CARE AND DISPOSITION OF AMPUTEE WAR CASUALTIES

A Student Paper Written for the
Communicative Arts Program
U. S. Army Command and
General Staff College

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April, 1971

A B S T R A C T

The guidelines provided to the military surgeon for the management of amputee war casualties are incomplete. A series of 410 case studies of amputees treated at Valley Forge General Hospital is critically reviewed to establish pertinent more complete guidelines. Failures of techniques are identified and related to misguided concepts of management. Techniques within specific categories of amputations are reviewed. The greatest cause for difficulty is the failure to appreciate the negative effects of evacuation. Three principles are presented as guidelines for future amputee casualty management.

(SENTENCE OUTLINE)

CARE AND DISPOSITION OF AMPUTEE WAR CASUALTIES

THESIS: A review of 410 case studies of amputees treated at Valley Forge General Hospital exposes problems of techniques but demonstrates optimal solutions.

I. The experience of World War II and the Korean conflict revealed that specific techniques and guidelines needed to be followed in the care of amputee casualties.

A. Wound debridement must be complete and wounds never closed primarily.

B. Amputation levels should be selected to save maximum length and to salvage all viable tissue.

C. Skin traction should be used to protect against soft tissue retraction and loss of additional stump length.

II. The 410 case studies of amputees treated at Valley Forge General Hospital reflect methods utilized in the initial and intermediate stages of care in forward areas as well as a comparative study of the results of those methods.

A. The Syme's amputations performed in forward areas consistently failed; those defered till arrival at Valley Forge consistently proved successful.

B. Below the knee amputations performed as textbook definitive procedures were not in the best interests of the individual.

C. The very short below the knee amputation stump, when defered to a CONUS based hospital, may be salvaged by plastic surgery or may be successfully converted to a knee disarticulation.

D. The knee disarticulation amputations performed in VietNam resulted in an excessive number of failures.

E. Above the knee amputations frequently required further shortening due to lack of use of skin traction.

F. Upper extremity amputations tolerated early closures better but also suffered from lack of skin traction.

III. Medevac is a significant factor in the treatment of casualties and must be taken into account by the surgeon in selecting surgical technique and wound management.

A. Initial retrieval is much swifter now bringing more severely wounded to more advanced treatment facilities.

B. Intermediate evacuation is traumatic to unhealed wounds, thus there is a variance between the conventional techniques popular in civilian practice and those required of the military surgeon in forward treatment facilities.

IV. The guidelines for amputee war casualty management are redefined.

Introduction

The experience of World War II and the Korean conflict revealed that specific techniques and guidelines were needed in the care of amputee casualties. Every surgeon is issued a copy of the NATO Handbook which outlines effectively the collective experience of military surgeons in the management of war casualties. The chapter on amputations is brief but makes three pertinent points.[4]

The first point is related to surgical technique. Amputation levels must be selected to save maximum length and to save viable though damaged tissues. The author recognizes a tendency of inexperienced surgeons to amputate too high once the awfull decision of amputation has been made.. Often the surgeon attempts to amputate proximal to the severe injury or infection forgetting that a portion of the involved part of the extremity may be recoverable once the more threatening distal aspect has been removed. In addition surgical training centers in this country perform amputations primarily for vascular disease; they emphasize in their teaching definitive levels of amputations established for rapid recovery and prosthetic fitting.[1] This directs the attention of the surgeon away from ideas of strict debridement and salvage of all viable tissue toward ideas of definitive amputations.

The second point relates to wound closure. Primary closure of stump wounds is absolutely contraindicated. This

is the same principle followed in the management of all other war wounds which are debrided and never closed primarily to avoid infection.

The final point is skin traction, but it is not emphasized adequately. It is mentioned to be used after stump closure. Skin traction is not mentioned in the initial management of the open stump. It is not indicated as a means of effecting stump closure without surgery. The inference is that most stump wounds should be closed surgically by delayed primary suture.

