MEDICAL DEPARTMENT, UNITED STATES ARMY

SURGERY IN WORLD WAR II

VASCULAR SURGERY

Edited by
DANIEL C. ELKIN, M. D.
MICHAEL E. DEBAKEY, M. D.

OFFICE OF THE SURGEON GENERAL
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This volume was prepared by the Historical Unit, Army Medical Service, under the direction of Colonel Calvin H. Goddard, MC, AUS, formerly Editor in Chief; Associate Editor for Vascular Surgery, Helen Orr.

Foreword

The group of historical volumes now in preparation upon the activities of the United States Army Medical Department in World War II constitutes the third series of such works devoted to recording the formal history of that department under war conditions. The first such series, published over the years 1870–88, comprised six ponderous tomes, three of medicine and three of surgery, which appeared under the title *Medical and Surgical History of the War of the Rebellion.* The second, following World War I, embraced fifteen volumes published in seventeen parts (1921–29). This series was entitled *History of the Medical Department of the United States Army in the World War.* Two volumes of the seventeen dealt with surgical matters.

The present treatise, Vascular Surgery, is among the first of the third series to receive publication. It will offer mute but convincing testimony to the vast progress recently recorded in the field whereof it treats. Not that vascular surgery, per se, is a new phenomenon. In its simplest form, ligation, it was practiced in the American Civil War on a great many more occasions than is generally known. Thus, in 672 recorded operations for wounds of the face alone, no less than 69 involved ligation of an artery or vein—the common carotid artery figuring in 55 of these. Based on cases whose dispositions were known, mortality for the entire series was 65 percent, for cases involving the common carotid about 72 percent, and but 6 of the 65 patients operated upon (3 of these, common carotid cases) were later able to return to duty.

Despite the amount of space accorded other surgical specialties in our World War I medical history (e. g., 535 pages on neurosurgery in one of the surgical volumes), vascular surgery is there dismissed with a single paragraph. As a result, the meteoric expansion of activity in that field to the point where its adequate discussion in World War II records calls for an entire volume, becomes especially significant. Truly, vascular surgery has come of age.

GEORGE E. ARMSTRONG
Major General, United States Army
The Surgeon General

Preface

The history of injuries produced by war wounds is in effect the history of surgery. A surgical record of World War II is therefore no innovation except that certain features are now for the first time receiving substantial recognition and treatment. One of these features concerns vascular surgery.

This volume does not purport to be a complete record of casualties with vascular injuries in World War II. Data from many of the theaters of operations are unavailable—notably China-Burma-India, Southwest Pacific, and Pacific Ocean Areas, and records from the North African, Mediterranean, and European theaters are far from complete. Under battle conditions, the existence of vascular injuries was often masked by more extensive injuries to bone and soft tissue. Furthermore, many deaths on the battlefield which might rightfully have been attributable to wounds of the major arteries were not so recorded.

This volume *does* purport to give a reasonably complete accounting of complications which followed combat-incurred vascular injuries in casualties evacuated to the Zone of Interior. It also includes an accounting of peripheral vascular disorders observed in Army personnel during World War II, with the exception of trenchfoot, immersion foot, and cold injuries, which will be discussed in a separate volume in the Medical History series.

The principles of vascular surgery have been established for many years, and in the interim between World Wars I and II many significant technical advances were made. Vascular injuries, however, are relatively infrequent in civilian life, and few surgeons, even those particularly interested in the subject, had had a large experience with them.

The problem of supplying competent specialized care for the numbers of casualties with these injuries was, therefore, a difficult one. It was solved in World War II by the establishment of three vascular centers to which surgeons experienced in this specialty were attached.

It is to the credit of Surgeon General James C. McGee and his successor, Surgeon General Norman T. Kirk, that these centers were inaugurated soon after the first casualties began to arrive in this country. The chief consultant in surgery, Brigadier General Fred W. Rankin, by his untiring efforts in securing and holding trained personnel and in procuring proper equipment, was responsible in a large measure for the success of this undertaking. In this he had the understanding aid of his assistants, Colonel B. N. Carter, MC, and Colonel Michael E. DeBakey, MC. For the first time in history there was a concentration of clinical material under the supervision of specialists who could carry out concurrently definitive treatment and important phases of clinical investigation.

As a result, knowledge regarding the circulatory system has been extended and interest has been generated in a field which, though long recognized, has attracted few workers.

The lessons learned, as reflected in the low mortality rate and the remarkable functional results achieved in these centers, came not by chance but through careful planning and execution. Those who had part in it prayerfully hope that these lessons will not soon be forgotten.

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28 May 1954.

