

WORLD WAR ONE:

THE EVOLUTION OF ABDOMINAL SURGERY FOR TRAUMA

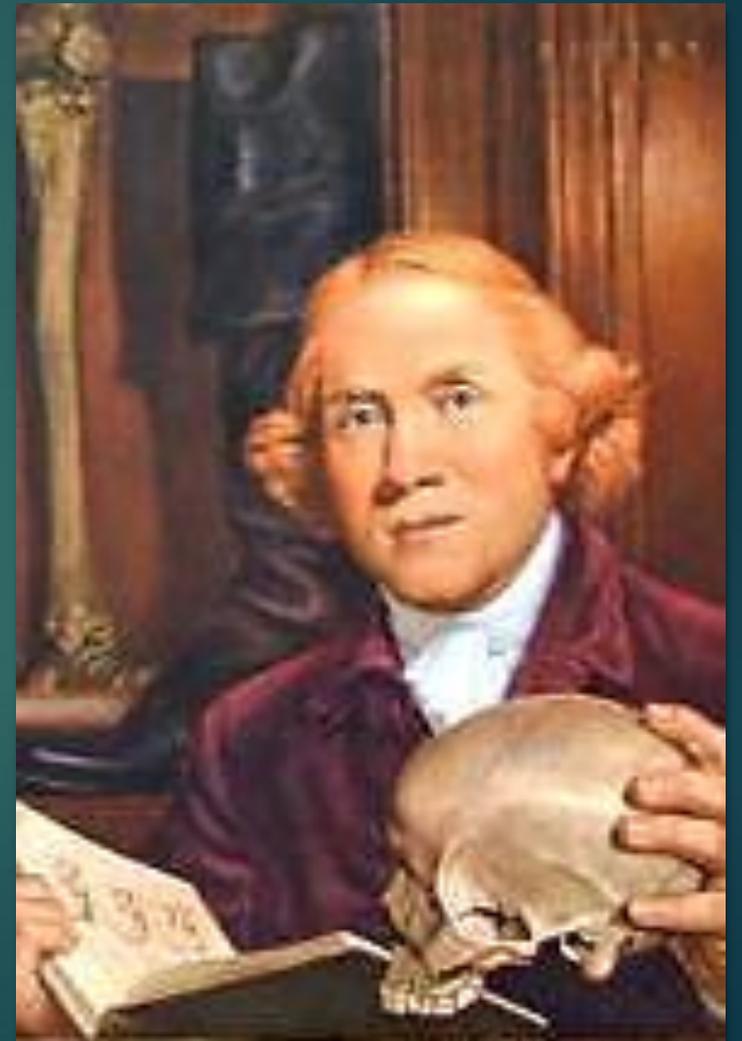
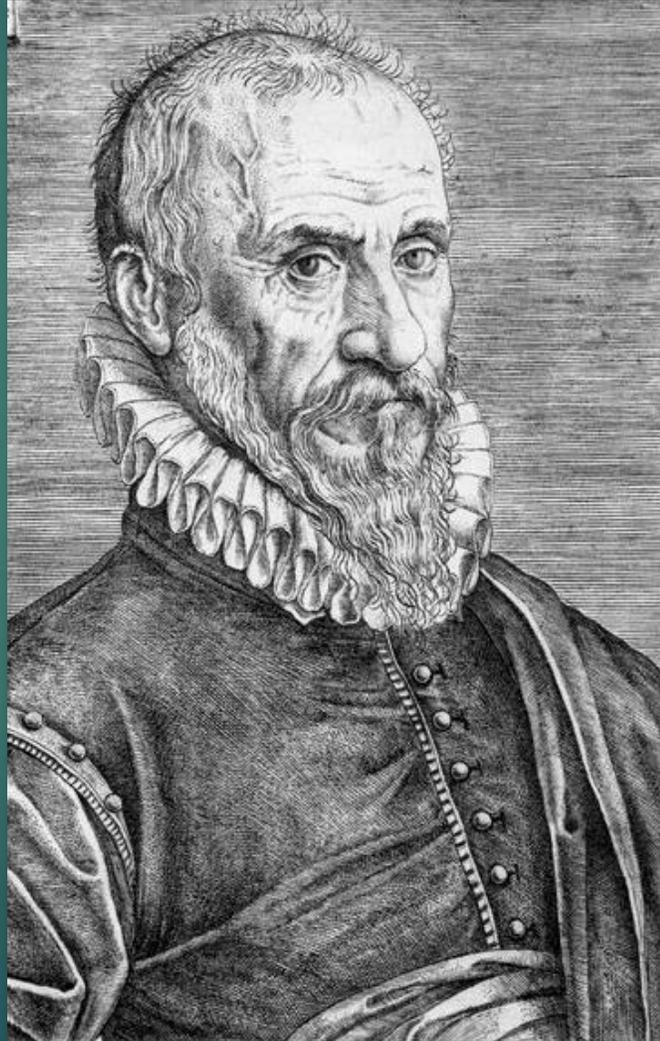
GERALD STULC, MD, FACS(RET), FICS, MFA, CAPT(RET) USNR MC