A consideration not at all addressed is the relationship between stump wound closures and time of evacuation. The NATO Handbook does recommend delayed primary closure at seven days even if the casualty is still in the forward area. There is no discussion as to possible contraindications to evacuation for some period of time after stump wound closure by means of delayed primary suture. Furthermore, when that optimal time for delayed primary suture, five to seven days, is coincident with an oportunity for evacuation, which should take precedence? It is evident to me that a clarification of the interrelationship amoung these factors, i.e., delayed primary closure of the stump wound, use of skin traction and time of evacuation, is needed.

General Review

Over a two year period from 1968 to 1970, I collected clinical data on 410 amputees treated at Valley Forge General Hospital. During 1968 I ran a general orthopedic ward of which aproximately 10% were amputee casualties from Viet Nam. The Chief of Surgery became concerned that amputee management had become an increasing problem at Valley Forge. Increasing numbers of amputees were arriving. Amputee casualties generally required longer than average surgical care and rehabilitation; they were accumulating in increasing numbers. All the amputee casualties required Medical Evaluation Boards and Physical Evaluation Boards. At that time an administrative backlog caused an even greater accumulation rate. The problem was highlighted by increasing Congressional inquires as to the plight of these individuals.

Within the professional structure of the hospital, the amputee casualties were under the care of many physicians on an individual basis and were within several departments. Amputee care was uncoordinated. Individuals with similar conditions were treated by varying techniques, sometimes, as perceived by the patient, contradictory in nature. No standard procedures could be assumed by nursing or physical therapy staff.

On 1 Feb,1969, I was given the authority to establish an amputee service to direct and supervise the care of all amputees in the hospital. The first three months were con-

summed by organization of the service and development of procedures. It then became evident that our experience was significant and worth recording. The obvious means to do this was to preserve the hospital records for future reference. Unfortunately the records left the hospital at the time of disposition and could not be recovered. Therefore, I established a duplicate research file on all patients available. The file includes serial photographs, photocopies of pertinent xrays, copies of pertinent summaries and progress notes. By the end of June, 1970, the file included 410 cases; it is to that point in time that the following data refers. It is my intent to update the file periodically to include annual questionnaires. This will establish a long term study of amputee casualties and their problems and develop a data base for a comparative analysis of the rehabilitation techniques used. Reliable information of this sort does not exist in the literature today.

Table 1

Admissions to Valley Forge General Hospital of Orthopedic Patients and Amputee Patients; The Percentage Relationship of the Amputee within the Total Orthopedic Group

Year	Ortho	Amp	Percent
1967	1394	103	7
1968	1412	173	12
1969	1192	184	15

An inquiry to the hospital registrar in June, 1970, revealed the data in table 1. Data prior to 1967 was not available to the newly installed computer, and the data for 1970 was not yet complete. Column 1 refers to the calender year. The third column is the total number of amputee patients admitted for that respective year, while column 2 is the number of orthopedic admissions inclusive of amputees. The last column reveals the percentage of orthopedic admissions that are amputees. As can be seen, the number of amputee and orthopedic admissions increased each year, but the percentage of amputee casualties doubled from 7 to 15 percent. Although I do not have the data, it is my impression that there is a slight decrease in admissions for 1970 but a persistence of the relatively high percentage.

Table 2 reviews the groupings of the records that I have so far collected. Group A represents patients who were treated and completed disposition prior to 1 Fe, 1969, when the amputee service was established. This is a selected group rather than a random group since they were problem cases that I was able to recall after their departure. I was able to recover enough information to establish an informative file on only 25 cases for group A. Group B represents the 115 amputees who were still assigned to the hospital at the time that I assumed responsibility for them. Both they and their records were still available for record keeping purposes. However, many of this group had completed their treatment and were merely awaiting administrative dis-

Table 2

Clinical Records of Amputee Patients Treated at Valley Forge General Hospital Collected and Reviewed for Analysis of Treatment Techniques

Group	Number of cases
A[a]	25
B[b]	115
C[c]	200
D[d]	70
Total	410

[a]Treatment and disposition completed by 1 Feb 69.