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CHAPTER I

Specialized Centers for the Management of Vascular Injuries and Diseases

*Daniel C. Elkin, M. D.**

The arrest of hemorrhage and the preservation of an adequate arterial supply to injured extremities have been the primary concern of military surgeons in all the wars of history. In each successive war the relative number of vascular injuries has steadily become larger because the development of weapons of increasingly higher velocity has magnified the chances of vascular trauma.

During World War II, as a result of widespread use of weapons of such type, multiple wounds were more frequent. Dozens of nonfatal wounds were often observed in the same casualty and as high as two hundred wounds have been recorded. Furthermore, while case fatality and amputation rates were high in injuries of the major arteries, improved methods for the control of hemorrhage, shock, and infection greatly decreased the incidence of death and mutilation and increased the numbers of casualties who lived with possible post-traumatic complications.

The medical records of World War I supplied almost no information about vascular injuries in American military personnel. Early in World War II it became evident that this type of injury was likely to be frequent and would create grave problems. While the principles of vascular surgery had been established for many years, and prior to the outbreak of World War II many significant advances had been made in this field, the fact remained that wounds of this type occurred infrequently in civilian life and that surgeons with extensive experience in this specialty were few.

ESTABLISHMENT OF VASCULAR CENTERS IN THE ZONE OF INTERIOR [1]

The problem of supplying competent specialized care by experienced personnel for large numbers of casualties with vascular injuries was solved in World War II by the establishment in the Zone of Interior of vascular centers [2] to which surgeons experienced in vascular surgery were attached and in which

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[1] Unless otherwise specified, all data contained in this chapter are derived from reports prepared for this purpose by J. W. Kahn (formerly Captain, MC, Ashford General Hospital), H. B. Shumacker, Jr. (formerly Lt. Colonel, MC, Mayo General Hospital), and A. H. Storck (formerly Lt. Colonel, MC, DeWitt General Hospital).

[2] WD Memo W40-14-43, 28 May 43.

other surgeons could be trained. To these centers were sent patients with vascular injuries and diseases.

The establishment of these centers made it possible to carry out the necessary treatment of such patients with an economy of equipment, personnel, and effort which would have been impossible had the patients been scattered through a large number of hospitals. It also permitted the observation of patients with vascular injury and disease in numbers far beyond those of any similar previous experience. Careful and detailed records were kept and analysis of data derived therefrom permitted deductions and conclusions which could not be gained from the small series of cases previously observed by surgeons in civilian practice.

The first vascular centers to be activated were located at Ashford General Hospital, White Sulphur Springs, W. Va., and Letterman General Hospital, San Francisco, Calif. These centers were established by a War Department memorandum dated 28 May 1943.[3] The former center continued in operation throughout the war and was not deactivated until 30 June 1946.[4] The author of this chapter served as chief of the vascular surgical section throughout the period of operation.

The vascular center established at Letterman was active until 23 December 1943 [5] and the patients on the vascular ward at the time were transferred to Torney General Hospital, Palm Springs, Calif., which had been officially designated a vascular center 17 December 1943.[6] Lt. Col. Russell H. Patterson served as chief of the center during the 7 months period of activity at Letterman. Torney General Hospital continued to house the vascular center until 12 June 1944 when DeWitt General Hospital, Auburn, Calif., was officially designated as a hospital to which patients with vascular disorders should be sent.[7] Capt. (later Major) LeRoy J. Kleinsasser served as chief of the vascular surgical section at both Torney and DeWitt General Hospitals.[8] He held this position until May 1945 when he was succeeded by Maj. (later Lt. Colonel) Norman E. Freeman who served until the center was deactivated.[9]

Early in 1944 the influx of patients with vascular disabilities from the European and Aleutian theaters reached a point where it became necessary to establish another center for patients with vascular disorders. A third vascular center was therefore designated at Percy Jones General Hospital, Battle Creek, Mich., 12 June 1944.[10] This center was active only a short time for on 25 August 1944 Mayo General Hospital, Galesburg, Ill., was designated a vascular center and all patients and personnel were transferred from Percy Jones to

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[3] See footnote 2, p. 1.

[4] Final Rpt, 1946, Ashford General Hospital. HD.

[5] Annual Rpt, 1943, Letterman General Hospital. HD.

[6] Ltr, Gen Somervell to CGs all SvCs and MDW, 17 Dec 43, sub: Hospitals designated for specialized treatment. SG: 323.7–5.

[7] WD Cir 235, 12 Jun 44.

[8] Annual Rpt, 1945, DeWitt General Hospital. HD.

[9] Ibid.

[10] See footnote 7 above.