KEY POINTS, EVOLUTION, WWI ABDOMINAL SURGERY:

- ▶ BRIEF HISTORY, ABDOMINAL SURGERY THROUGH 19TH CENTURY
- ▶ MANAGEMENT, ABDOMINAL TRAUMA, TURN OF 20TH CENTURY
- ▶ INCIDENCE, ABDOMINAL INJURIES, WWI
- ▶ PIONEERS OF SURGERY FOR ABDOMINAL TRAUMA
- ▶ CONCOMITANT ADVANCES AND ABDOMINAL SURGERY
- ▶ DATA AND RESULTS
- ▶ LESSONS LEARNED FOR THE FOLLOWING CENTURY TO THE PRESENT

BRIEF HISTORY, SURGERY FOR ABDOMINAL TRAUMA: PRE-ANESTHESIA/ANTISEPSIS

- ▶ HOMERIC GREEKS
- ▶ ROMANS
- ▶ AGE OF GUNPOWDER:
- ▶ AMBROISE PARÉ (16TH CENTURY)
- ▶ WILLIAM CULLEN (1676)
- ▶ JOHN HUNTER (18TH CENTURY)



“GUTSHOT”

- ▶ Matthew Brady:
- ▶ Battle of Sharpsburg, MD, Dunker Church-After 17 Sep, 1862



BRIEF
HISTORY OF
ABDOMINAL
SURGERY FOR
TRAUMA: PRE-
WWI

POSTANESTHESIA SURGERY
LANDMARKS:

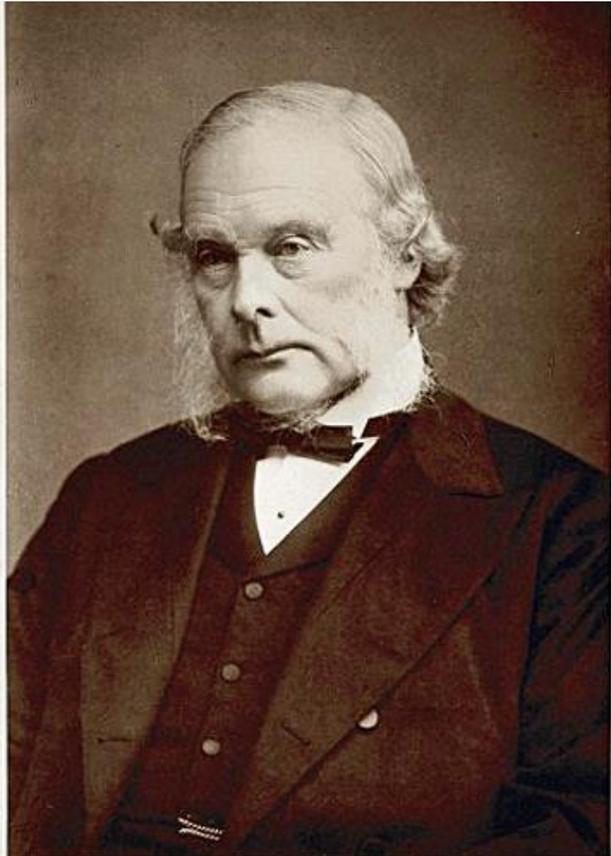
SIR JOSEPH LISTER (1867): ANTISEPSIS

GOODFELLOW (1881): SURGERY for
ABDOMINAL TRAUMA

BILLROTH, CZERNY, MICKULICSZ

PIONEERS OF ABDOMINAL SURGERY, LATTER HALF, 19TH CENTURY:

Sir Joseph Lister



Theodor Billroth



George E. Goodfellow



BOER WAR EXPERIENCE, ABDOMINAL TRAUMA (1899-1902)

