THE SURGERY OF TRANSPORTATION*

BY

Lieut.-Colonel J. P. MITCHELL, M.S., F.R.C.S.

Royal Army Medical Corps, Territorial Army

Officer in Charge Surgical Division, 19th Sn. (City of Bath) General Hospital T.A., and Consultant Urological Surgeon, United Bristol Hospitals and Southmead General Hospital

When I was asked to speak on the "Surgery of Transportation," the subject left me puzzled. Did the title mean the surgery of casualties on the line of evacuation or was it the means by which these surgical casualties were to be evacuated? I pondered on what transatlantic influence had affected our military terminology, and ultimately interpreted the title as meaning the way in which the methods of evacuation and care of the casualty en route have changed in recent years. These changes have produced new problems in themselves and in addition they have to be visualised in the light of a possible mass casualty situation. The latter problem varies from a small atomic shell to the larger thermonuclear H-bomb, but in these large explosions it will not be so much a problem of evacuation as one of collection of casualties. If an H-bomb were to drop on a big city in the United Kingdom the necessary surgery will almost certainly be brought to the incident, not the casualties evacuated to the site of surgery. However, an atomic bomb dropped on our own troops in the field is bound to be small, otherwise it would cause almost as much embarrassment to the sender as to the recipient. If our troops are advancing and casualties are heavy, there is no reason for evacuation, and our medical services can be brought up to the nearest point behind the incident where they can then open up and hold casualties. We also, however, have to face the large numbers of casualties which may occur when the forward units are in retreat or regrouping, a tactical manoeuvre which will probably be necessary when their numbers have been depleted. We therefore have to consider evacuation firstly in conventional warfare and secondly when a small atomic incident occurs.

I intend to deal with the casualties right from the front line, back to the base hospital, with a few observations at each area as seen through the eyes of a surgeon. We must consider the place of forward surgery in the line of evacuation and the transport of the bulky equipment necessary for that surgery, including a few words on the reduction of these loads. Some of the modern methods of evacuating casualties will be described and I shall try to cover briefly the modern views on first aid and forward treatment of shock and burns.

Starting in the battalion area, I recall with some amusement, the trends in shock therapy about the middle of the Second World War. I was taking over a regimental aid post from a battalion medical officer, when a major injury was...
brought in following the burst of an anti-personnel mine. Clearly this injury was sufficient to produce a state of shock within the next few hours. Intravenous fluid had recently been issued even as far forward as the regimental aid post and between us we set up a transfusion. The patient on his stretcher, was then loaded on to a mule with a sitting casualty on the other side of the animal as a counterbalance. The drip bottle was hung on a broomstick fixed vertically to the middle of the pack saddles. The other R.M.O. and I watched with great satisfaction as this quaint procession disappeared over the mountain passes. Nowadays we hope that the patient will always reach the forward surgical unit in good time and well before shock has set in, and that intravenous fluid will not be needed so far forward.

Another occasion I remember as an R.M.O.; I had evacuated a casualty with an abdominal wound and a fractured femur. This was always one of the worst combination of injuries, but the R.A.M.C. orderlies at the regimental aid post were justly pleased with their efforts because the patient had been brought in from a forward position in the dark, trussed up in a Thomas splint and despatched by jeep all within half an hour. It was only a short run to the A.D.S. and not more than another half an hour back to the C.C.S. where two surgical teams were also attached. I had inspected the Thomas splint by torchlight before sending the patient on and was impressed by the excellent immobilisation my R.A.P. corporal had achieved in the dark. Furthermore, the patient's condition was quite satisfactory considering the severity of the injury. Some three hours later, when things were quiet at the R.A.P., I slipped back to the A.D.S. for a chat with my colleagues, only to find my patient still lying there, but by this time he was in a profound state of shock. They were attending to his Thomas splint, "fiddling with it" would be a more appropriate description, because the dressing was heavily blood-stained, which was not surprising and they thought they could do something to improve it. Fortunately they had blood available at the A.D.S. and this was put up, but the patient was quite unfit to move even the short half-hour run on to the C.C.S. In all it was eight hours before the patient finally reached the C.C.S., whereas he could have been back within an hour and a half at the most.

