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ACUTE ISCHAEMIA IN LIMB INJURIES

BY

E. G. HARDY, M.D., F.R.C.S., F.R.C.S.Ed.

AND

D. J. TIBBS, *M.C.,* M.S., F.R.C.S.

*From the Department of Surgery, King's College, and the
Professorial Surgical Unit, Royal Victoria Infirmary,
Newcastle upon Tyne*

During the Korean war many injured limbs in which the main artery was damaged were restored to good function by the use of modern arterial techniques (Jahnke and Howard, 1953 ; Hughes, 1955). Correspondingly good results might be hoped for in comparable civilian injuries similarly treated. It is disappointing, therefore, that of nine such patients admitted recently to this unit attempts to save the injured limb failed in no fewer than six.

It is proposed to give a brief account of our experience, to study the causes of failure, and to make tentative recommendations for the management of such cases in the future.

Case 1

A 33-year-old man was admitted to hospital with a simple fracture of the left femoral shaft. It appears that at first the existence of circulatory impairment was missed and conservative treatment of the fracture was begun. Eight hours after admission it was realized that severe ischaemia was present in the distal part of the limb, and manipulation under anaesthesia was performed ; the foot, however, remained cold and pulseless.

The patient was transferred to this unit and was operated on about 11 hours after injury. A 2-cm. segment of popliteal artery just below the adductor hiatus was found to be occluded completely by bruising and thrombosis. Resection of the segment with end-to-end anastomosis led to restoration of distal pulses. The fracture was fixed with a Küntscher nail. Next day there was gross swelling of the leg and foot, and fasciotomy was performed. The foot, though swollen, stayed warm and retained palpable pulses until the seventh day, when sudden complete ischaemia developed. Arteriography showed that the block was well below the popliteal bifurcation. Gangrene of the foot ensued, and below-knee amputation was performed on the fifteenth day. Though the posterior tibial artery was pulsatile at the level of amputation, the leg muscles showed extensive aseptic necrosis above this point. Convalescence was slow owing to delayed healing of the stump.

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Comment.—Restoration of the circulation failed to reverse the damage done by more than 12 hours of ischaemia, so that extensive necrosis of muscle and late peripheral thrombosis ensued.

Case 2

A 56-year-old man caught his right arm in a moving belt, sustaining crushing in the elbow region, without fracture. He was seen soon afterwards in a local hospital, where occlusion of the brachial artery was diagnosed, and he was transferred without delay to this unit. Examination here showed that the elbow region was grossly bruised, the forearm and hand were white, pulseless, and numb, and contracture was present in the thenar muscles. At operation, six hours after injury, a 4-cm. segment of the brachial artery at the elbow was found to be occluded by bruising and thrombosis. The median nerve was anatomically intact. After excision and homograft replacement of the segment normal circulation was restored. Oedema of the forearm and hand ensued and persisted for several days. On recovery from the anaesthetic he was found to have a median-nerve palsy which took some months to resolve.

Comment.—Restoration of the circulation within eight hours was rewarded by the saving of a limb in which ischaemic contracture would have been inevitable and gangrene probable.

Case 3

An 82-year-old widow was admitted to hospital with a dislocated right shoulder. The right hand was ischaemic. The dislocation was reduced without anaesthesia, whereupon a large haematoma developed in the shoulder region. Thereafter the circulation in the hand was thought to have improved a little, though the radial pulse remained absent. Next day the ischaemic changes were more severe. The distal forearm and hand were pale, cold, and numb ; the fingers were cyanotic, and severe contracture was present.

She was transferred to this unit 28 hours after admission, and was soon operated on. The axillary artery was found to be torn half-way across owing to avulsion of the posterior circumflex humeral branch, and was stretched over a large clotted haematoma. The involved segment was resected and a short homograft inserted. Good pulsation returned in the brachial artery down to the elbow, but the hand and distal half of the forearm remained ischaemic. Next morning arteriotomies were made at the wrist and at the elbow, and long string-like thrombi were washed out of the ulnar and radial arteries by the retrograde flush technique (Crawford and DeBakey, 1956). After this there was good circulation down to the wrist ; the hand as far as the roots of the fingers was warm, but showed gross damage with vesication and discoloration ; the fingers were gangrenous. The patient was treated conservatively with a view to limited amputation later. After about one week mental and physical deterioration started, and she died 15 days after the second operation.