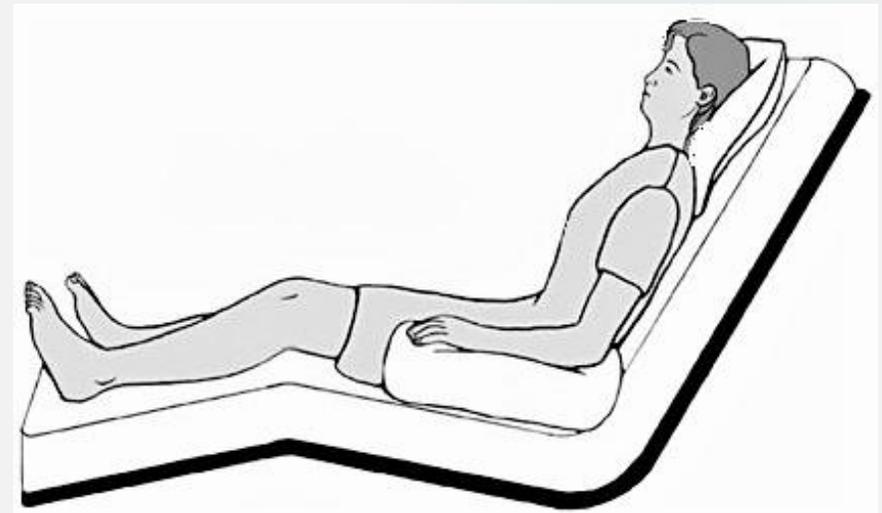
- ▶ TOTAL of 207 ABDOMINAL WOUNDS RECORDED
- ▶ 26 ATTEMPTED LAPAROTOMIES
- ▶ SURGICAL MORTALITY RATE OF 70%
- ▶ APHORISM of SIR Wm MacCORMAC
- ▶ DRY, STERILE SOIL OF BATTLEFIELDS

MILITARY CONSENSUS ON ABDOMINAL SURGERY FOR TRAUMA: 1914

- ▶ AT COMMENCEMENT OF THE FIRST WORLD WAR, MILITARY MEDICAL ORTHODOXY CALLED FOR “EXPECTANT MANAGEMENT”
- ▶ DICTUM CONTRARY TO EMERGING CIVILIAN SURGICAL PRACTICE AND EXPERIENCE
- ▶ >80% MORTALITY WITH EXPECTANT MANAGEMENT OF ABDOMINAL TRAUMA

PRINCIPLES, EXPECTANT MANAGEMENT OF ABDOMINAL TRAUMA: 1914

- ▶ PATIENT PLACED IN FOWLER'S POSITION
- ▶ PATIENT KEPT WARM (STOVE, HOT WATER BOTTLES)
- ▶ NPO FOR THREE DAYS
- ▶ MORPHINE
- ▶ RECTAL SALINE INFUSIONS



VERA GEDROITZ (1876-1932)

- ▶ **RUSSO-JAPANESE WAR**
- ▶ **ADVOCATE OF SURGERY FOR PENETRATING ABD TRAUMA**
- ▶ **SURGERY WITHIN 3 HOURS OF INJURY**
- ▶ **168 LAPAROTOMIES**
- ▶ **RESULTS IGNORED BY THE WEST**



ESTIMATED NUMBER OF MILITARY WOUNDED IN WWI: 22,000,000

- ▶ ESTIMATED NO., ABDOMINAL INJURIES TRANSFERRED BY FIELD AMBULANCE (BEF):
 - ▶ 1.92% ALL INJURIES
 - ▶ ~ 442,000 ABD CASUALTIES
- ▶ ESTIMATED NO., ABDOMINAL INJURIES ARRIVING AT CASUALTY CLEARING STATIONS (BEF):
 - ▶ 0.72% ALL INJURIES
 - ▶ ~ 160,000 ABD CASUALTIES
 - ▶ IMPLICATION → 62.5% OF ABDOMINAL INJURIES DIED DURING TRANSFER TO CCS, DEFINITIVE CARE

