interest to note that men with red cell counts below two millions were doing full duties before admission. Though every one of these 24 cases had a complicating factor, which was irregularly distributed, the incidence of such factors was not higher than in the remaining 26 cases, except that bacillary dysentery or its history was present in 9 cases and not in the anaemia of other groups. But each case occurred in a vegetarian, and, what is more, not a single meat-eater of the 17,000 had developed this type of anaemia. Vegetarianism was thus thought to be the principal cause of nutritional macrocytic anaemia in this series. It is not, however, the purpose of this note to discuss what is present in the meat ration which prevents the occurrence of macrocytic anaemia.

One case showed how quickly a severe nutritional macrocytic anaemia may develop. A champion wrestler—a vegetarian—had had excellent rations, with four extra tins of milk weekly, and plentiful fruit and vegetables, as he lived in a fertile part of the country. He was transferred to the desert, where his ration contained little or no fruit and vegetables, and no milk. After three months of this diet he developed a severe macrocytic anaemia with a red cell count of 1,250,000 and Hb of 4.9 g.

In the 5 cases of sprue anaemia there was nothing of particular note.

The patient with severe undulant fever developed macrocytic anaemia after two months in hospital. In health he was a meat-eater, but in hospital was given a milk diet without eggs. There was no clinical anaemia on admission, but after two months' fever he looked very pale, which led to a full blood investigation, with the following results: R.B.C., 2,100,000; Hb, 6.72 g.; M.C.H., 31.5 $\gamma\gamma$; M.C.H.C., 26.28%; M.C.V., 119.0 c. μ . The sternal marrow differential count showed 7.75% megaloblasts, 14% erythroblasts, 27% macroblasts, and 18% normoblasts. No other anaemia-producing factors were present. The blood picture in this case was of interest because undulant fever usually produces a microcytic anaemia, the macrocytic form being rare. The anaemia usually is not severe. Strong (1942) says: "The lowest recorded count by Basset-Smith was 2,500,000, and by Kern 2,800,000."

3. That 9 of these 24 macrocytic cases had an M.C.H.C. below 30% was of interest. Four were infested with hookworms. Two had achlorhydria, but free acid returned as anaemia disappeared. In the remaining three the iron deficiency appeared to be purely dietetic in origin. These 9 cases were similar to the "dimorphic" group recently emphasized by Trowell.

4. Koilonychia occurred in 7 cases (Table III). There was a low M.C.H.C. in all except one. Five cases had hookworm infestation. In one of these there was achlorhydria. The case with a normal M.C.H.C. (30.5%) had an M.C.V. of 127 c. μ .

5. Test meals gave the following abnormal results. Achlorhydria was present in 7 nutritional macrocytic anaemias and 5 iron-deficiency anaemias on the first examination. Acid was later found in four of the former group and two of the latter. Histamine was not available.

6. The results of the examination of the lips, buccal mucous membrane, tongue, and eyes have been tabulated. Cheilitis and angular stomatitis were common, but exact records were not kept in the earlier cases. Sublingual glossitis was a condition in which the under surface and sides of the tongue were very red and tender, and, in some, large red papules were present.

TABLE III.—Findings in Mouth, Eyes, and Nails

Disease	Meat-eaters	Vegetarians	Temporary Vegetarians	Sprue
Generalized glossitis	—	8	—	5
Geographical tongue	2	4	—	—
Sublingual glossitis	4	4	—	—
Enlarged numerous fungiform papillae	11	16	—	2
Koilonychia	5	2	—	—
Bitot's spots (xerophthalmia) ..	—	2	—	—

Conclusions

A full blood investigation of 50 consecutive cases of anaemia in Indian men in an extreme desert climate, where there was a low sickness rate (about 1.5 per 1,000 per day), showed that the

admission rate to hospital for anaemia per 1,000 of population among vegetarians was 22 times greater than among meat-eaters. The incidence of severe anaemia was very much greater in vegetarians than in meat-eaters in this series.

The anaemia differed in type and severity in the two groups, being mainly macrocytic in the vegetarians (nutritional or tropical macrocytic anaemia) and hypochromic and either normocytic or slightly microcytic in the meat-eating group. No case of nutritional macrocytic anaemia was seen in a meat-eater.

In all cases except one a complicating factor was found, hookworm and malaria being most frequent.