Comment.—The circulation was reopened too late to prevent extensive ischaemic damage. Earlier repair of the artery might have saved the limb and the patient's life. In retrospect, amputation through the forearm should have been performed at the time of the first or second operation.

Case 4

A 21-year-old man was admitted to hospital with a compound fracture of the shaft of the right humerus. At operation extensive flaying of skin and crushing of muscle was noted, and the ulnar nerve was found to be severed. The brachial artery was thought to be in spasm, and attempts were made to restore circulation by applying papaverine to it. Next morning ischaemia of the hand remained complete, and there was severe contracture of the forearm muscles.

The patient was transferred to this unit and operated on approximately 12 hours after the accident. It was found

that a segment of the lower brachial artery close to the fracture was contused in appearance and diminished in calibre. An arteriotomy at this level revealed a small dark clot in the lumen, with a slender tail extending distally; when the clot was removed an area of lacerated intima could be seen. The contused segment was excised, the distal artery cleared of clot by retrograde irrigation, and direct end-to-end anastomosis performed. A good pulsatile circulation was restored to the limb, and this was followed almost immediately by a striking degree of oedema in the previously ischaemic area. Over the next few days massive oedema persisted; however, though sensation remained absent in the fingers, their temperature and colour progressively improved. By the fifteenth day oedema was less but had taken on a "boggy" quality; the patient had a high fever and looked ill. Surgical exploration showed massive liquid necrosis of the forearm muscles, and the arm was therefore amputated at the level of the fracture. Recovery was rapid. Dissection of the specimen showed that the arterial anastomosis and the arteriotomies were healthy and that the major arteries were free from clot.

Comment.—Restoration of the arterial supply was achieved after more than 12 hours' interruption. This failed in its purpose, however, because the forearm muscles had been irreversibly damaged by ischaemia. Indeed, though reopening the arterial flow had preserved the hand, it had probably converted what would have been a dry necrosis of the muscles into a moist gangrene.

Case 5

A man aged 28 was admitted to hospital with a dislocated knee, sustained as a result of a blow from a mechanical shovel. The dislocation was reduced, a haemarthrosis aspirated, and a plaster cast applied. At this time there was some anxiety about the distal circulation, but, as one observer thought he felt an ankle pulse, nothing was done other than to bivalve the plaster. Next day, about 18 hours after injury, the patient was transferred to this unit. At this time the foot was cold, blue, and numb, and there was marked contracture of the calf muscles. Exploration showed that the popliteal artery and vein were completely severed. The ends of the artery were trimmed and anastomosed, and the vein, which was full of clot, was ligated.

Post-operatively, massive oedema developed from the knee downwards, but there was good circulation, with a warm pink foot and palpable dorsalis pedis pulse. Oedema persisted, and during the second week became characteristically boggy. The patient became progressively more ill, with profound toxaemia and high fever. Several local collections of pus were drained, but it became clear that all the leg muscles were in a state of liquid necrosis. Above-knee amputation was necessary, and was followed by prompt recovery.

The dorsalis pedis pulse had been palpable throughout, and examination of the amputated limb showed the anastomosis to be healthy and patent.

Comment.—Re-establishment of the circulation after 18 hours' ischaemia averted gangrene of the foot, but amputation was necessary because of extensive necrosis of the calf muscle.

Case 6

An 8-year-old girl was admitted to hospital with a fractured left femur and an extensive flaying injury of the whole limb, sustained when she had been run over. After wound toilet and repositioning of skin, the fracture was reduced and a split plaster shell applied. On the fifth day after injury the foot was cold, blue, and numb, and there was marked contracture of the calf muscles. At this stage she was transferred to this unit, where arteriography was performed. This showed a patent popliteal artery and a slender circulation down the posterior tibial; the anterior

tibial was not shown. It was decided that there was no indication for arterial exploration, but because of massive oedema a fasciotomy was carried out.

Over the next few days the foot became warm and pink except for the great toe; sensation did not return to the foot, and limited patchy skin-gangrene developed in the leg. High fever and toxaemia developed and the child became very ill.

Exploration of the calf showed gross liquid necrosis of muscle, but a strip of healthy muscle was present along the pulsatile posterior tibial artery. Since the foot was viable, consideration was given to excising the necrotic muscle; however, this was abandoned because of the extent of the damage and the severity of the toxaemia. Below-knee amputation was followed by rapid recovery. The child later walked well on an artificial limb.

Comment.—This case shows how severe ischaemia may result from injury to soft tissue even when the major arterial channels are open. This is an important factor, and is discussed more fully below.