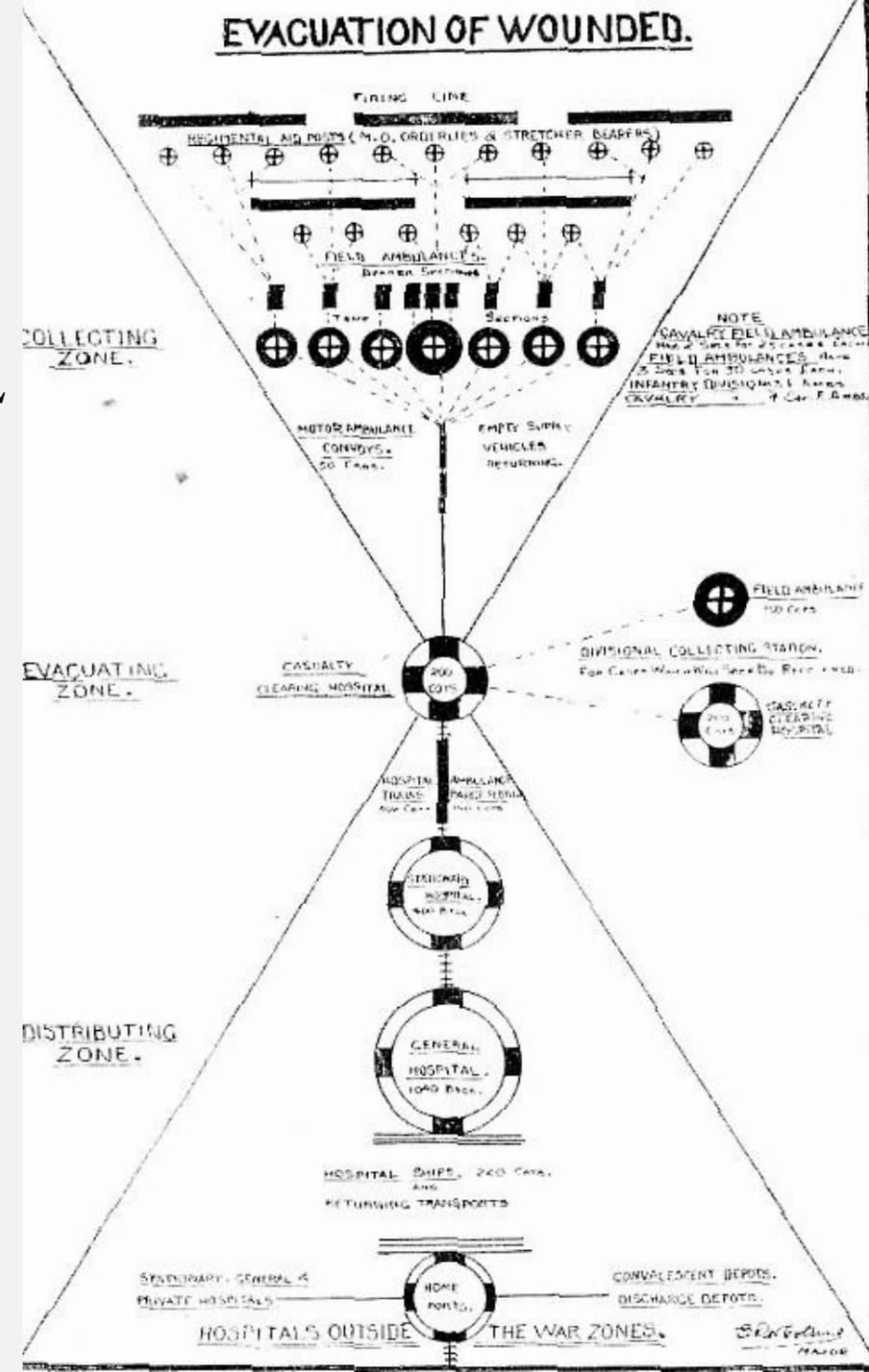
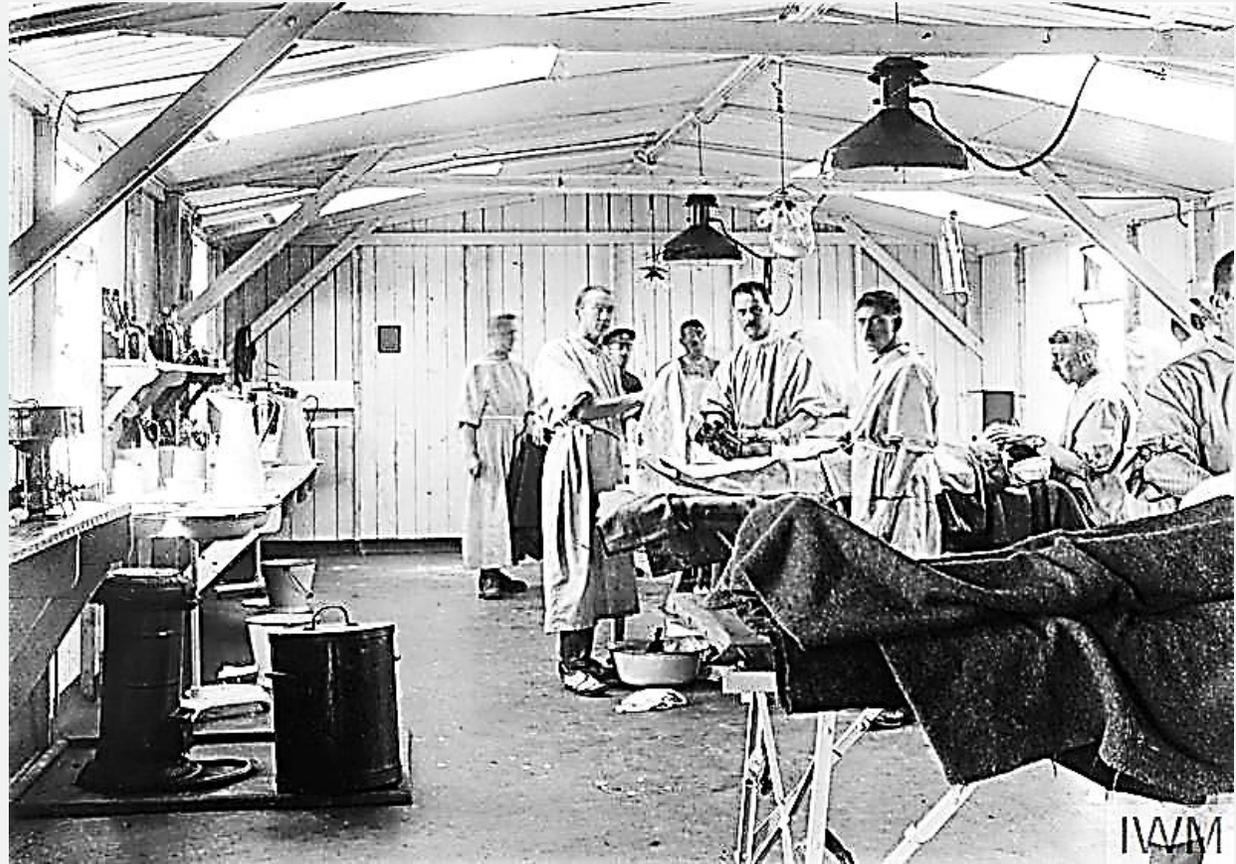
DISTRIBUTION AND CAUSE OF PENETRATING ABDOMINAL WDS, WWI:

