Journal of the Royal Army Medical Corps. 1981; **127:** 31-54

HUNTERIAN LECTURE 1980*

A Computerised Data Retrieval System for the Wounds of War

The Northern Ireland Casualties

LT COL M S OWEN-SMITH, MS, FRCS, FRCS(Ed), RAMC

Professor of Military Surgery
Royal Army Medical College, Millbank

John Hunter was an Army surgeon. His service falls naturally into two separate periods, the first when he was commissioned by the Inspector General of Army Hospitals, Robin Adair, in 1760 and he commenced his professional career as a surgeon in the Army for 3 years. The second was as Assistant Surgeon General and then Surgeon General from 1790 until his death in 1793 (Fig. 1).

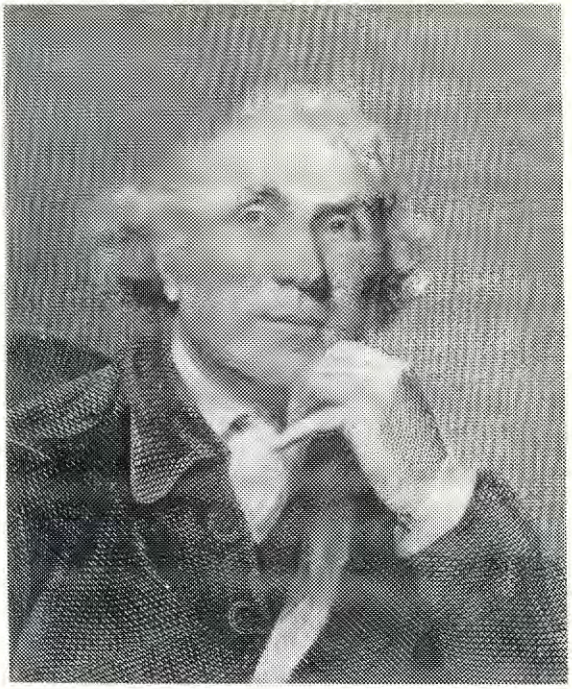

Fig. 1 *John Hunter*

It is probable that he first saw the results of war surgery at Chelsea Hospital where he received his early lessons from William Cheseldon, Senior Surgeon of St George's Hospital and one of the greatest teachers of the day. During his

* Given at the Royal Army Medical College, Millbank on 30 April 1980.

period at St. George's Hospital which he entered as a surgeon pupil early in 1754, he came under the influence of Mr. David Middleton, the senior surgeon who also happened to be the Surgeon General of the Army. It is not unlikely that he influenced Hunter over a choice of career for his immediate future.

In 1759 Hunter contracted pneumonia and recovered rather slowly, his brother James and five other members of his family had died of tuberculosis and so with this rather worrying background he was advised to change his occupation to that of a vigorous life in the Army abroad! There are at least three other good reasons why John Hunter may have enlisted in the Army. To earn his livelihood, to obtain a medical qualification which was possible by performing military service, or to gain surgical experience. It is likely that all three combined influenced his decision. The problems of earning a living must have been a major consideration and indeed much of his letters from Belleisle to brother William were concerned with pay and how he could get more of it! The pay he started on in the latter half of the 18th Century was four shillings a day and it is interesting for me to note that when I joined the Army in National Service days as a Gunner, my pay was exactly the same as his.

Almost certainly the main reason was to gain surgical experience, for the vast majority of surgeons up until a century ago learnt their craft mainly from war service and indeed from trauma in general.

The seven years war with France had been going on for about five years and the Navy, which was blockading the French coast, required a secure base. The island of Belleisle, which happened to be well defended, was chosen and was taken after a three month campaign in which British killed and wounded were about 500. Hunter's experience of gunshot and other war wounds is based mainly on this period. The papers later collected and published as the book called "On the Blood, Inflammation and Gunshot Wounds" were arranged and written at Belleisle in 1762, yet were only published posthumously after a delay of 32 years[1]. Although he wrote to William Hunter that he had "succeeded in all he attempted" what he actually did was not recorded. His practice in treating gunshot wounds he wrote as "different from all others" but we have no means of knowing whether his fellow surgeons at Belleisle would accept that statement. There is no evidence that his methods were markedly different from the practice of the day or that he made any advance in the treatment of these particular wounds, they were essentially conservative as laid down two centuries before by Ambroise Paré. He did make some observations on gunshot wounds which are worth discussing.

He commented that the contusion around the wound was proportional to the velocity and that the higher velocity made the wounded part less capable of healing. He recognised that the contusion of the missile produced a much larger slough than normal trauma and that this slowed healing, and that prolonged time was necessary for the body to liquify and get rid of all dead and contaminated tissue. He persisted with bleeding patients to diminish the body's reaction! He recommended the bringing of the edges of the wound together soon after injury but did not draw distinction between its practice and the results

in minor and major injuries. He deprecated the routine enlargement of a wound to remove a retained missile, loose bone fragments or foreign bodies when the reverse was true of many widely experienced military surgeons before and after him. He opined that the principles of military surgery were just the same as those of general surgery and a wound should not be opened just because it was a gunshot wound, but in compensation for this he did also say "the first great requisite for healing is rest".

In the last chapter he gave detailed instructions for the management of the wounds of different regions of the body. General treatment of the wounded patient was encouraged but note that he was a strong advocate of delayed amputation as opposed to Richard Wiseman's advocacy of early surgery.