Case 7

A youth of 18 had his ankle snared in a trawler's mooring hawser, sustaining a compression force presumably of many tons. He was admitted to hospital with a compound dislocation of the ankle. A good deal of skin remained intact, but most of the remaining soft tissues had been severed. An attempt was made to preserve the circulation by bridging the ends of the divided posterior tibial artery with a polyethylene tube. This soon thrombosed, however, and he was transferred to this unit. The polyethylene tube was replaced by a vein graft, but though the foot was perfused temporarily the flow soon stopped, probably for lack of sufficient venous return.

Below-knee amputation was performed a day or two later, and the patient recovered uneventfully.

Comment.—The original injury was virtually a traumatic amputation; after dissection of the specimen it was realized that the attempt at arterial repair had been hopeless from the first.

Case 8

A 26-year-old man fell through a glass roof, sustaining a large incised wound of the right arm and a closed injury of the left chest. The distal part of the right forearm and the hand were cold and pulseless, and there was anaesthesia of glove distribution. He had numerous rib fractures on the left side, with a limited area of paradoxical movement. He was admitted to this unit and operated on within five hours of injury. It was found that the brachial artery and the median nerve had been completely divided; the former was effectively sealed by its retraction within a sleeve of adventitia. The ulnar nerve had been nicked but not severed, and the biceps and brachialis had been extensively divided. An important feature was the venous damage; the cephalic and basilic veins and the brachial venae comitantes had all been cut. The artery was repaired by end-to-end anastomosis and primary suture carried out on the median and ulnar nerves. Full normal circulation was restored to the limb with no vascular sequelae. Sensation returned promptly, except for the expected area of median-nerve anaesthesia. Tracheostomy was required for the management of the chest injury, and thereafter the patient made a good recovery. At the time of writing the neurological deficit remained but the circulation was normal.

Comment.—The initial well-marked glove anaesthesia and its prompt relief by arterial repair indicate that the limb was saved from dangerous ischaemia by early operation. The absence of congestion after extensive venous damage is noteworthy, and supports

the belief that the oedema often seen after relief of ischaemia is not necessarily due to concomitant venous injury (see below).

Case 9

A 15-year-old boy was admitted to hospital with a closed fracture of the left femoral shaft at the junction of the middle and lower thirds. No significant circulatory impairment was evident until treatment by skin traction was begun ; ischaemia then developed rapidly and progressed to stocking anaesthesia. On release of traction, adequate circulation returned to the foot, though ankle pulses were not restored. Any attempt to pull on the limb caused impairment of the circulation, and so traction was discontinued.

Next day he was transferred to this unit, where it was seen that there was no threat of gangrene, but that the fracture was in poor position. Exploration showed that a segment of lower femoral artery was looped round the bone end in such a way that traction on the limb caused complete obstruction. After the vessel was released there was good pulsatile flow in the involved segment, but pulsation did not extend further than the mid-popliteal region. On the suspicion that there was "consecutive" clot at this level, a popliteal arteriotomy was made. No clot was found, and there was no back-bleeding. However, after some external manipulation there was sudden profuse back-bleeding, probably from dislodgment of a fragment of clot. After repair of the arteriotomy good pulsation returned to the whole popliteal artery. Ankle pulses were still absent, but the circulation of the foot was so adequate that further procedures seemed unnecessary. The fracture was fixed with a Küntscher nail. Post-operatively there has been no anxiety about the condition of the foot. This was a recent case, and at the time of writing the patient was still under treatment for the fracture ; the ankle pulses were then palpable.

Comment.—Prompt recognition of the ischaemia and its effective treatment by release of traction were the important measures in this case. Operation on the artery led to further improvement in the circulation and allowed the fracture to be treated.

Pathological Factors

The pathology of acute limb ischaemia has been reviewed by Scully and Hughes (1956) on the basis of experience in the Korean war. After a few hours' interruption of circulation a muscle contracture similar to rigor mortis develops. Scully and Hughes stress that this does not progress inevitably to fibrotic (Volkmann's) contracture, though the latter of course is a frequent sequel. In other words, this initial contracture, though of grave import, may be recoverable. These early changes may be accompanied by little or no histological alteration. Paradoxically, restoration of circulation at this stage often leads to sudden increase in the *apparent* severity of muscle damage. (It should be noted, however, that the previous " normal " histology may be merely that of dead or dying muscle preserved in a chilly environment). Thus there may ensue vascular engorgement, swelling, exudation, and focal haemorrhages, with release of myoglobin and consequent pallor of the muscles. The end-result may range from apparent normality, through varying degrees of patchy necrosis and regeneration, to complete death of the muscle.