The difference in the habits of the two groups, which were otherwise alike, was that social customs prevented the vegetarian group from eating the weekly ration of 20 oz. of fresh mutton in the meat-eaters' ration. The absence of this meat appeared to be the cause of macrocytosis and severity and frequency of anaemia in the vegetarian group. The rations contained over 3,000 calories and over 80 g. of vegetable protein. Riboflavin and vitamin A were known to be low.

It will be of interest to compare these results with findings when the stress of severe frequent malarial infection and dysentery is great.

One case showed that a severe macrocytic anaemia may develop within three months if milk, fresh fruit, and vegetables are much reduced in a vegetarian diet. Another case in which severe macrocytic anaemia developed during a prolonged fever (undulant fever) showed the need of liver and iron in the diet in cases of chronic illness.

Summary

The incidence, type, and severity of anaemia in an Indian adult male population of about 18,000 were shown to depend on the meat content of the diet. Nutritional macrocytic anaemia occurred only in vegetarians in a series of 50 cases.

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THE DIAGNOSIS OF DOUBTFULLY PENETRATING ABDOMINAL WOUNDS A LESSER OPERATIVE PROCEDURE

BY

CHARLES DONALD, O.B.E., Ch.M., F.R.C.S.

Brigadier, Army Medical Service

A diagnostic procedure for doubtfully penetrating abdominal wounds, introduced by me in the Desert Campaign and thereafter often referred to among field surgeons as my test, has recently (Rogers, 1944) been designated, not unkindly but with some lack of euphony, "Donald's explorotomy." Rogers mentions the test as if it were generally known, and does not elaborate it. Lest other references should appear I feel it advisable to put a description on record; otherwise the implications and limitations may not be understood. The circumstances attending its origin are not without interest.

In the casualty clearing stations behind El Alamein there was great congestion of casualties for the first week or so of the battle. Only first priority cases could be operated upon; all else had to travel on to the base hospitals, not far away in distance but a fair way in time. The first priority cases were numerous enough to overwork the surgeons, and among abdominal cases there had to be a discrimination as to who were worth operating upon and who were not, to an extent that I have not seen repeated.

Most penetrating wounds of the abdomen are easily diagnosed. With experience on the part of the surgeon the proportion of doubtful penetrations, usually with wounds of entrance at a distance, becomes less. But till that experience is gained, and after then in lesser degree, there are cases in which doubt remains and precious hours are allowed to pass in waiting for more signs. The alternative is an exploratory laparotomy. When severe casualties are waiting their turn in large numbers, as at El Alamein, it is galling to do a negative

laparotomy of the usual searching kind, and under field conditions this wastes more than a good hour of time and a great deal of energy.

It soon became apparent to me that no missile ever entered the peritoneal cavity without, by the time the patient reached the surgeon, there being some blood, little or much, in the pelvis. Such did not necessarily imply that a viscus had been injured, only that the abdominal wall had been completely pierced, with some bleeding from it into the general peritoneal cavity. Even without visceral injury there could be a large collection of blood if a particular vessel in the parietal wall had been hit; there was always some. From civil practice one recalls how irritatingly a stab incision through the abdominal wall can bleed until it is tautened on the drainage-tube. The absence of any blood in the pelvis, conversely, meant that the parietal wall had not been pierced.

The Method.—A time-saving, and life-saving, procedure in doubtful cases, based on this fact, seemed justifiable in the conditions then existing. Instead of the usual large laparotomy, turning over of the gut, and palpation of other viscera, a small 1½-in. exploratory incision, halfway between umbilicus and pubis, was made. Through this a swab on a long holder was passed to the pouch of Douglas. If no blood was found on the swab the incision was closed. If the swab was blood-stained the wound was extended into a proper laparotomy, which might or might not reveal visceral injury as well. The small incision was made through the rectus muscle, as any extension necessary then produced what was regarded generally as the quickest and best of abdominal incisions in abdominal injuries—the vertical rectus-splitting. The procedure does not take more than 20 minutes, time for induction of anaesthesia included.

The value of a test depends in great measure on its proper performance and interpretation. It is necessary, for instance, to make sure that the swab on the holder is not soiled on its passage through the small exploratory hole. Again, a purely retroperitoneal injury, perhaps necessitating laparotomy, will of course not give a positive result, but the position of the wound, the signs, and often the odour from it, will not lead one into the performance of the test under these conditions.

While I did not advise the test to be done save under exceptionally busy circumstances, where the greatest good of the greatest number was the prime consideration, it would now be of interest to know of any other experiences in the matter. Personally I have not heard of an instance where a negative finding on the swab did not mean one could shut up the small incision with confidence. While the same thought of the underlying principle must have entered other surgeons' minds, I have found no note of it in the literature, and experienced surgeons of the last war tell me it was not a practice known to them.