Needless to say, my wrath was unquenchable until the second-in-command of the field ambulance, who was a man of great tact, gave me a stiff whisky, and sent me back to the R.A.P. to cool off.

I quote this case with no reflection on my colleagues as it happened many times on lines of evacuation of casualties, until those responsible for the various staging posts realised the intense value of time. So often they would complain that once the patient reaches the C.C.S. there may be considerable further delay. But that is not the point. Once shock sets in, the patient becomes a bad transport risk, and the object should be to move a seriously wounded patient back as quickly as possible, so that he reaches the forward surgical unit in time to forestall any shock by appropriate intravenous therapy under better conditions than a regimental aid post or advanced dressing station can offer.

There is nothing new in this plea to economise in time. The rapid and smooth
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evacuation of the wounded soldier has long been the ideal sought by military surgeons. We all know the value of every minute saved between the time of injury and the time when initial transport has been completed. Our attention has therefore been focused in recent years on attempting to reduce the number of staging posts and secondly on more speedy means of transport. In the Second World War the field surgical team first made its appearance. This consisted of a surgeon, an anesthetist and half a dozen men who could be attached either to a field dressing station or to a casualty clearing station. They rarely came farther forward in the line of evacuation than either of these holding units, except in the case of airborne field ambulances who had two field surgical teams attached to each field ambulance. It was decided in those days, quite rightly, that surgery could not be brought any farther forward than adequate nursing could be maintained. At that time we were totally dependent on our nursing officers, but gallant as these ladies are, it is impossible to arrange the necessary accommodation and attention in areas farther forward than the field dressing station. I trust that our Q.A.R.A.N.C. officers will not take these words as a slight on their courage, because nothing could be farther from my mind. But thinking on this matter, I asked a Royal Air Force officer in transport command, who was responsible for evacuation of casualties, what arrangements were made for some degree of privacy for the female casualty. His reply was simple. He said that he only catered for wounded soldiers in the forward area. This is only one of many difficulties that arise when we have ladies in the forward areas. The same question was considered in great detail when it was first suggested that Q.A.R.A.N.C. officers, or as they were in those days Q.A.I.M.N.S., were to drop with the parachute field ambulances. Even though there were numerous volunteers, it would have been impossible to make the necessary provision for ladies. Finally we must not forget the danger to the fair sex of leaving them unchaperoned amongst hordes of uninhibited soldiery, who have been leading a violent but otherwise monastic existence.

In the airborne field ambulances there were many other ranks of sufficiently high intelligence to be instructed up to a high standard of nursing. This process of training them came, however, as a rude shock to the surgeon and other medical officers who realised for the first time how little they themselves knew of the first principles of nursing, in fact, the most elementary principles of how to deal with the daily physiological functions. Now the Army is making a great effort to train a large number of male nurses up to the standard of state registered nurse and I believe we have our present Director-General to thank for this laudable plan in the training of the R.A.M.C. other rank. With the help of these men we may yet be able to take surgery still farther forward in the line of evacuation; in fact, I hope that it will be possible in the future to transport our casualties to the surgeon in one or at the most two hops from the regimental aid post.

Two years ago we heard about units called medical collecting units, medical staging units and evacuation hospitals. Nothing has been heard of these units however, since that time, and I have reason to believe that we are back at square
one, in other words we are back with the old field ambulance, though its role and its training will be different. My own belief is that the light field ambulance, modified on the airborne lines, will fit the requirements of modern warfare in every respect. You will recall that I mentioned this at our exercise here in Taunton in 1956, and it was with great satisfaction that I witnessed at the Director-General’s exercise last year the field demonstration enacted exactly on these lines using an airborne field ambulance complete with field surgical teams.