On his return he determined to establish himself as a surgeon without giving up his scientific and experimental pursuits. His rise was meteoric and he was a Fellow of the Royal Society within four years and an accepted member of an elite London circle. How did Hunter become famous as a surgeon so quickly after his return from army service in Portugal? Previously he had been a pure anatomist although he had done some surgical dressing at Chelsea Hospital. Undoubtedly he owed much to the confidence and experience he had gained from his Army service.

In the history of warfare some information on battle casualties has usually been recorded. The classical works of Homer on the Greek and Trojan wars described the wounds in some detail together with the weapon used and the result. It is true that some of the hereos were apparently treated by superhuman Deities but the military surgeons were well documented in their treatment of the rest. It is of interest to note that the armorial bearings of our Royal College (Fig. 2) and its predecessor the Company of Surgeons, include features associated with the Armed Services. The supporters represent the sons of Aesculapius, the Greek surgeons Machaeon and Podalirius, the former holding the broken arrow extracted from King Menelaus. The Army is represented by the lion and portcullis and the Navy by the anchor.

The wars of the Middle ages gave rise to much reporting in the literature of the day but the statistics were confined to total numbers killed or wounded, or specific case histories, usually about wounds of important people. Detailed analyses really began in the 19th Century and one of the best examples of this recording is in the three massive volumes of the Medical History of the American Civil War by Otis published in 1870 and 1876. We have copies of this work in our library and one can easily look up the distribution of wounds of the different parts of the body, the weapons that cause these wounds such as musket ball, sabre cut, cannon ball and so forth together with some results.

The medical history of World Wars I and II from the combatant nations record considerable amounts of data on wounds. There are very few finely detailed studies relating to a specific weapon, at an approximate range, hitting a specific part of the body and recording the injuries, the treatment and the results. There are such studies, some from World War II, some from Korea and of course WDMEV — the Wound, Data and Munition Effectiveness study in Vietnam pub-

Fig. 2

lished in 1970. This study, as I am sure those who know it will agree, was the result of a typically American large volume effort and is of a type and detail not practicable in most war zones.

The International Classification of Diseases from the World Health Organisation is not adequate in its application to wounds as not sufficient detail is included. Rutherford and Ferguson in 1975 highlighted these coding problems in attempting to classify injuries in Northern Ireland from the civil disturbances in 1969-1971 and suggested their own modifications and additions purely to cover the injuries received and their cause.

In the last ten years over 2200 soldiers have been wounded and over 300 have died on active service in Northern Ireland. After serving in Ulster on several occasions my main worry as Professor of Military Surgery was that we had no effective means of producing good statistical evidence which would be sufficient to provide an accurate analysis of wounds, their treatment and the end results.

It was felt that in Northern Ireland there is a unique situation in which reliable data can be obtained on the weapon used, the wounds sustained, their treatment and eventual outcome both short and long term. The development of a computerised data retrieval system would enable this information to be used not only as a store but as a research tool. The material would be available to all clinicians or scientists who are interested in wounds but in particular those from military surgery encompassing a number of different disciplines. For example it

could relate the overall morbidity and mortality for different types of wounds or from specific weapons. It would produce killed in action, died of wounds and survivors figures; categorisation of severity of wounds; analysis of regional injuries or of specific systems such as vascular, joint, genito-urinary or brain injuries; could produce meaningful data on problem areas such as blast injuries to hearing and to the lungs, to the relationship of psychiatric sequelae of wounds in general and head injuries in particular. Finally it could act as a model for computerised data retrieval for hospital admissions.

Early in 1976 I started work to develop a method whereby all information about Army casualties in Northern Ireland could be recorded in a simple way that would be acceptable to a hard pressed surgeon and which could easily be transferred for recall on a computer. I was able to produce such a system and then got the co-operation of the Ministry of Defence Statistics Branch who gave enthusiastic help in the planning stages of the development of the coding sheet. Unfortunately it was not possible to get authority for a small team to help with the work of investigating the case notes and the follow up of wounded patients and to place the large backlog of cases on record. Therefore, virtually all this work has had to be done personally and laboriously, which has slowed down the final product as presented to you today.

The system consists of a coding sheet onto which is placed the information that it was felt would be required in the foreseeable future. It consists of four sides of paper, on the first sheet is the identity of the soldier, the date and time of wounding, the time of evacuation to surgery, whether body armour was worn and whether it was struck or penetrated, and the condition on arrival (Table I). Section 2 is the cause of injury divided into various named bullets or generically high or low velocity, high explosive fragments or home made bomb fragments, explosive blast injury, hand thrown or secondary missiles, physical assault, negligent discharge, flame weapons and traffic accidents (Table II). Section 3 is the type of injury, whether it is penetrating or perforating, contusion, laceration, fracture, burns or pure blast injury (Table III). Section 4 is the impact area divided into the traditional zones of head, neck, chest, abdomen, pelvis, upper extremity, lower extremity with the addition of disruption to account for the properties of explosives (Table IV).

The second page consists of specific details of the injury divided into the sections of the body that has been damaged, in some detail (Tables V, VI and VII are examples). In each case the number of the detailed injuries are placed in the boxes 62-77 shown in Table V in order of importance.