These pathological changes correlate well with the clinical phenomena observed in this series and indeed in most cases in which acute limb ischaemia is relieved surgically—for example, embolectomy, or bypass-grafting for impending gangrene. Plethora and oedema of the limb develop, apparently in proportion to the severity of the preceding circulatory impairment. The changes may persist in diminishing form for months. Involved muscle may recover completely or may suffer any degree of damage (with subsequent fibrotic contracture) up to complete necrosis. Skin is more resistant to ischaemic damage than is muscle ; unless the blockage is so peripheral that muscle largely escapes, the limb may be irretrievably damaged even though the skin remains viable (Cases 4, 5, and 6).

It is obvious, then, that acute complete limb ischaemia has a short time limit beyond which return of circulation is useless and may be dangerous ; to restore blood-flow to the ischaemic area may rob the general circulation of much fluid by local extravasation and may release toxic materials into the blood-stream. Unfortunately the time limit cannot be defined categorically. Griffiths (1948) stated that "little good can come from attempts to relieve total ischaemia of 12 hours' standing." Our experience in the present series and in cases of embolectomy supports this conclusion, and suggests that even shorter periods may cause irreversible damage when the ischaemia is indeed total. However, since a trickle of blood may be reaching the periphery through collaterals, some latitude may be permitted short of endangering life from "tourniquet shock." We believe that this latter risk is small in healthy adults, but may be significant in the elderly, especially when circulation is restored to a large volume of ischaemic tissue. Though in some instances late restoration of blood flow may appear to precipitate a moist gangrene, this does not seem in our cases to have led to amputation at a higher level than would have been necessary in any event. Nevertheless, it is a possible danger that must be kept in mind.

Causes of Failure

There were only two causes of failure in this small series—extensive soft-tissue injury and undue delay in reopening an occluded main artery. The former may offer an insuperable barrier to recovery, but the latter should not.

The Factor of Soft-tissue Injury

Whenever the main artery to a limb is sacrificed, gangrene or residual disability is a significant risk, which varies with the level of arterial occlusion. Useful survival of the limb may be possible but cannot be relied upon, and at some levels—for example, the popliteal artery—the risk is critical (DeBakey and Simeone, 1946). The danger exists even with elective ligation ; in traumatic cases it is increased by soft-tissue injury. For this, a number of factors are responsible. Thus there may be direct destruction of large areas of muscle, often with superadded infection. Widespread interruption of small vessels will affect the collateral circulation and can of itself cause ischaemia even though the main channels survive (Case 6). Finally, compression due to traumatic oedema may hamper the collateral circulation still further.

It follows, then, that if there is extensive soft-tissue trauma the effects of acute ischaemia are aggravated, and may in some cases become irreversible. Irreversibility should not be assumed too readily, however. The existence of soft-tissue injury should rather underline the urgent need for restoration of the circulation if the limb is to have the best chance of survival.

The high incidence of mangling and crushing injuries in our small series may have been an unfavourable

prognostic factor compared with other series, military and civilian, in which missile injuries and knife wounds predominate (Jahnke and Howard, 1953 ; Hughes, 1955 ; Morris, Creech, and DeBakey, 1957). However, the major cause of failure in our cases was delay.

The Factor of Delay

The situation in acute traumatic ischaemia is analogous to having a tourniquet on the limb. Treatment must be appropriately urgent.

As a technical procedure, restoration of blood-flow in the major arterial channels can be achieved even after considerable delay (Cases 1, 3, 4, and 5). The crux of the problem is that the circulation must be re-established during the all-too-brief period of viability of the ischaemic tissues, of which muscle is the most sensitive.

Some delay may be unavoidable if the patient's life is in danger from multiple injuries ; resuscitation obviously takes priority over local treatment of the limb. In this respect restoration of a good general circulation by replacement of blood volume is of great importance ; not only will the collateral circulation be benefited thereby, but the actual recognition of local ischaemia may be difficult or impossible during shock. *Avoidable* delay may occur in cases of established ischaemia for various reasons. Perhaps the commonest is what Griffiths (1948) aptly calls " an attitude of wishful thinking." It is compounded of the fear of doing harm by exploration and the hope that improvement may follow conservative treatment. Both the fear and the hope are misleading. In competent hands (and the number of surgeons with vascular experience is increasing rapidly) operation is unlikely to jeopardize the chances of survival of the limb ; indeed, it may be wiser to explore than to observe the borderline case. The hope of spontaneous improvement, on the other hand, seems to rest principally upon two fallacies—that most major arteries can be interrupted with little risk to the limb, and that arterial spasm is a frequent cause of traumatic ischaemia. Of these two misconceptions the former has been discussed already. The latter, since it is of great importance, is considered here in detail.