The field ambulance of the future must be capable of collecting, treating and holding casualties for anything up to eight or even ten days. The casualties will then be evacuated by a motor ambulance convoy or aircraft in regular, orderly lifts to the base hospital, after the heat of battle or the immediate chaos of an atomic explosion has passed. This is not a new problem in war and was first experienced in the airborne units when these were expanded up to divisional strength. The situation in this case was anticipated to produce a vast number of casualties, up to fifty per cent of the division, in a limited area and in a very short space of time. All the casualties from one division were to be collected, treated and held by the medical units. With this task in view, considerable modification of the divisional medical services was necessary. Much thought, labour and, above all, experience went into the planning of the airborne medical services and the ultimate conclusion was to equip each field ambulance with two surgical teams and each fighting battalion with more medical personnel who were equally distributed between the companies and the regimental aid posts. As you know, these units coped with vast numbers of casualties occurring in airborne operations. They worked as a team, each one being a cohesive unit, self-contained and self-supporting. The officers and men, including the surgical teams, had trained and worked together and that as we all know is the fundamental basis of an efficient army unit.

The new arrangement of our combatant forces into independent brigade groups suggests a further reason for making the field ambulance even more an integral part of the brigade than it has been in the past. The brigade group must be self-supporting in every respect, even to the treatment, sheltering and feeding of its own sick and wounded. You may suggest that this would be extravagant in personnel, but I would remind you that in the British Army, only 4.9 per cent of military personnel are concerned with medical services as against 9 per cent in the Russian army although their training probably does not reach our standards.

We must now consider what surgery is to be given at this forward point in the line of evacuation. You will recall that three years ago I spoke here on the possibilities of bringing young surgeons forward. I felt that young men were quite capable of doing useful work in the forward area. Since then, however, I appear to have been slightly misquoted. It was not intended to convey the impression that these were inexperienced young doctors with little surgical training, nor was it intended that they should be sent forward without any supervision. These young men, if they are going to be used in the forward areas, require a reasonable training in traumatic units in this country and also...
in other specialist units. When they are ultimately sent forward with the field surgical team as graded surgeons—or in modern terminology, junior specialists—they are then still under the supervision of a more senior surgeon, presumably in charge of the other field surgical team. The senior surgeon is there to give guidance and also to treat the more difficult cases. On the other hand I feel that the skill of the more senior man is wasted on treating many of the smaller, peppering wounds which often take up so much of his time. This is going to be even more important in the future when many of the casualties will be burns, the majority of which could easily be treated by a junior surgeon. The training of surgeons who are going to function in these forward areas requires further thought.

The training of surgeons is not only a problem affecting the junior and relatively inexperienced man, but nowadays affects many of the more senior surgeons as well. Most of those who claim to be general surgeons, and this includes even our professors, are in fact, no longer general surgeons. Many of us who are in even more clear-cut specialties will be expected in the event of war to cope with general traumatic surgery, but few of us these days can claim to see many injuries with the exception of the occasional road accident and then only when our own specialised portion of the anatomy is involved. Our plastic surgeons, orthopaedic surgeons and neurosurgeons have taken most of the traumatic surgery out of the hands of the general surgeon. I would therefore suggest in all deference to my general surgical colleagues that most of us would, in the event of war, require some initial training in traumatic surgery as a refresher course. It would not be out of place if part of the territorial training of all T.A. medical officers and especially surgeons, was devoted to attending burns and traumatic centres. T.A. general hospitals nearly always have an excess of officers at camp and most C.O.s. will, I am sure, agree with me, that it is often difficult to keep them all occupied and entertained, and a visit such as this would be profitable, not only for the individual officer, but for the Army Medical Services as a whole.

One additional factor to consider in forward surgery, is the weight of the equipment. Our logisticians are hammering louder and louder in their efforts to reduce the bulk of equipment that has to be carried by an army. We are rapidly reaching the stage where our forward troops are anchored down by the weight of second echelon. The medical corps must accept part of the blame for this and as a surgeon, I readily admit that we are probably the worst culprits of all. It is therefore very important that we should reduce our requirements to a minimum, both in weight and in bulk. Once again we have much to learn from the airborne field surgical teams. One airborne jeep and trailer can carry sufficient equipment and sterile dressings for two surgical teams to function for 36 hours (Goligher & Wells, 1945). The load included eight folding camp beds, a 4-kilowatt light generator and an operating table. In addition, each member of the team carried a 60 lb. load in a rucksack. To illustrate a few recent developments aimed at this weight reduction, I quote the following examples:

(a) New burn dressings, of which 100 correspond in bulk and weight to
twelve of the old types and these have the additional advantage of being non-adherent, fully absorbent and painless to change as they do not damage new granulation tissues when they are removed.