The third page consists of the primary treatment in detail, again according to the section of the body that has been damaged (Tables VIII, IX and X are examples).

Page 4 consists of Section 7 — complications (Table XI), Section 8, the duration and stay in hospitals together with the total time. Section 9 is the effect of the injury in the long term, whether the patient died, whether he had any disability and if so what (Table XII). Section 10 was whether the patient was evacuated to UK or not and Section 11 was the final result — whether the

patient died, was medically discharged or returned to duty either fully fit or in some way downgraded (Table XIII). Section 12 was the date of discharge from hospital or death.

All injuries have been classified into four stages — Death, Major, Moderate and Minor. In retrospect, I would have liked to have sub-divided the minor group into minor but significant, and trivial as there have been a large number of relatively trivial wounds. All the information required has been transferred, personally, from the original records, including follow-up data obtained to the present day from AMD Stats. All the information on the HACS Coding Sheet has

Table I
Hostile action casualty system — coding sheet

HOSPITAL NO. HACS NO. INJURY GRADING

HOSTILE ACTION CASUALTY SYSTEM — CODING SHEET

1. **IDENTITY** 1 — H A C S; 5 — 1 4

Surname	8	
Service 1. Navy 2. Army 3. RAF	18	
Service Number	19	
*Rank.....	27	
*Regiment/Corps.....	29	
Date of Injury	31	D D M M Y
Times of Wounding	36	H H M M
Arrival at Hospital	40	
First Surgery	44	

ARMOUR WORN

0 Body Armour (not struck)
1 Body Armour (struck)
2 Body Armour (penetrated)
3 Helmet (struck)
4 Helmet penetrated
5 None

48 ☐

CONDITION ON ARRIVAL

1 Conscious, shocked
2 Conscious, not shocked
3 Unconscious, shocked
4 Unconscious, not shocked
5 Moribund
6 Dead

49 ☐

Table II
Cause of injury

Bullet

01 0.22"
02 0.38"
03 0.45"
04 9 mm
05 0.303"
06 M1 Carbine
07 Garrand
08 5.56 Armalite
09 7.62 FN
10 HV (Unspecified)
11 LV (Unspecified)
12 Shotgun pellets
13 Unknown
14 Multiple
15 Other

HE Fragments

21 Shell
22 Grenade
23 Mortar
24 Mine
25 Bomb
26 Home made bomb
34-44 Bomb Blast by **Size and Distance**

Hand Thrown

60 Brick
61 Bottle
62 Stone
63 Other

Missiles

Secondary

65 Glass
66 Metal
67 Wood
68 Other

Physical Assault

Negligent Discharge

By other person
On self
Flame weapon
Traffic accident

50 52 54

Table III
Type of injury

1 Fracture
2 Penetrating missile
3 Perforating missile
4 Contusion
5 Abrasion
6 Laceration
7 Burns
8 Other F.B. penetrating
9 Pure Blast Injury
0 OTHER

56 57 58

Table IV
Impact area

1	Head	5	Pelvis	59	
2	Neck	6	Upper extremity	60	
3	Chest	7	Lower extremity	61	
4	Abdomen	8	Body disruption		

Table V
Details of injury

CHEST

601	Soft tissue	612	Pericardium	62			
602	Ribs	613	Heart	65			
603	Clavicle	614	Artery, major	68			
604	Scapula	615	Artery, minor	71			
605	Sternum	616	Vein, major	74			
606	Thoracic vertebra	617	Vein, minor	77			
607	Spinal cord	618	Nerve				
608	Lung	619	Pneumothorax, simple				
609	Trachea	620	Pneumothorax, compound				
610	Bronchus	621	Haemothorax				
611	Oesophagus	622	Other				

Table VI

Details of injury
HEAD

101	Scalp	105	Midbrain
102	Fracture simple	106	Cerebellum
103	Fracture compound	107	Concussion
104	Cerebrum	108	Other

Table VIII

Treatment
GENERAL

RESUSCITATION

001	MAJOR	006	Primary closure
002	Minor	007	Delayed closure
003	Wound excision	008	Split skin graft
	Removal of FB	009	Full thickness graft
004	Metal	010	Pedicle graft
005	Other	011	Observation only

Table VII

Details of injury

ABDOMEN and PELVIS

701	Soft tissue	716	Colon, left
702	Diaphragm	717	Colon, sigmoid
703	Lumbar vertebra	718	Rectum
704	Pelvic bones	719	Omentum
705	Spinal cord	720	Kidney
706	Cauda equina	721	Ureter
707	Retroperitonal haematoma	722	Bladder
708	Liver	723	Genitalia
709	Spleen	724	Artery major
710	Stomach	725	Artery minor
711	Duodenum	726	Vein major
712	Pancreas	727	Vein minor
713	Small bowel	728	Mesenteric vessel
714	Colon — right	729	Nerve
715	Colon — Transverse	730	OTHER

Table IX
Treatment

CHEST

			LIGATION OF:-	62			
601	Thoracentesis	613	Major artery	65			
602	Thoracotomy	614	Major vein	68			
603	Suture of Lung	615	Intercostal drain	71			
604	Lobectomy	616	Aspiration of pericardium	74			
605	Pneumonectomy	617	Tracheostomy	77			
	REPAIR OF:-	618	I.P.P.V.				
606	Bronchus	619	Laminectomy				
607	Trachea	620	OTHER				
608	Oesophagus						
609	Heart						
610	Diaphragm						
611	Major artery						
612	Major vein						