[b]Arrived before and still in hospital by 1 Feb 69.

[c]Admissions for 12 months, 1 Feb 69 to 31 Jan 70.

[d]Admissions for 5 months, 1 Feb 70 to 30 June 70.

position, whereas the remainder were exposed to the stresses of reorganization, etc. Group C includes 200 amputee admissions for the twelve month period from 1 Feb, 1969, to 31 Jan, 1970. This group is the most significant in reviewing the effectiveness of the techniques I followed, in that all of this group came under my direct management for their entire stay at Valley Forge. The final group, group D, is 70 patients admitted from 1 Feb, 1970, to 30 June, 1970. Their initial care came under my supervision, but the majority are still under various stages of medical care and rehabilitation. Their records are accordingly incomplete.

Table 3 presents a breakdown of the 410 case studies into types of amputations. BK means a below the knee amputation of the leg. AK refers to an above the knee amputation of the leg. U/E stands for any amputation of the upper extremity or arm. M/E means multiple extremity or more than one extremity is lost. This table was compiled to represent the spectrum of the degree of injury the casualties have sustained as well as an indication of the commitment of the medical facility in their management.

Patients in the U/E column represent the mildest of amputation management problems (but not necessarily of the degree of disability of the final outcome). This problem involves partial absence of one arm. This permits the patient to be ambulatory since it is consistent with elevation and protection of the injured extremity. These stumps heal [illegible]

Table 3

Distribution of Amputation Sites

Group	BK[a]	AK[b]	U/E[c]	M/E[d]	Total
A	5	1	6	13	25
B	49	40	14	12	115
C	86	56	25	33	200
D	35	12	12	11	70
Total	175	109	57	69	410

[a]Below the knee amputation of the lower extremity.

[b]Above the knee amputation of the lower extremity.

[c]Upper extremity amputation.

[d]Multiple extremity amputations.

promotes higher morale and a more rapid and optimistic return to normal activities. Very little surgical, nursing or rehabilitative support is necessary. The hospitalization time is usually less than the administrative disposition time. The BK column represents the next level of complexity of disability and management. Having a portion of the leg absent imposes bed rest as the only means by which significant rest and elevation of the limb can be attained. Ambulation and self-care are restricted for prolonged periods which amplifies feelings of anxiety and insecurity. The AK has these same problems as the BK, but the rehabilitation phase is more prolonged and complex. The M/E group is phenomenally complex. The problems of having more than one limb absent is a geometric progression rather than a linear one. The initial constitutional recovery from the severe injury is usually more prolonged. Depression and other forms of anxiety become the next major problem area. Ambulation, self-care and activities of daily living become almost impossible hurdles due to prolonged bed rest, repeated surgery and the complexity of multiple prosthetic fittings. Success requires a fantastic effort on the part of the individual patient and a massive, coordinated, continuing commitment on the part of all the support elements of the amputee service.

The big surprise in this data is the high percentage of multiple amputees. Multiple amputees represented 16% of the total in both groups C and D. Group A reveals the [illegible] with the

majority of this group being multiple amputees. In group B the percentage is lower than the other three groups because at that particular time the hospital policy was to transfer multiple amputees to the Veterans Administration in priority and early in their treatment.

Group B is different as a statistical group than groups C and D. Group B is a distribution based on occurance and accumulation rates combined, wheras groups C and D are based on occurance rate alone. Group A again is an interesting extra group unrelated to either occurance or accumulation.

The incidence of upper extremity amputees was generally consistent with expectation at 12% in both groups B and C but somewhat higher in group D at 17%.

The ratio of BK to AK amputees is unusual. In group B it is 1:1; group C, 3:2 and group D, 3:1. This suggests improving surgical results in salvaging maximum length. It might also be due to a progression of less effective enemy weapons, but this is inconsistent. The low ratio in group B may be distortion due to the accumulation factor. The AK rehabilitation time is longer than that for the BK, and, if both types were kept to the completion of their treatment, the accumulation of BK's would be less than of AK's. However, the policy at the time was to transfer the AK's to the Veterans Administration prior to completion of their treatment and to retain the BK's if there were no complications. The accumulation factor for both AK's and BK's

Thus the ratios obtained should reflect the true incidence ratios.