(b) Intravenous drip bottles and tubing, made entirely from plastic which can be packed into a very small space.

c) A light folding bed designed by R.A.O.C., with a total weight of 23\frac{3}{4} lb.

d) A light field model autoclave of only 2\frac{1}{2} cwt.

e) A light 1 ton shelter measuring 54 \times 20 ft., including petrol-driven heater.

(f) Thackeray's compressed plastic gauze which can be re-sterilised several times.

So far we have tried to shorten the time between the patient's injury and the time at which he reached the field surgical team by bringing the surgery farther forward. We must now cast our thoughts on the more modern methods of transporting the casualty. Baron Larrey, Surgeon-in-Chief to Napoleon's grand army, recognised the importance of speedy evacuation and ordered the first horse-drawn ambulance. This was so much faster than any other means at that time that it was known as the "flying ambulance." Some years later in 1870, during the siege of Paris, sick were transported by aerial means for the first time. An observation balloon was used and this lifted 160 patients from the city (Pillsbury, Macmillan & Artz, 1957). The first time a force was largely dependent on air evacuation for its sick and wounded was in Burma in 1943. When faced with an enemy such as the Japanese, there was an overwhelming need for evacuating all casualties as quickly as possible. Having to abandon casualties under such circumstances would have been a great strain on the morale of the men and their commanders. The lessons learnt in Burma were surveyed in considerable detail by Wigglesworth (1948). He described the various methods used and the tremendous advantages of air evacuation over the long and slow land routes which were sometimes impassable; how during the siege of Imphal, casualties were evacuated at an average of over a thousand per week and how aircraft, used for taking stores forwards, were then adapted to bring casualties back. Where small aircraft could not be landed on airstrips, then other methods were used such as Sunderland flying boats landing on inland lakes or rivers when, for example, the Chindits were surrounded, or on the second Wingate expedition when gliders were used and "snatched up" by low-flying Dakotas. A Wayco glider could be made to hold as many as fifteen sitting casualties or four stretcher cases. He also stated that towards the end of the campaign, aircraft were frequently required at short notice and a small proportion were allotted for the role of casualty evacuation only.

The Americans have their military air transport service and several Convairs are constructed especially for air evacuation of casualties only. This would, however, appear to be wasteful as the normal transport plane should be readily convertible at short notice, by the simple addition of stretcher fittings. In Korea the helicopter was used for the first time to evacuate casualties from forward
areas, and it was an astonishing revelation to see at that time, how safe this form of transport came to be. One would imagine from the appearance and lumbering gait of this aircraft that it would be highly vulnerable in the air, but it was readily manœuvreable and suffered little from attacks by fast-flying jet aircraft. I understand from our R.A.F. colleagues that a helicopter is an extremely difficult target to hit from a jet powered plane. The helicopter really came into its own in the Suez campaign, where they were flown back and forth from an aircraft carrier and casualties were receiving surgical treatment within half an hour of injury. In Korea we were told that the helicopter was hard to obtain and often the delay was long, but I understand that at Suez our medical services received no such complaint.