Table X
Treatment
LOWER EXTREMITY

901 Fasciotomy

Excision of:—

902 major muscle
903 bone fragments
904 MUA
905 Internal fixation
906 Traction
907 External fixation
908 POP

Marking of:—

909 nerve
910 tendon

Repair of:—

911 nerve
912 tendon
913 artery
911 nerve
912 tendon
913 artery
914 vein
915 Vein graft
916 Exploration of joint
917 Removal FB from joint

Amputations:—

918 mid-thigh
919 knee
920 below knee
921 ankle
922 foot
923 digit
924 OTHER

Table XI
Complications

Infections:-

01 Localised
02 Abcess
03 Septicaemia
04 Osteomyelitis
05 Haemorrhage, reactionary
06 Haemorrhage, secondary
07 Delayed healing
08 Failure to heal
09 Fistula
10 Sinus
11 Wound disruption

Fractures:-

12 delayed union
13 non union
14 mal union
15 Venous thrombosis
16 No complications
17 OTHER

27 | | |
29 | | |
31 | | |

Table XII
Effect of injury

DEATH

01 Dead on arrival
02 Died before specific treatment
03 Died during surgery
04 Died subsequently

45 | | |
47 | | |
49 | | |

Table XII continued

DISABILITIES

		Upper Limb	Lower Limb
10	No disability		
11	Psychiatric		
12	Persistent pain		
13	Hearing loss		
14	Vision loss		
15	Respiratory defect		
16	CNS deficit		
		20 Limitation of movement	30
		21 Peripheral nerve deficit	31
		22 Vascular deficit	32
		23 Structural deficit	33
		24 Loss of function	34
		25 Late amputation	35

Table XIII
Result

Returned to duty:- 52 ☐

1 No disability
2 Downgraded
3 Light duties
4 Change of jobs

Lost to Military Service:-

5 Medical Discharge
6 Died

then been put on to computer by one of two computer programmers using the AMD computer. The information has been recalled regularly to check on the effectiveness of the system and to answer specific questions. The first analysis was done at 1000 cases and the second analysis at 2000 cases (up to 1977). The follow-up has been good as, thanks to MOD Stats, we were able to follow-up almost every patient and the number who have disappeared out of the system is very low. I should like at this point to give my thanks for their help in this project to my secretary Mrs Christine Squires, Dr Oelman, Miss Holloway and Miss Parr of MOD Stats and Sgts Tigwell and Cunningham of the Medical Records Dept of Musgrave Park Hospital.

From the 1st of January 1978 all casualties occurring from internal security duties in Northern Ireland are classified on the HACS system on admission to hospital. Copies of these reports get sent to the Professor of Military Surgery. If the patient has been treated to completion and follow-up in Northern Ireland, then the completed HACS sheet arrives. If not then a copy of the report completed to date is sent and the original is evacuated with the patient to the definitive hospital in the UK. When treatment has been finalised or the patient has died then the form is completed and sent on to Millbank. Double checks exist with lists of all injured produced by the Medical Records Department of Musgrave

Park and lists produced by AMD Stats, so that there are several fail safe mechanisms to try and gather in all wounded patients.

The initiation of the HACS form has been made the responsibility of the Consultant in charge of the case and there is little doubt that the influence of filling in the coding sheet has resulted in an improvement in the standard of the information recorded on the medical summaries on wounded soldiers.

There has to be a cut off point for making final assessment, most patients will have completed their treatment and a final assessment can be made by the end of 3-6 months but some cases may need follow up for 18 months before a final decision as to retention within the Service may be made.

The information acts as a data bank on specific injuries from the weapons of war, their treatment and the final results.

Specific case histories can be recalled in order to provide information and to follow up patients with specific wounds or who have been injured by specific weapons. The printout from the computer in these cases is shown in Table XIV.

Table XIV

Computer recall of record

Area—14 Name—**Pearson C. G.** Service—2 Serv. No.—24213849
Rank—31 Regt—21 D.O.I.—07082 Times—2030, 2045, 2115
Armour—0 C.O.A.—1 C.O.I.—08 T.O.I—3
Imp. Area—7 Details—910, 922, 924, 907, 908, 902, 901
Treatment—915, 914, 902, 906, 002, 003, 007 Comp—16 D.O.S.
030, 001, 254, 285 E.O.I.—33, 30, 34 Medevac—1 Result 5
Discharge—180573 Grading—MAJOR HACS 344 263072

Computer recall

Name, Rank and Number. Body armour was not struck, condition on arrival conscious but shocked, cause of injury Armalite 5.56 rifle bullet, type of injury perforating, impact area lower limb. *Details*: Fractured femur, severed femoral artery and vein, damaged sciatic nerve, major muscle and soft tissue damage.

Treatment: Saphenous vein graft to artery, vein repaired, muscle excised, skeletal traction applied, wound excision and delayed primary closure. No complications, 285 days in hospital.

Effect of injury: Structural deficit 1 inch shortening. Limitation of movement of knee. Loss of function.

He was evacuated to the United Kingdom, medical discharged on 18 5 73. Grade—Major. HACS No=344. NI No=2630-72.