We believe that there is erroneous emphasis on the role of " spasm " or " stupor " of the artery in the production of traumatic ischaemia. From experience with many different types of arterial case we feel that this has become a *mystique* which is to some extent based upon imprecise observation. A healthy artery is normally in a state of considerable elastic distension. When occluded, the vessel distal to the occlusion becomes narrow from elastic recoil, and this is often the basis for a diagnosis of spasm. For example, if after embolectomy the distal artery remains contracted and pulseless, it will be found to contain residual " consecutive " clot. Possibly this clot may induce some spasm of the artery containing it, but if the clot is removed completely by retrograde irrigation the " spasm " will disappear and pulsation return. Similarly, an injured arterial segment which is firm and pulseless almost invariably shows mechanical blockage from bruising, thrombosis, and interstitial haematoma, and the artery distal to this is contracted from loss of the *vis a tergo*.

It is significant that in a series of eight cases of supra-condylar fracture of the humerus explored in the Mayo

Clinic for ischaemia the artery was found to be completely torn across in two, thrombosed in two, stretched over the proximal fragment in two, pinched in a split in the bone in one, and impaled on a spicule in one (Lipscomb and Burleson, 1955). In other words, there was in every case a gross mechanical obstruction of the vessel. We do not deny the possible existence of arterial spasm as a cause of acute ischaemia, but feel that it would be wise to relegate it to a less prominent position than it holds in many authoritative writings. In this way waste of time in hopeful but futile spasmolytic treatment would be avoided.

Conclusions

We believe that more of our patients could have been spared amputation (Cases 1, 4, and 5) and the one fatality avoided (Case 3) had arterial patency been restored in the first few hours after injury.

When the distal part of a recently injured limb is cold, pulseless, and of abnormal colour (pallid, cyanotic, or mottled), and especially if there is anaesthesia of the digits, then a dangerous degree of ischaemia exists. Unless simple measures (removal of splints, adjusting the position, for example, of the elbow) produce striking improvement within the hour, intervention as soon as possible is necessary. The presence of muscle contracture (rigor) calls for immediate exploration. Where possible the help of a surgeon specially experienced in vascular work should be obtained, but the procedures are within the compass of any general or orthopaedic surgeon who learns the simple basic techniques in anticipation of such an emergency.

In some equivocal closed injuries an arteriogram may prevent unnecessary exploration, but in most cases direct inspection of the artery at the likely site of damage is the most reliable course. At operation the lowest point of arterial pulsation should be defined. If the artery is found to be severed, the ends should be trimmed and anastomosed. Lateral tears are best treated by excision of the affected segment and anastomosis.

If " spasm " is found, the presence of clot is highly probable. The artery should be mobilized and occluded just above the lowest point of pulsation ; gentle palpation then will often reveal the soft irregularity of clot in the lumen. The clot should be removed through an arteriotomy, and if inspection reveals intimal damage excision of the affected segment of artery is the wisest course. Direct anastomosis may be feasible after resection of segments up to about 4 cm. in length. If the gap is such that there is a risk of undue tension a reversed saphenous-vein graft should be inserted.

In every case, before the anastomosis is made, it is of great importance that all " consecutive " clot be removed from the distal artery. Normally there should be good back-bleeding from the distal stump. If there is any doubt about the patency of the vessel, it should be exposed at a lower level—for example, at the wrist or ankle—and flushed retrogradely, quite forcibly, with heparinized saline via a wide-bore needle or cannula. If this step has been omitted and if the arterial repair fails to restore distal circulation, this retrograde flushing should be performed through suitably placed arteriotomies.

In conclusion, we would emphasize that we do not advocate indiscriminate exploration of arteries on flimsy indications. On the other hand, we have attempted to

define certain rational grounds upon which operation should be undertaken urgently and resolutely.

Summary

Nine cases of acute traumatic limb ischaemia are presented. In spite of the fact that technically successful arterial repairs were performed in the majority, only three of the affected limbs were saved.