Air evacuation resolves itself into two distinct types. The short forward evacuation from casualty collecting posts or regimental aid post back to the field surgical unit—in other words, pre-surgery. This evacuation is usually carried out by small low-flying aircraft such as Austers or helicopters. The second type of air evacuation is the longer lift required from the forward surgical area back to the base hospital or from the base hospital back to the U.K. For the short forward evacuation, the Auster is probably the ideal aircraft as this can fly for eight hours and at the end of that time requires only one hour’s servicing. The helicopter, however, is just about the reverse of that economy. I am told that after one hour’s flying, it requires about eight man-hours to service it. Nevertheless, the helicopter can be flown into places where not even an Auster can land, and the larger helicopter, such as the Whirlwind, can do a round trip as far as 300 miles with six stretcher casualties and an orderly on board. Other smaller helicopters, such as the Widgeon, have a range of 150 miles with two casualties and an orderly on board. Small aircraft such as this are particularly useful for evacuation of head injuries and it was in Korea that they were first used for evacuating casualties back to the neurosurgeons. The head injury requires separation from other casualties, not only because of speedy evacuation, but also because such a casualty amongst a number of limb injuries will take away the necessary medical attention from all the other casualties in the aircraft. In Korea special helicopters were attached to the neurosurgical team and the pilots of these aircraft lived with the members of the surgical team. Living with the unit in this way, the pilot soon learnt to be a very useful first aid assistant for the head injury.

The Americans now have helicopter ambulance companies on their army establishment, and they have put forward a good case for training medical officers as helicopter pilots—a scheme for which, I am sure, there would be numerous volunteers, though personally I doubt the value of training a doctor to be an ambulance driver. Neel (1955), describing the use of helicopters in Korea, states that ground to air recognition caused some difficulty. Radio communication with the pilot of the aircraft was much less effective than the use of smoke or visual panels, which were ultimately adopted in all cases.

We now come to the aircraft used for the longer flights. The aircraft still in use in transport command for casualty evacuation is the Handley Page
Hastings. This aircraft will take 32 stretcher and 26 sitting casualties. The stretchers are arranged on either side of central pillars and strapped to these pillars. At present this is the only aircraft which can take any large number of casualties and at the same time is fully equipped to cope with the emergencies which may arise amongst those casualties. The Beverley aircraft, which is probably the ugliest machine that ever took to the air, has also been demonstrated as a suitable aircraft for casualty evacuation, though in practice this has not been used yet to any great extent and it has certain disadvantages which cannot be overcome.

Let us now consider the requirements of an air ambulance. First of all it must have a good wide door for easy entrance for man-handling stretchers into the aircraft. Secondly, it must be adaptable for fixing these stretchers securely. Finally, it must have a comfortable flight and an adequate ceiling to avoid the weather. As regards its internal fittings, it should have a good water supply which is gauged at approximately half a gallon per patient for long hauls. There should be oxygen available which preferably could be tapped at any part of the aircraft near to the patient. There should be good toilet facilities and lighting all down the inside of the aircraft. In addition to these requirements there must be sufficient room for convenient nursing of the patient and a distance between each stretcher above and below to allow for administering bed pans and for the patients to turn for feeding or possibly to vomit. Finally the aircraft should have a small galley for preparation and storage of food.

The Hastings has the disadvantage of lack of pressurisation, which means that it cannot climb above the weather. The Beverley is ill-equipped for casualties as most of the essentials are lacking and its flight is too rough due to the tail whipping back and forth like the boom on a yacht when it is tacking.

Of the pressurised aircraft the only one used so far as an air ambulance is the Comet. This has a narrow entrance and an even narrower door in the bulkhead just behind the entrance, with the result that it can carry only three stretcher cases though the sitting casualties can be numerous. The Bristol Britannia will have all the essentials of a good air ambulance and is being adapted to carry fifty-four stretcher cases in nine groups of six.

The despatch and arrival of patients can be simplified by bringing the hospitals near to the airfields. The Royal Air Force have already planned the despatching end by the establishment of an evacuation unit called the Casualty Aero-evacuation Flight or C.A.E. This consists of three sections, the reception, the holding ward, and the despatching ward where the patients for the next flight are collected and prepared for their journey. On arrival at the other end the reception of the casualties will be speeded up by siting the base general hospital near or on the airfield, so that planes can taxi round the perimeter track to disposal bays near the main surgical wards.

It is impossible in one short lecture to discuss the surgical treatment of all casualties, but there are one or two subjects which have been discussed recently in the medical press and are worth repeating or amplifying here.