Northern Ireland casualties — results

Total injuries and deaths

The injuries and deaths giving the totals for each grading are shown in Table XV.

Severity of injury

The severity of the injury may be represented as a percentage of the total injuries as Table XVI. Note that deaths and major injury together constitute 30 per cent of the total whereas minor injuries constitute very nearly 60 per cent. In addition there is a hidden loss to the Service in that medical discharge P8 within two years runs at 8 per cent. This means that there is a total effective loss to the Army of deaths plus medical discharge of very nearly a quarter of all those injured.

Total for each result

In crude terms the results (Table XVII) may be expressed as four grades — Death, Medical Discharge, Medical Downgrading but allowed to continue to serve in the Army, and those with no disability. These figures show that over three quarters of the patients return to full duties.

Cause of injury

The cause of injury (Table XVIII) reflects the type of action that has taken place in Ulster over the last 10 years with regard to the internal security of the country. Bullets constitute very nearly half of all casualties which is an extraordinarily high figure when compared with many other campaigns. We would normally expect about 10-15 per cent of all wounds in battle to be caused by bullets. The vast majority are caused in wartime by fragments from high explosive devices like bombs, grenades, shells and rockets. In this series home made bombs involving both fragments, secondary missiles and blast effects have caused one third of all the injuries and the remainder have been a very high proportion from hand thrown missiles, from assault and from some road traffic accidents as a direct result of violence to the vehicle.

Effects of injury — deaths

The effect of injury (Table XIX) has been either death, some form of disability or return to full fitness. There were 300 deaths of which 214 patients were dead on arrival and thirty died before specific treatment was begun. These were usually patients who had mortal injuries but the speed of evacuation was such that many patients were in hospital in a matter of minutes although they could not be saved. It is from this small group that any future improvements in survival may have to be made. The number who died during surgery or who died subsequently form another even smaller group and the small numbers make it very difficult to show much improvement. Any future improvement will have to come from this small group and will result in a fractional effect on the figures for survival and quality. They represent a post operative mortality rate of 2.4 per cent.

Effects of injury — disabilities

The majority of survivors have no disability, but certain disabilities are shown in Table XX and it is worth drawing attention in particular to the small numbers

TABLE XV

Totals for each grading

Deaths	300	Major	303	Moderate	242	Minor	1155	Total	2000

Table XVI

Severity of injury — 2000 wounded

Deaths	15	30%	42%	Medical discharge P8
Major	15			within 2 years=8%
Moderate	12			
Minor	58			

Table XVII

Totals for each result

Medical discharge	161	8%	23%	No disability	1393	70%
Deaths	300	15%		Downgraded	143	7%

Table XVIII

Cause of injury — 2000 wounded

Bullets	45%	Low velocity	23%
Bombs and fragments	33%	High velocity	22%
Hand thrown. Assault, RTA	22%		

Table XIX

Effects of injury — 300 deaths

Dead on arrival	214	Died during surgery	13
Died before specific treatment began	30	Died subsequently	43

under the heading "Psychiatric", "Hearing and Vision loss". The very real social and welfare problems connected with the 32 patients with a CNS defect, usually a paraplegia can be imagined. Disabilities of the upper or lower extremity were of similar kind. There was a larger number of peripheral nerve defects in the upper limb but a larger number of structural deficits and late amputation in the lower limb.

We always teach that the most important factors in determining the wound and the eventual outcome is not only what hits you in terms of the energy of a missile but where it hits you so that the impact area plays a very important part in determining the outcome.

Table XX

Effects of injury

		DISABILITIES			
No disability	1249	Hearing loss	79	Central nervous system defect	2
Psychiatric	21	Vision loss	49		
Persistent pain	36	Respiratory defect	32		

	Upper Limb	Lower Limb		Upper Limb	Lower Limb
Limitation of movement	58	55	Structural deficit	5	26
Peripheral nerve deficit	25	10	Loss of function	9	9
Vascular deficit	1	3	Late amputation	3	10

Impact area per cent

Bullets in general are much more 'aimed' fire than other weapons. This is reflected in Table XXI which show a very much higher proportion of bullet wounds striking the head, the chest and the abdomen, that is the traditional aiming points, than the projected surface area of the various parts of the body. This is a reflection of the circumstances in Northern Ireland of sniper activity using rifles.

Table XXI

Impact area (percentages)

	Bullets	All causes		Bullets	All causes
Head	14	21	Pelvis	2	1.5
Neck	5	3	Upper extremity	24	19.5
Chest	16	18	Lower extremity	29	23
Abdomen	10	14	Disruption		1

Impact area by bullets — absolute totals

The total work load distributed to the different parts of the body is shown in Table XXII and again the very high figure for head, neck, chest and abdomen reflect this sniping activity. These are the vital areas of the body and although

Table XXII

Impact area by bullets

	High velocity	Low velocity	Total		High velocity	Low velocity	Total
Head	57	69	126	Pelvis	11	8	19
Neck	22	19	41	Upper extremity	67	146	213
Chest	107	35	142	Lower extremity	95	163	258
Abdomen	54	25	79	Total	413	465	878

they usually constitute about one third of the injuries they constitute almost all the patients who die or who have serious disability, whereas the large number of wounds of the extremities are associated with a very low mortality.