The Syme's Amputation

The Syme's amputation is recognized as the ideal below the knee amputation.[3] Any patient, who, at the time of initial debridement and amputation, has a viable heel pad, must be considered as apotential Syme's amputation candidate as a final result. Review of all the BK records revealed at least 36 cases which fell within this criterion. Less than 50% resulted as successful Syme's stumps and half of these have partial loss of their heel pad. This is a dismally poor result. Detailed review of these records reveals the reason for this failure and the means to correct this problem.

A 90% failure rate occured when the following steps were followed:

1. On the day of injury surgical debridement included open ankle disarticulation and dissection of the heel pad from the calcaneus.

2. The wound was packed open.

3. The patient was routinely evacuated away from the initial treatment facility.

An 80% success rate with a 90% complication rate, i.e., wound infection and partial heel pad loss, occured with the following technique:

1. On the day of injury surgical debridement included open ankle disarticulation and dissection of the heel pad from the calcaneus.

2. The wound was initially packed open.

3. The patient remained at the initial treatment facility.

4. At 5 to 7 days after initial debridement the patient is returned to surgery by the same surgeon. He performs delayed primary closure or a second stage Syme's procedure.

5. Evacuation occurs 2 to 3 weeks after the last surgical procedure.

A 100% success rate with no complications resulted in seven cases as follows:

1. Initial debridement included removal of only devitalized portions of the foot even in the presence of open fractures of the calcaneus and/or the talus.

2. The wound was dressed open.

3. The patient was evacuated routinely to CONUS.

4. A definitive Syme's procedure was performed under ideal conditions in CONUS.

The key to success or failure lies not with the technical proficiency of the surgeon but with the juxtaposition of definitive surgery with the trauma of evacuation. Dissecting the heel pad off of the calcaneus is no different than developing any skin flap in plastic surgery. No self-respecting plastic surgeon lets a patient with a tenuous skin flap get off his ward until it is satisfactorily secured. The heel pad once taken down is placed in a new position which kinks the posterior tibial artery. When the flap is than immobilized by only a dressing and then subjected to evacuation, loss of the skin flap is virtually guaranteed. When the flap is immobilized by the technique of suture as performed in delayed primary closure or a second stage Syme's

procedure,[3] the results are markedly improved. However, the complications seen after evacuation are still unacceptably high. These include wound breakdown, infection and partial loss of the heel pad. When the hindfoot is left intact, danger of thrombosis of the posterior tibial artery is negligible, and the heel pad survives evacuation without incident.

The original principle of maximizing length avoids this problem. The attitude, so prevelent, that definitive procedures done early will save time, is the source of this problem.

Below the Knee Amputations

The next best group among the BK's are the Syme's failures. Except for the necrotic heel pad, maximum calf length has been salvaged. Debridement has to be repeated to remove the heel pad and the exposed cartilagenous ends of the tibia and the fibula. The stumps then heal after delayed closures or with skin traction alone. Revisional stump surgery can then be scheduled under the optimal conditions of a healthy patient, a healthy stump, a stabilized environment and a medical facility institutionalized to best support this patient.

Including the Syme's, there were a total of 175 patients with below the knee amputations. If I add to these the number of below the knee amputations stumps among the M/E group, the total becomes 230 stumps for evaluation.

The majority of these are mid-calf amputations through the muscular part of the leg where circulation and healing are excellent. The surgical technique is simple. But a majority of military and civilian surgeons insist that, in the uncomplicated case, an early definitive procedure saves the individual time and avoids repeated surgery. By the time such a case reaches the CONUS hospital he should be already healed and quickly fitted for a prosthesis and sent on his way to home and civilian life posthaste. This argument is sensible and convincing especially after seeing several cases which fulfilled these contentions perfectly.

