiatric patients of other physical phenomena such as electricity, radio and radar. It was, however, agreed that the impact of the attitudes to atomic energy on very young children may become manifest in the next few years as those attitudes become incorporated into psychiatric and psychoneurotic symptomatology; but it was pointed out that this has not yet happened in Japan, where exposure to the first fearful atomic blast in history occurred 15 years ago.

Should a positive approach be taken in keeping public attitudes reasonably attuned to scientific accuracy? The answer, at least for the time being, is in the affirmative.

In my opinion—an opinion in keeping with the practice of all atomic establishments visited—the press as the most powerful controller of public attitudes should be well informed. The journalistic science writers should, by press interview or other means, be informed by nuclear physicist and physician about the science of nuclear physics and nuclear medicine, so that they can understand the implications of the news they handle and publish. In my own experience, the science writers are only too keen to know something of the principles and facts of ionizing radiation and their effects on biological systems. The cooperation of journalistic science writers in Johannesburg in the present case was notable.

The medical profession, too, must be informed. Unfortunately there is a feeling that those who press the dangers of ionizing radiation, who naturally are mainly radiologists, have an axe to grind and are exaggerating such dangers. This feeling is present in most countries. It is associated with the fear that the right of the non-radiological medical

practitioner to use an X-ray screening or film set will be denied by legislation. Nevertheless, medical practitioners untrained in the use of X-rays, and apparently unaware of their potential danger, may nonchalantly flout the ordinary rules of safety, and today reports regularly appear of self-inflicted X-ray 'burns' through carelessness and ignorance on the part of non-radiologists. Less tangible effects, such as gene mutations, are not immediately measurable.

Medical students, too, must be informed of the biological effects of ionizing radiations; so must physicists. In 1958 a British committee was enquiring into the instances of biological damage that people have sustained in University physics laboratories, some of which were far from biologically minded and a few of which were apparently antagonistic to the introduction of the theme of biophysics, including radiobiology, into their departments.

SUMMARY

1. The features of an accident in which a capsule of cobalt-60 of 1.75 curie radio-activity became a source of potential danger to man are described.

2. The biological effects of ionizing radiation applied to the gonads and to the whole body ('total body dose') are briefly discussed.

3. The method of clinical and laboratory investigations of an exposed case is described. The average teaching hospital laboratory can provide the essential tests necessary for the proper management of such cases. The physical

facilities for the estimation of dose to which a subject has been exposed must be provided and used expeditiously in such cases.

4. In the present case no untoward somatic effects of ionizing radiations were found. Some insignificant and unimportant local skin erythema might have been due to the ionizing radiations. The findings of a sperm count carried out 3 months after the exposure were compatible with a radiation effect but could have been due to other causes. The gonadal dose at its worst was well under the doubling mutation rate dose. There were no symptoms or signs of the acute radiation syndrome.

5. The importance of the management of the psychological aspects and the importance of keeping the public informed, particularly through the press, is discussed.

My thanks are due to Dr. K. F. Mills, Medical Superintendent of the Johannesburg General Hospital, for permission to publish details of this case, and to Dr. T. H. Bothwell, working on a grant from the South African Council for Scientific and Industrial Research, for the radio-active-iron study.

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