Body armour

Body armour (Table XXIII) modifies the type of injury occurring in Northern Ireland. All soldiers wear the body armour which gives excellent protection against fragments from explosive devices and good protection against low velocity bullets. It does not give protection against high velocity bullets and this is reflected in these figures which show the very small number of low velocity bullets that actually penetrate, and most of these cause little damage behind the armour as they had almost been stopped. Whereas there is a very large number, 162 of penetrations by high velocity bullets.

Table XXIII

Body armour

Low Velocity	01	02	03	04	11*	Total	High Velocity	05	06	07	08	09	10*	Total
Struck	2	1	5	0	9	17	Struck	0	0	0	1	1	3	5
Penetrated	0	0	1	2	8	11	Penetrated	3	11	11	35	6	96	162

Impact area v result per cent

The impact area decides the result (Table XXIV) to a very large extent. The vital parts of the head, the neck, the central part of the chest containing the heart and great vessels and the abdomen are all associated with high mortality rates whereas the upper and lower extremities are associated with very low rates.

Table XXIV

Impact area v result

	Downgraded	Fit	Discharged	Died	Total
Head	4	56	7	33%	425
Neck	3	50	12	35%	59
Chest	5	37	8	50%	347
Abdomen	6	41	12	41%	267
Pelvis	0	77	16	6%	31
Upper Extremity	10	80	8	0.5%	367
Lower Extremity	8	79	10	2%	457
Disruption	—	—	—	100%	18

Cause of injury v result — bullets

The type of weapon that caused the injury also modifies the results (Table XXV). In general terms injuries by low velocity bullets have far less severe

Table XXV

Cause of injury v result (bullets)

Bullets	Fit	Downgraded	Discharged	Dead	Total
0.22 inch	10	1	—	—	11
0.38 inch	12	1	1	7	22
0.45 inch	17	3	1	8	29
9 millimetre	14	3	4	7	28
Low velocity	292	38	32	13	375
0.303 inch	1	1	0	5	7
M1	5	1	0	13	19
Garrand	2	0	1	13	16
5.56 millimetre	47	7	11	38	103
7.62 millimetre	14	1	1	8	24
High velocity	104	24	41	75	244
Shotgun	10	1	0	1	12

effects (with mortality rate of 7.5 per cent and invaliding 2.5 per cent) than do high velocity bullets with mortality rate of 37 per cent and invaliding bringing this figure up to 50 per cent.

Cause of injury v results — bombs, blast etc

The remaining weapons that have caused injury vary in their effects from the surprisingly high mortality or severe injury rates of 30 per cent in explosive blast to the low figure for hand thrown missiles and physical assault (Table XXVI).

I propose now to take some of the regions, to describe the present teaching with regard to the management of such wounds, to give the results from Northern Ireland and to try and define whether the treatment is apparently satisfactory or whether it may need to be modified in the light of the total experience.

Table XXVI

Cause of injury v result (bombs etc)

Bombs etc	Fit	Downgraded	Discharged	Dead	Total
21-25 HE fragments	23	2	8	5	38
26 Home made bombs	126	18	20	10	174
30-30 Explosive blast	177	23	21	79	300
60-63 Hand thrown	289	9	6	0	304
65-68 Secondary missiles	98	6	9	4	117
70-72 Physical assault	90	1	0	0	91
90 Flame weapon	12	1	0	1	14
95 Traffic accident	38	6	4	5	53

Number with more than one cause of injury — 466

Head injuries

The essential treatment of penetrating wounds is, as with all head injuries, to maintain the airway and then the wound should be excised involving suction removal of the damaged brain and any fragments of bone or debris that have been sucked into the wound. Dura and the skin must be closed, any bone defects may be replaced later usually by titanium or acrylic cranioplasty. The results show that the prognosis is very much related to the weapon and to the severity of the injury. High velocity bullets are invariably fatal whereas there are a number of survivors from severe injuries from low velocity bullets or fragments, with compound fractures with brain injury. (Tables XXVII-XXIX).

Table XXVII

Head injuries v result

No disability	237	56%	Discharged	29	7%	Total	425 100%
Downgraded	16	4%	Deaths	143	33%		(126 Bullet)

Table XXVIII

Head injuries. Grade v result

	Fit	Downgraded	Discharged	Died	Total	Percentages	
Minor	204	1	3	0	208	49	55
Moderate	16	7	3	0	26	6	
Major	17	8	23	0	48	11	46
Died	—	—	—	143	143	33.5	
Total	237	16	29	143	425		

Table XXIX

Middle and inner ear damage

Eardrum	134	Inner ear	2	VIII nerve	25
Middle ear	7	VII nerve	5	Total	173

Chest injuries

There is a tremendous distinction within chest injuries when the heart, great vessels and mediastinal structures have been damaged. Those with high velocity wounds are invariably fatal. Those with low velocity wounds are usually fatal but there are some survivors (Table XXX). If the lung alone is damaged then this is associated with an excellent prognosis. There have been one or two deaths which are potentially avoidable usually from massive haemothorax which has not been drained rapidly enough. Standard treatment of penetrating wounds of

the chest is the immediate insertion of a chest drain with Heimlich valve to drain the haemothorax and re-expand the lung with connection to an underwater seal as soon as is possible. Thoracotomy is reserved for specific indications such as massive air leak, blood loss in excess of 1-1.5 litre or a defect of the chest wall but if circumstances allow then there is no reason why it should not be done on all high velocity wounds if required.