The data presents a different picture. 41% of the mid-calf BK's were surgically closed prior to evacuation to Valley Forge. Obviously, these are selected cases in that the worst cases were left open. The balance of 59% were left open until arrival at Valley Forge. The results of the early closures are that 44% successfully healed per primum whereas 56% failed due to gross infection. The villain again is the trauma of evacuation. These same surgeons and cases would have a less than 10% failure rate in a stabilized environment.

What of the contention that, on the average, time is saved because the successes required nothing more than recovery time and prosthetic fitting. To evaluate this, I computed the hospitalization time from the date of injury to the date of separation after completion of treatment and satisfactory fitting with prosthesis.

closure prior to arrival in CONUS averaged 11 months of hospitalization. This compares to a 9 month average for those left open until arrival in CONUS. The morbidity and loss of time sustained among the failures of the early stump closures far outweighs the benefits accrued to the minority of successes.

Another group among the 230 BK stumps reviewed are represented by 14 very short stumps with 3 or less inches of tibia remaining and inadequate skin to cover the stump end. Of these 6 have retained knee function by the successful use of a pedicle skin flap to replace the deficiency in full thickness skin. Another 7 were converted to knee disarticulation stumps with full end bearing capacity. Only 1 was converted to an AK. I am concerned that there are several AK's who had these two options removed by the initial surgeon. Again the simple principle of maximum length must be paramount. Concepts of definitive amputation surgery has no place in the forward echelons of war surgery.

Knee Disarticulation[2]

I have included in the AK category the knee disarticulation amputation which is by definition not above the knee but through the knee. It is functionally the same since knee action is lost in either case. In this series there were 43 candidates for knee disarticulation after their initial surgery in the forward hospital. The success rate is only 37%. A fantastic 63% failed and as a result were

converted to a higher AK level. This might be entirely excusable had the intent been to maximize length and defer definitive AK revision. Of the failures not one case history suggests this. In fact, every case had flaps formed according to the textbook description of this definitive procedure.

I can make the percentages even worse. 7 of the 43 candidates arrived at Valley Forge as very short BK stumps. Length had been maximized by the initial surgeon. Those 7 had their knee disarticulation performed at Valley Forge with a 100% success rate. This leaves a group of 36 open knee disarticulation attempts in Viet Nam with only 9 successes. Or stated another way, there was a 25% success rate and a 75% failure rate.

The failures were consistently due to marked retraction of what was adequate soft tissue with the cartilagenous femoral condyles exposed and infected. One simple well known technique which can reverse this retraction of soft tissue is skin traction. Skin traction was absent in every case that failed.

Another significant variable in this series is early wound closure. Of the 36 knee disarticulations performed in Viet Nam, 23 were left open and 13 were closed by delayed primary suture. 22 of the 23 left open failed. The one success arrived at Valley Forge in less than two weeks when skin traction was still able to partially reverse the soft tissue retraction. In addition the femur was

compensating for the soft tissue retraction. I think it is correct to say that open knee disarticulation in Viet Nam is guaranteed to fail. Of the 13 cases closed by delayed primary suture, 8 were successful although all were infected. The suture prevented the soft tissue retraction, but, when subjected to the trauma of early evacuation without the assistance of skin traction, all wounds failed.

Success can be close to 100% if this data is utilized in future decisions concerning candidates for knee disarticulation. You must save maximum length. If a portion of the tibia can be retained, even when the knee joint is open, the insertions of the thigh muscles on the tibia prevents marked soft tissue retraction. If knee disarticulation is forced by circumstances, success can be salvaged by: 1, the use of continuous skin traction, 2, the use of delayed primary closure and 3, the avoidance of evacuation until success is established.

Above the Knee Amputations

a discussion of above the knee amputations will always bring an image to my mind of what I saw all too often at Valley Forge. He is usually 21 years old arriving from Japan via Air Force jet. He is exhausted, in pain, sometimes glad to be home, sometimes just depressed. Initial examination reveals the soft tissue of the stump to be retracted with one to four inches of exposed bone pointing out. Once again, an already too short limb must be made shorter.