Mayo General Hospital.[11] The vascular center at Mayo continued in operation until 17 October 1946 [12] when it lost its designation. Lt. Col. Harris B. Shumacker, Jr., served as chief of section in this center during its entire period of operation.

ORGANIZATION

Although the vascular centers were briefly conducted as specialized surgical sections attached to the surgical service of the hospitals in which they were located, they soon became, for all practical purposes, independent units.

The organization was not precisely the same at all centers though it was always based on the principle that medical and surgical specialists should be in constant consultation with each other and should collaborate in the management of individual patients.

Organization at Ashford General Hospital. At Ashford General Hospital, at Torney, and at DeWitt during most of its period of operation, all patients with vascular disorders were assigned to the vascular surgical section. At these centers, when circumstances permitted, the following organizational setup was considered ideal:

A surgeon in charge of the center with wide experience in the field of vascular surgery. He performed most of the operations, was responsible for all administrative, medical, and surgical policies (in conformity with existing directives), and supervised all medical and surgical treatment.

An assistant surgeon, an experienced general surgeon, with fairly wide experience in vascular surgery. He supervised the center and carried out surgical procedures in the absence of the director.

Two medical officers with a thorough grounding, through training and experience, in the physiologic concepts of vascular diseases and injuries. They supervised or performed special tests, skin temperature and oscillometric studies, and diagnostic spinal punctures and lumbar sympathetic blocks (in collaboration with the chief anesthetist). At least 2 officers were necessary as it proved impossible for a single officer to appraise the vascular status of more than 4 patients per day.

A physiotherapist to give both diagnostic and therapeutic advice.

An officer to supervise reconditioning once definitive treatment was concluded.

A cardiologist to serve as consultant in appropriate cases and to advise on nonsurgical therapy. (While this officer was attached to the medical service, he was available for consultation at all times.)

A neurologist and neurosurgeon to serve as consultants; the former to attend weekly ward walks during which new patients were seen and the latter

[11] WD Cir 347, 25 Aug 44.
[12] Annual Rpt, 1946, Mayo General Hospital. HD.

to cooperate in the performance of sympathectomies. (These officers were attached to the neurologic service, but were available for consultation.)

Organization at Mayo General Hospital. The plan of operation at Mayo General Hospital differed from that at Ashford General Hospital in that the unit was divided into medical and surgical sections. The general understanding at this installation was that patients with vascular conditions requiring surgical treatment should be admitted directly to the surgical section. All other casualties were admitted to the medical section, from which, after the proper workup, they were transferred to the surgical section whenever surgery seemed indicated. Generally speaking, patients were admitted to the medical section if the diagnosis was trenchfoot, frostbite, thrombophlebitis, Raynaud's disease, peripheral edema, or vasospastic and obliterative arterial disease without ulceration. Patients were admitted directly to the surgical section if the diagnosis included arterial aneurysm, arteriovenous fistula, traumatic lesions of the blood vessels, gangrenous and other open lesions of vascular origin, varicose veins, hemangioma, or venous thrombosis. These policies, while carried out with reasonable consistency, were by no means inflexible. Patients with post-traumatic vasospastic disorders, for instance, might be admitted to the surgical section in some instances and to the medical section in others. The decision depended upon the particular clinical manifestations which the patient presented at the time of his admittance.

This plan was adopted at DeWitt General Hospital in May 1945 and was followed until the center was closed.[13]

Collaboration Among Services

No matter what the details of organization were in any particular center, the management of patients with vascular lesions was always a combined responsibility. The amount of work prevented collaboration in every case, but whenever it was to their best interests, patients were treated jointly by internists and surgeons. They were never regarded as the sole responsibility of one service or the other.

At all centers, collaboration with the department of roentgenology was excellent. The physical therapy and reconditioning department participated actively in the care of patients. Their personnel supervised corrective exercises and gave the special treatments required by patients with cold injuries and with trauma to the major arterial stems. When personnel of the physical therapy department was in short supply, as it frequently was, corrective gymnastic exercises were developed by the reconditioning section and were used, as far as possible, as substitutes for physical therapy.

In all centers, full use was made of the occupational therapy departments, partly for reconditioning purposes and partly to supply diversion during necessarily prolonged periods of hospitalization. Red Cross workers also

[13] See footnote 8, p. 2.

participated in the programs at the vascular centers. At DeWitt General Hospital a special ward was set aside for patients who agreed to discontinue smoking as a phase of the therapy. Special privileges were granted to these patients and Red Cross workers were particularly cooperative in providing recreation.