Table XXX
Chest injuries by cause

	Low velocity bullets	High velocity bullets	Bombs and blast
Lungs	24	110	72
Heart / Aorta	9	52	18

Chest injuries v result

You will see that the overall mortality is 50 per cent (Table XXXI) but almost all of these deaths are associated with penetrating wounds of the heart, or great vessels. Injury to the lung even from a high velocity bullet that has passed through body armour is a relatively innocuous wound associated with an excellent prognosis.

The vast majority of injuries to the lung, the heart, great vessels and mediastinum is from high velocity bullets. One of the reasons being that soldiers are protected to a large extent from damage from low velocity bullets whereas the high velocity bullets penetrate the body armour. This is in striking contrast to the series on civilian patients where the vast majority are from low velocity bullets with a relatively good prognosis.

Table XXXI

Chest injuries v result

		Per cent	Thoracotomy			Per cent	Thoracotomy
No disability	127	37	22	Deaths	174	50	10
Downgraded	19	5	9	Total	347		51
Discharged	27	8	10		(147 bullet)		

Abdominal injuries

Abdominal injuries v result

Again low velocity wounds have a relatively good prognosis whereas the high velocity wounds have a rather poor prognosis. Overall 41 per cent died from these wounds and the vast majority of these were as a result of high velocity bullets (Table XXXII). Those coming to laparotomy, the mortality rate was 31 per cent. Again what matters is the cause of injury. The mortality rate from high velocity bullets is much higher than that from low velocity bullets as obtained in most civilian series.

Table XXXII

Abdominal injuries v result

		Per cent	Laparotomy			Per cent	Laparotomy
No disability	110	41	20	Deaths	110	41	15
Downgraded	16	6	7	Total	267		50
Discharged	31	12	8		(79 bullet)		

Abdominal injuries — organ damaged v result

The organ damaged by the penetrating missile or the explosive blast influences to a great extent the result. Colon and liver are two notorious organs associated with high mortality and morbidity rates (Table XXXIII).

Table XXXIII

Abdominal injuries

Organ damaged v result

	Fit	Downgraded	Discharged	Died	Total
Liver	4	4	5	47	60
Spleen	6	1	2	26	35
Stomach and duodenum	2	2	5	17	26
Pancreas	0	0	0	8	8
Small gut	13	4	7	14	37
Colon	17	5	7	30	59
Genito-urinary	12	3	2	20	42
Major vessel	2	1	6	21	26

Abdominal injuries — operation v result

The result of treatment of those patients who have actually reached hospital alive is influenced by the organs that have been damaged (Table XXXIV). These figures show the crude mortality rates but note that overall, after laparotomy necessitated by penetrating wounds, mortality is of the order of 31 per cent.

Table XXXIV

Abdominal injuries — operative cases

	Downgraded	Died	Total	Per cent mortality
Laparotomy	8	16	51	31
Stomach	6	1	10	10
Duodenum	1	2	5	40
Small gut	8	9	37	25
Colon	6	11	33	33
Liver	5	7	19	33
Urinary tract	3	3	9	33

Upper extremity injuries

Upper extremity injuries (Table XXXV) must be studied in the light of the fact that some 25 per cent of all injuries overall occur to the upper extremity. If soft tissue alone is involved the mortality rate is very low and those who are discharged from the Services unfit, again is quite low. If the injury is complicated by significant fractures or injury to major nerves, arteries or by traumatic amputations then although the mortality rate is relatively low the percentage of those unfit for further service rises. The standard treatment of these wounds is excision of all dead and contaminated tissue and tiny fragments of unattached bone. The results of wound excision have been generally good. I would emphasise that our standard teaching involves the application of a single layer of gauze covered by a very bulky fluffed up gauze dressing, the object of this being to draw the inflammatory fluid out of the wound so allowing the body to deal with the surface infection, which it does extremely well. The dressing is not taken down until the time of delayed primary closure 4-5 days later when the dirty dressing can be thrown into the bucket leaving a clean healthy wound which can be closed by fine sutures or by skin graft or a combination. There is no place for the use of antiseptic packs such as proflavine. These packs prevent the outflow of evil humours from the wound and have undoubtedly resulted in a number of cases where delayed healing occurs. There should be no packing of the dressing so that it acts as a plug, just simple dry gauze and a bulky dressing.

Table XXXV

Upper extremity injuries

		Discharged unfit (per cent)			Discharged unfit (per cent)
Soft tissue	495	7.5	Major nerves	80	42
Fractures — Arm	118	30	Major artery and vein	18	70
— Hand	79	16	Traumatic amputations	16	75
Major muscle	38	3.5	Traumatic amputations		
Tendon	25	16	— fingers	11	33

Lower extremity injuries

The same principles attain as for upper extremity injuries with about 30 per cent of all injuries involving the lower extremities (Table XXXVI). There is a slightly higher incidence of traumatic amputation due to the effect of explosions taking place at ground level in particular from mines. I would emphasise again the same points about wound excision and note in particular that there is no place for the use of metal plates and screws but external fixation devices are acceptable and gentle traction on a Thomas' splint using a Steinman's pin is perfectly adequate for most cases. What happens in limb wound if the treatment

is incorrect? The major threat is gas gangrene and it is this threat that lies behind every high velocity missile wound.