Something has to be done to avert this complication. My preconceived idea was that skin traction was decidedly lacking. It is technically more difficult to apply skin traction to the AK stump. Of the 185 AK stumps in this series, 122 records were complete enough to analyze this problem. Of this group, 74 never had any skin traction; 27 had intermittent skin traction; only 21 had well applied continuous skin traction. I think this establishes the case without question that skin traction was not effectively utilized.

To continue the evaluation of stump wound closures, I found 58% were left open while 42% where closed by delayed suture. The infection rate in the two groups were equal, 19%. The average hospitalization time in the two groups were equal, 12 months. In the small series of 6 cases where delayed primary closure was used in conjunction with continuous skin traction, 100% healed per primum. Among the open category without skin traction, 12 cases developed osteomyelitis of the distal femur requiring shortening, whereas no osteomyelitis or shortening was required in the closed group.

The big lesson here is skin traction. In the absence of skin traction, the closed technique is on a par with the open technique. The open technique does not reasonably work without skin traction, so osteomyelitis develops requiring further shortening. I contend that with the apropriate use of skin traction, the osteomyelitis rate will

technique.

Upper Extremity Amputations

The upper extremity amputations were consistently much less of a problem. Skin traction was used much more frequently. 72% had skin traction before arrival at Valley Forge. Failure to use it did occur in some cases that needed it and five cases of osteomyelitis resulted. Delayed primary closures were utilized in 39 out of 66 cases with only 3 of these complicated by infection. This 8% infection rate is reasonable and acceptable. The overall results in this group are excellent and may reflect in part the advantages of skin traction. A significant difference is revealed in the management of the upper versus the lower extremity in that delayed primary closure is preferable in the upper extremity but contraindicated in the lower extremity when associated with evacuation.

Medevac - Positive and Negative Effects

Medevac is the difference between the conventional civilian practice of casualty management of traffic and industrial accidents and the casualty management in the military in Viet Nam. Mass casualties could be an additional exception, but the medical facilities in Viet Nam were often strained but never pushed to mass casualty modes of operation. In most every case the Army Medical Department was prepared to provide adequate support [illegible].

The primary influence modern air evacuation has had on casualty management is the amazing speed by which many severely injured casualties are brought to established surgical facilities. This explaines the unusually high percentage of multiple extremity amputees in this series. In addition, this places a greater challenge on our rehabilitation centers to return these individuals to productive civilian life.

The secondary influence of evacuation is very negative. Further rearward evacuation of casualties is mandatory for tactical and logistical reasons. What is not fully apreciated by the majority of physicians is the deleterious effects evacuation has upon casualties. The process is traumatic to all casualties. All physicians receive their training in centers where the accident casualties are managed under stable conditions. Techniques, which work well and are effective under these stable conditions, often fail under the stress of evacuation.

Guidelines Redefined

This series of case studies of amputees demonstrates several necessary changes from conventional techniques. The specific changes described can be covered by three general principles:

1. Save maximum length and ignore conventional definitive procedures which can be defered till such time

as the patient enters a stable environment.

2. When circumstances necessitate commitment to a definitive type procedure, defer evacuation and create a stable environment until success is assured.

3. Use skin traction on all stumps whenever possible.

References

1. Crenshaw, A. H. (ed.), Campbell's Operative Orthopedics, 4th ed., Saint Louis: C. V. Mosby Co., ch 9:709-785, 1963.

2. Katch, J. W., Spittler, A. W. and McFaddin, J. G., Advantages of the knee disarticulation over amputations through the thigh, J. Bone & Joint Surg., 36-A: 921, 1954.

3. Spittler, A. W., Brenan, J. J. and Payne, J. W., Syme amputation performed in two stages, J. Bone & Joint Surg., 36-A: 37, 1954.

4. U. S. Superintendent of Documents (comp.), Emergency War Surgery, Washington: Government Printing Office, 1958.