The Thomas splint having served us well for many years, has now come
under fire of criticism. It has been described as outmoded by the new American version with an anterior strap and only a half ring. Let me assure anyone who may be in doubt that the full ring of the Thomas splint is still the most effective method of immobilising a limb. The half ring and strap does not fit so firmly on to the ischial tuberosity and the whole splint tends to rotate. Some of the civilian accident units have suggested that the Thomas splint is unnecessary as the damaged limb can be tied to the good limb and the patient moved straight to hospital. These critics do not allow for a long bumpy journey in an army ambulance over somewhat indifferent road surfaces.

The use of morphia in trauma is probably overdone. The severely injured patient does not always complain of pain, in fact that is usually one of his least worries. He may be restless, and morphia is then required to settle him, but when given the morphia should be injected intravenously where possible. So often we have seen the shocked patient given a subcutaneous or possibly an intramuscular injection of a morphine derivative when their peripheral circulation is poor and the drug merely pools beneath the skin. As soon as the shock is relieved, the circulation improves and the drug is absorbed with consequent depression of respiration just at the time when the anaesthetist is about to perform. I would here condemn the "tubonic." This toothpaste tube of morphia has a short needle, which can scarcely reach beyond the subcutaneous tissues. The amount squeezed out is very variable in quantity and it is impossible to give it intravenously. The new cartridge type of syringe to be issued to all regimental medical officers appears to be the safest and most effective means of giving morphia.

New emergency dressings are frequently produced. I have already mentioned the new burns dressing and compared it with the old type. Various ideas were suggested for replacing the old shell dressing, but the quantities stored are more than enough for another war, so I doubt whether anything will supersede them.

Now for a word on the treatment of shock and of burns. Most of you will have read the excellent article by the late Ruscoe Clarke (1957) from the Birmingham Accident Hospital. This summarises the views that most surgeons and anaesthetists have been tending towards in the past few years. It has been well known that when severe collapse followed a major injury, there was an associated fall in blood volume. The amount of haemorrhage visible was not enough to account for the fall in blood volume, and therefore it was assumed that the missing blood must still be in the circulation. But where in the circulation could it have disappeared? We were left with the assumption that the blood must be pooled in the capillaries.

Unfortunately this theory fell down on the failure of this hidden blood to appear, and secondly one had to postulate that only the hidden capillaries dilated, because the surface capillaries went into spasm and emptied themselves of blood as was obvious to anyone who looked at the patient.

The answer appears to be much simpler—the blood volume has disappeared into the tissues around the site of the injury and not into the hidden capillaries. In fact it has not really disappeared into the damaged tissue because, as Ruscoe
Clarke showed, the swelling of the injured tissues is equal in most cases to the actual loss in blood volume.

In this brief lecture I have tried to cover various aspects of forward surgery and the evacuation of surgical casualties. I have purposely omitted discussing the well-tried and proven facts of casualty evacuation and treatment as I am sure most of you here are well acquainted with these facts. I have confined myself to the controversial features about which there is still some doubt.

One last word I would like to add is a suggestion for the training of Territorial medical officers in the near future. I feel we must all concentrate, whether our unit is a general hospital or a field ambulance, on preparing ourselves for the double role, firstly the highly mobile small holding unit and secondly the normal functions for which our unit was originally designed for conventional warfare. Our Director-General has conceived the idea of the field medical company, which in principle is excellent; however, it still is in embryo and has many shortcomings. Our efforts as Territorials should be, not only that of training our units, but of contributing ideas and constructive criticism which can help in overcoming the formidable casualty problems of the future. I therefore suggest that our young medical officers should have discussion groups on this subject, followed by practical layouts and as I mentioned earlier in my lecture, some traumatic surgical training should be arranged for all.

Finally may I take the liberty of saying to our visitors from Whitehall—we have the enthusiasm, will you please let us have the equipment that is not already obsolete, even if it is only on very temporary loan, so that we do not have to plan and instruct in the land of “make-believe.”

REFERENCES