The pathology is reviewed and the causes of the failures are examined. Some are unavoidable because of associated soft-tissue injury, but the majority are attributable to simple delay in restoring blood-flow.

The reasons for this delay are discussed. It is felt that the aetiological role of arterial " spasm " in such cases has been overemphasized, to the detriment of their prompt and effective treatment.

A suggested scheme of management is outlined.

APPENDIX

Since submitting this article two further cases of acute ischaemia resulting from trauma have been encountered.

In one patient, a labourer aged 50, the axillary artery had been damaged by an injury to the shoulder. Operation was undertaken about four hours after the injury, and it was found that pulsation in the axillary artery extended down to a segment of narrowed contused artery beyond which the axillary artery was diminished in calibre and non-pulsatile. Exploration showed that continuity of the axillary artery was maintained only by a cuff of adventitia within which lay a thrombus effectively sealing the artery. The damaged portion was excised and the artery reconstructed by end-to-end anastomosis. An excellent result was obtained. In effect, the injury had completely severed the artery, and the ends were held in proximity by the adventitia ; the outward appearances resembled some descriptions of " spasm " of the artery.

The other patient, a labourer aged 52, was first seen 14 hours after a severe crushing injury confined to the thigh. At this time there was complete ischaemia of the leg and foot with gross swelling and contracture of the leg muscles. At operation, traumatic thrombosis of the femoral artery at the adductor hiatus was found ; the clot was removed from within the artery and a good popliteal flow restored. In view of the gross ischaemic damage to the leg, nothing further was done. Over the next 12 days the popliteal artery remained open, but massive septic necrosis of the leg muscles became apparent and the foot showed extensive gangrene, although two toes survived. A below-knee amputation was undertaken, during which a copious blood supply was encountered. In this patient the extensive injuries to the thigh had interfered with collateral circulation, so that occlusion of the main artery had caused almost complete ischaemia for 14 hours. Recognition of this ischaemia and relief by surgery within 6 hours of the injury might have saved the limb.

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INCIDENCE OF CHRONIC ARM OEDEMA AFTER TREATMENT FOR BREAST CANCER

BY

A. H. W. NIAS, B.M., B.Ch., D.M.R.T.

Formerly Radiotherapy Registrar, United Oxford Hospitals

Survival has long been the main criterion of success in cancer treatment. But morbidity should be considered as well as survival time. Five-year survival figures give no indication of the degree of discomfort that patients may suffer during that time. When some of this discomfort can be attributed to the method of treatment itself, full regard should be paid to this possibility when undertaking it. In this series of patients with breast cancer the morbidity due to swelling of the arm has been studied.

Arm-swelling is a common sequel to treatment for breast cancer and is often observed in the follow-up clinic, but the frequency with which it occurs has rarely been estimated with any accuracy. A wide range exists in the figures quoted for its incidence : from 8% (Aird, 1957) to 80% (Lobb and Harkins, 1949). This discrepancy is partly explained by different definitions of what represents a significant amount of arm-swelling.

Aird (1957) says that " arm-swelling is present to a considerable degree in only 8% of patients who survive five years." The definition of " a considerable degree " refers to Devenish and Jessop's (1937) study of 90 patients, of whom seven had sufficient swelling to " render the limb heavy and fatiguing to use, to cause disfigurement, to necessitate the wearing of special sleeves, and to produce undue susceptibility to inflammation."

Holman, McSwain, and Beal (1944) found that 44 out of 100 unselected patients had more than a 3-cm. increase in arm circumference measured 10 cm. above and below the olecranon process. Daland (1950) found than 22.5% had more than 2.5 cm. difference, but this group of 90 patients was selected more from his private than from his clinic practice. In Nicolson and Grady's (1948) review of 905 cases of carcinoma of the breast, 273 patients were surveyed for arm swelling and 36% had " slight," " moderate," or " severe " swelling.

The importance of arm-swelling as a symptom is rarely mentioned. Holman *et al.* (1944) give figures for " good," " fair," or " poor " arm function in relation to the degree of swelling. They point out that a significant degree of swelling may exist without recognition, unless measurements are made. On the other hand, when considering morbidity, the subjective aspect may be more important than the objective. Nevertheless, unnoticed arm-swelling, or swelling that is no inconvenience to the patient, may obviously be accepted in the treatment of breast cancer. Furthermore, subjective evidence is chiefly of individual significance and is not readily susceptible to statistical analysis. The subjective figures in this present series are of doubtful value, therefore, though it is important to consider subjective symptoms in a study of morbidity.