Table XXXVI

Lower extremity injuries

	Discharged unfit (per cent)		Discharged unfit (per cent)
Soft tissue	8	Major nerves	50
Fractures — leg	30	Major artery and vein	47
— foot	11	Traumatic amputations	100
Major muscle	34	Traumatic amputations — toes	15

Arterial injuries v result

I will make no further comment on this in the light of Professor Barros D'Sa's later presentation only to show the bare figures and that we are not at all happy with the eventual results of arterial damage from high velocity missiles (Table XXXVII).

Table XXXVII

Arterial injuries v result

No disability 10	Downgraded	2	Medical Discharge	20	Deaths 106	Total	138

13 vein grafts — 2 deaths, 8 discharged, 3 fit

Genito-urinary injuries

At 42 these form a very tiny proportion of the total number of injuries (2 per cent). The standard methods of treatment of penetrating wounds of the genito-urinary tract have proved totally acceptable in terms of the result. Yet again it has been shown that the only major problems are those of urethral damage which has to be repaired later on by a urologist but the immediate treatment of wound excision, urinary diversion, drainage and suprapubic cystotomy are the principles which should be applied. The GU tract is commonly involved in major multiple injuries which is why the associated mortality is about 20 per cent.

Spinal injuries

A number of cases have occurred when interruption of the cervical cord by a high velocity missile has caused immediate death but there have been considerable numbers of cases who have survived with paraplegia. They commonly have had other injuries and it is an unfortunate fact that a number of these patients die in the spinal unit within the first year from complications as a direct result of the paraplegia (Table XXXVIII). There is confirmation that wounds

Table XXXVIII

Spinal cord injuries v effects of injury

Dead on arrival	15	Paraplegic (discharged P8)	12
Died before specific treatment	2	Paraparesis	1
Died subsequently	6	Total	36

affecting the spinal cord should only be explored if there is an increase in the neurological deficit or to stabilise the spine to make nursing procedures easier.

These then are some of the figures. As is usual in practice with a computer when one uses it as a store to retrieve information there is not much problem as it is a convenience to use it. However, already it has become apparent that there is an incredible amount of information available that can be recalled in a number of different ways. What is needed now is to use the computer perhaps as a research tool to tell us some of the things that we do not know, perhaps to put a finger on certain combinations of injury or certain patterns of medical discharge.

This is only a very superficial view of the crude figures that can be obtained from the Army casualties from Northern Ireland but the development of a computerised data retrieval system has now given us a system which is easy to initiate, record and recall. It is remarkably simple when compared with any of the very complicated methods that have been evolved elsewhere. I would add that we now have authority to give this information to our colleagues in the United States to expand the data base on wounds and in particular for its use in the study of wounds on Computer Man.

I believe that the data is as accurate as we can reasonably attain, it is as comprehensive as I believe we need and is simple enough to use in many different situations. The data is there, it is up to all those who have an active interest in wounding missiles, the wounds they create, the surgical treatment and the end results, to utilise it in whatever way they see fit. I believe it will be of great use.

In his lifetime it was acknowledged that John Hunter was the master whom almost every surgeon should strive to follow and he was described at that time as the "mastermind of the surgical world". He was a meticulous observer and recorder, from these studies he would draw logical conclusions and thus formed the basis of scientific study applied to surgery which has proved so important in training and practice today.

As Surgeon General he brought his vigorous attitude and sharp intellect to bear in cutting out much of the patronage and preferment that existed. He firmly believed that the best man would be appointed without any other considerations, he stated that promotion by merit and surgical experience would improve the service and he was also greatly concerned with establishing thorough training for military medical officers.

The great majority of famous surgeons whose names are familiar to us all gained their experience in military service, and John Hunter whose portrait can be seen in the Officers Mess here at Millbank was one of those. The type of war wound seen in his day was well recorded in the paintings of Sir Charles Bell which can be seen in the library in this College.

I believe that John Hunter would have been pleased to know of the development of the Army Medical Services and their reputation for devoted service to the wounded as exemplified in the motto "In Arduis Fidelis" and by the bronze statues in the entrance hall to the Mess. John Hunter would have been gratified to know that a lecture carrying his name had been given today in a Royal Army Medical College and I am sure he would have been generous in acknowledging his personal debt to his years of service as a Surgeon in the Army.

REFERENCE

1. Treatise on The Blood Inflammation and Gun-Shot Wounds. By the late John Hunter. To which is prefixed A Short Account of the Author's Life by his Brother-in-Law Everard Home. Printed by John Richardson for George Nicol, Booksellers to His Majesty, Pall Mall, London. 1794.

Senior Appointments

Maj Gen T S Hart, QHP, MB, BS, MRCS, LRCP, FFCM, DPH, DTM&H, was appointed Director of Medical Services, British Army of the Rhine, in February 1981.

Brigadier A M Ferrie, CBE, QHS, MB, ChB, MFCM, was promoted Maj Gen, and appointed Director of Medical Services, United Kingdom Land Forces, in February 1981.

Brigadier J P Crowdy, MB, ChB, FFCM, DPH, DIH, DTM&H, is to be promoted to Maj Gen, and appointed Commandant of the Royal Army Medical College, in March 1981.