Rogers, in the article above referred to, indicates the value of the test in those few cases in which the signs leave doubt as to the advisability of operating, and (a) the amount of shock seems out of proportion to the external wounds, (b) the haemoglobin and red cell count are lower than normal in early cases or the white cell count higher than normal in late cases, and (c) the failure of the patient's condition to improve in a reasonable time.

While I agree with these indications I think they suggest that the doubt arises only in cases of the relatively ill. I would add the occasional case in which the patient is relatively well but his signs are equivocal, and something—call it clinical sense or what you will—leaves the examiner unhappy as to delaying for what may be precious hours. Writers on the subject of abdominal wounds usually record a proportion of negative laparotomies. If, especially in shocked patients, the exploration can be cut down to what is described above, then lives as well as time may be saved.

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J. McConnell (*Amer. J. med. Sci.*, 1945, **209**, 41) describes an outbreak of epidemic pleurodynia affecting young women in a nurses' training school. The source of the epidemic was not determined. Signs and symptoms referable to the central nervous system were usually present. In three patients the symptoms resembled those of meningo-encephalitis. Attempts to reproduce the disease in animals failed.

CASE-FATALITY RATES OF GAS GANGRENE IN RELATION TO TREATMENT*

BY

M. G. MACFARLANE, Ph.D.

(*Lister Institute of Preventive Medicine, London*)

The War Wounds Committee of the Medical Research Council recommended in 1940 a combination of measures for the treatment of gas gangrene—the use of surgery and bacteriostatic drugs to control the infection and the use of polyvalent antitoxin to alleviate the toxæmia. At this time the therapeutic value of antitoxin in clinical gas gangrene had not been assessed. It was shown later, by analysis of the case reports on Army Form I 1241 (Macfarlane, 1943), that the fatality rate was significantly lower among patients who received prompt treatment with antitoxin in addition to surgical treatment; even among those who underwent amputation of the affected limb within six hours of diagnosis the beneficial effect of antitoxin was demonstrable. It seemed clear that, in general, the combined use of surgery and antitoxin was more effective in saving life than either of these measures alone, but it was pointed out that patients in whom the gas gangrene involved the thigh or buttock region showed a poorer response to treatment than those in whom the lower leg or arm was affected. This was thought to be due to the difficulty of controlling the infection in a region with a relatively poor collateral circulation and in which surgical elimination of the infection might be difficult or impossible.

In a later memorandum (M.R.C. War Memorandum No. 2, revised edition, 1943) it was recommended that the initial dose of antitoxin should be increased to 50,000 units, given intravenously; it seemed possible that with a more intensive use of antitoxin and with more effective drugs the fatality rate might be further decreased. The case reports from the Central Mediterranean Force have therefore been analysed to assess the effectiveness of the treatment at present recommended, and to examine the factors contributing to death in those patients who died in spite of such treatment. During the period under review penicillin was increasingly used in addition to or instead of sulphonamide drugs, and it is necessary to compare the effect of the combined treatment with and without penicillin before coming to any conclusion on the efficiency of the therapy now available.

Out of a total of 295 reports of anaerobic infections on Army Form I 1241 between the beginning of the campaign in Sicily and June, 1944, 185 reports have been considered to be typical of cases of gas gangrene, the main criterion being the infection of muscle, since bacteriological confirmation of a clostridial infection was not always given. It was shown in an interim analysis (MacLennan and Macfarlane, 1944) that there was good correlation between the data obtained in the early part of the campaign by personal investigations in the field and those obtained from the reports, and a further check is possible by comparison with the report made by Jeffrey and Thomson (1944) on 33 cases of gas gangrene in the C.M.F. treated with penicillin during the early months of 1944.

I. General Features

Method of Analysis.—The difficulties in the evaluation of therapeutic measures in gas gangrene have been discussed previously. Briefly, because of the many variables involved it is necessary to group together cases which are similar in nature and have received similar general treatment and then to determine within such a group the effect of the particular measure to be evaluated. The main facts which must be taken into account are the adequacy of the treatment with surgical measures, antitoxin, and drugs, and the site of the gas gangrene; other factors, such as the general facilities for evacuation and surgery, must also be considered.

Adequacy of Treatment.—The cases have first been grouped according to the level of treatment with surgical measures and

* Based on a report to the Subcommittee on Anaerobic Wound Infections, War Wounds Committee, Medical Research Council.