Ward Rounds

Time was saved and effiiciency increased by the coordinated ward rounds held weekly at each center. They were attended by all members of the medical and surgical staffs and by others concerned with the treatment of patients with vascular lesions. At these rounds new patients with problems of special interest or special difficulty were presented, the management of unusual cases discussed and agreed upon, and general policies were explained. Weekly progress notes on each case were also dictated at this time by the section chief. In addition to the ward walks, dry clinics were held at regular intervals.

PATIENT LOAD

Ashford General Hospital

The original allotment of beds for the vascular center at Ashford General Hospital was 50 out of a total bed capacity of 1,875; this was increased as the patient load increased, and at the height of military activity 600 beds were so allotted. Typical of the proportionate distribution of cases was the report made by a representative of the Office of The Surgeon General[14] who inspected the center in September 1944. At that time, of the 241 patients in the vascular section of the hospital, 164 had trenchfoot, 33 had aneurysms or arteriovenous fistulas, 16 thrombophlebitis, 7 thromboangiitis obliterans, 5 Raynaud's disease, 3 frostbite, and 13 miscellaneous vascular conditions.

The heavy patient load carried by the Ashford General Hospital Vascular Center during 1944 and 1945 (Table 1), and the number of operations performed there during those years (Table 2), clearly indicate the wisdom and expediency of concentrating patients with vascular injuries in centers where they can receive highly specialized treatment. The statistics also provided evidence that concentration in these centers of the few available specialists is an economical use of personnel, for under any other setup their particular skills would be dissipated.

Percy Jones—Mayo General Hospitals

Because of the physical limitations of Percy Jones General Hospital, only 28 patients were admitted directly to its vascular section. Another 23 were transferred from other sections of the hospital; 78 were seen in consultation but not transferred. Thirty-eight operations were performed, including 23 sympathectomies and 4 excisions of arteriovenous fistulas.

[14] Memo, Lt Col M. E. DeBakey, Chief Gen Surg Br, Surg Consultants Div for SG, 13 Sep 44, sub: Report of visit to Ashford General Hospital. HD: 730 (Ashford Gen Hosp).

TABLE 1. COMBINED DIAGNOSTIC ANALYSIS REPORT ASHFORD GENERAL HOSPITAL VASCULAR CENTER

[1 January 1944—31 August 1945]

Diagnosis	Number of patients		
	1944	1945	Total
Arteriovenous fistula:			
Anterior tibial	-------	11	11
Axillary	2	7	9
Brachial	6	11	17
Carotid artery and jugular vein	14	11	25
Cavernous sinus	-------	2	2
Cirsoid	-------	2	2
Common iliac	-------	2	2
External iliac	2	3	5
External carotid	-------	3	3
Internal carotid	-------	1	1
Femoral	33	40	73
Parietal scalp	1	1	2
Peroneal	3	6	9
Popliteal	17	27	44
Posterior tibial	-------	10	10
Radial	1	1	2
Subclavian	12	14	26
Temporal	1	2	3
Tibial	14	13	27
Transverse scapular	-------	1	1
Vertebral	1	2	3
Innominate	1	-------	1
Vessels of foot	2	-------	2
Multiple arteriovenous fistulas:			
Femoral, tibial, carotid (3)	1	-------	1
Radial, right and left ulnar vessels (3)	1	-------	1
Two tibial left, one tibial right (3)	1	-------	1
Radial and Brachial (2)	1	-------	1
Arterial Aneurysm:			
Anterior tibial	-------	3	3
Axillary	1	8	9
Brachial	10	16	26
Carotid	2	2	4
Common iliac	2	1	3
External carotid	-------	2	2
Femoral	5	8	13
Gluteal	-------	1	1
Intracranial	-------	1	1
Postauricular	-------	1	1
Posterior tibial	4	8	12
Popliteal	4	6	10
Radial	4	4	8
Subclavian	8	3	11

TABLE 1. COMBINED DIAGNOSTIC ANALYSIS REPORT ASHFORD GENERAL HOSPITAL VASCULAR CENTER—Continued

[1 January 1944—31 August 1945]

Diagnosis	Number of patients		
	1944	1945	Total
Arterial Aneurysm—Continued			
Ulnar	----	1	1
Thoracic aorta	1	----	1
Trenchfoot syndrome	348	634	982
High altitude frostbite	22	2	24
Thrombophlebitis, acute and chronic	156	186	342
Raynaud's disease	37	60	97
Thromboangiitis obliterans	66	98	164
with Raynaud's disease	2	1	3
Arteriosclerosis obliterans	13	19	32
Acrocyanotic syndrome	68	39	107
Secondary vasospasm	61	50	111
Varicose veins	----	15	15
Thrombosis, arterial	4	9	13
Thrombosis, venous	11	11	22
Postoperative ligation of major vessels	21	25	46
Postoperative arteriovenous fistula	6	3	9
Postoperative arterial aneurysm	----	2	2
Postoperative tonic vasomotor spasm	----	1	1
Venous incompetency	----	3	3
Constriction of arteries by scar	----	5	5
Dilatation of brachial artery	----	2	2
Causalgia	2	3	5
Embolic syndrome	1	2	3
Hemangioma	10	10	20
Angioma	2	2	4
Sudek's atrophy	9	2	11
Scalenus anticus syndrome	6	3	9
Periarteritis nodosa	2	5	7
Meralgia paraesthetica	----	1	1
Carotid body tumor	1	1	2
Rheumatoid disease with secondary vasospasm	3	3	6
Venous obstruction	----	1	1
Telangiectasia	----	1	1
Recurrent hematoma, left thigh	----	1	1
Traumatic gangrene of hand	----	1	1
Muscular pseudohypertrophic dystrophy	----	1	1
Veno-vitallium graft femoral artery	1	1	2
Fibrosis of calf muscles secondary to vascular insufficiency	----	1	1
Foreign body in ventricle	1	1	2
in myocardium	1	----	1
Lymphedema, chronic	5	----	5
Scleroderma, diffuse	1	----	1
Vasomotor imbalance	2	12	14

TABLE 1. COMBINED DIAGNOSTIC ANALYSIS REPORT ASHFORD GENERAL HOSPITAL VASCULAR CENTER—Continued

[1 January 1944—31 August 1945]

Diagnosis	Number of patients		
	1944	1945	Total
Vascular reevaluation	152	71	223
No vascular disease	11	24	35
Total	1, 180	1, 547	2, 727

TABLE 2. COMBINED OPERATIVE ANALYSIS REPORT ASHFORD GENERAL HOSPITAL VASCULAR CENTER

[1 January 1944—31 August 1945]

Procedure	Number of operations		
	1944	1945	Total
Excision of arteriovenous fistula:			
Femoral	22	35	57
Popliteal	18	20	38
with resection of fibula	----	2	2
Posterior tibial	15	22	37
with resection of fibula	----	8	8
Anterior tibial	----	6	6
with resection of fibula	----	2	2
Carotid artery and jugular vein	8	9	17
Subclavian, resection of clavicle	7	9	16
Brachial	4	10	14
Ulnar	3	2	5
Carotid	2	4	6
Peroneal	2	6	8
Axillary	2	8	10
with resection of clavicle	----	3	3
Iliac	1	5	6
Profunda femoris	1	4	5
Vertebral	1	4	5
Transverse cervical	----	2	2
Transverse scapular, with resection of clavicle	----	1	1
Superficial temporal	----	1	1
Cirsoid of arm	1	----	1
Vessels of scalp	1	1	2
Vessels of foot	1	4	5
Vessels of hand	2	----	2
Excision of arterial aneurysm:			
Brachial	8	7	15
Subclavian	3	2	5

TABLE 2. COMBINED OPERATIVE ANALYSIS REPORT ASHFORD GENERAL HOSPITAL VASCULAR CENTER—Continued

[1 January 1944—31 August 1945]

Procedure	Number of operations		
	1944	1945	Total
Excision of arterial aneurysm—Continued			
Femoral	6	3	9
Popliteal	1	1	2
Tibial	1	1	2
Axillary	1	3	4
Profunda femoris	1		1
Carotid	1	2	3
Radial		1	1
Cirsoid (1) hand and finger, (2) wrist		2	2
Ulnar		2	2
Endoaneurysmorrhaphy:			
Femoral	5	6	11
Brachial	5	4	9
Tibial	3	3	6
Radial	2	1	3
Axillary	2	2	4
Iliac	2	2	4
Popliteal	2	5	7
Profunda femoris	1		1
Posterior tibial		6	6
Ligation of artery:			
Common iliac	2		2
Femoral	1		1
Internal carotid		6	6
External carotid	8	3	11
Vertebral	2	2	4
Innominate	1	2	3
Superficial temporal	2	1	3
Transverse cervical		1	1
Occipital		1	1
Tibial		1	1
Ligation of saphenous veins	12	28	40
Amputation and debridement of toes and fingers	48	86	134
Amputation of feet	1	2	3
Excision of hemangioma	5	10	15
Scalenotomy	2		2
Excision of subclavian muscle	2		2
Excision of carotid body tumor	1		1
Exploration for lacerated vessels	2		2
Excision ingrown toenail	6		6
Dorsal laminectomy	1		1
Exploration subclavian artery, resection of clavicle		1	1
Suture femoral artery		1	1