ORGAN WOUNDED	BULLET (%)	SHELL/SHRAPNEL (%)	BAYONET (%)
STOMACH	46.2 %	53.8%	0
SMALL BOWEL	15.5	16.2	0
LARGE BOWEL (COLON)	11.9	16.2	0
RECTUM	13.2	2.0	0
BLADDER	3.6	1.0	0
KIDNEY	2.6	6.9	0
SPLEEN	2.6	2.3	0
LIVER	49.5	56.1	0.3

CASUALTY CLEARING STATIONS (CCS):

REGIMENTAL POST → CCS → BASE HOSPITAL

CCS SPECIALIZATION: HEAD and ABDOMEN



CONCOMITANT MEDICAL ADVANCES ENABLING ABDOMINAL SURGERY:

BLOOD TRANSFUSION:

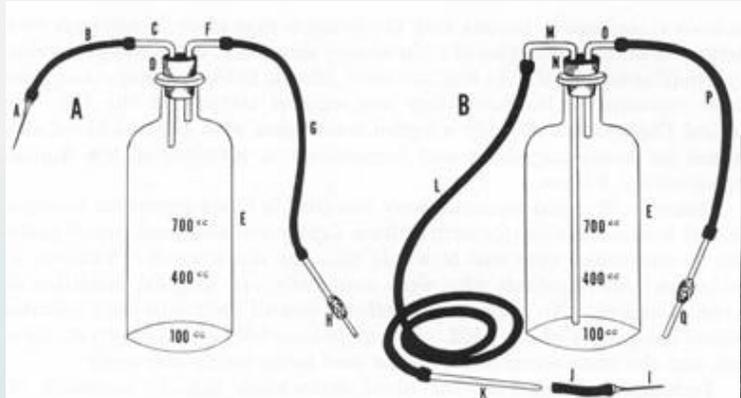


FIGURE 3.—Blood transfusion apparatus used in World War I.

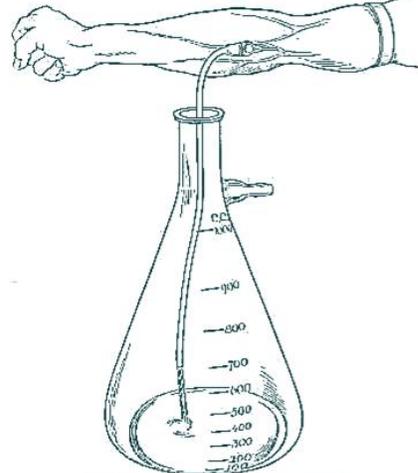


Fig. 10.—DRAWING BLOOD FOR TRANSFUSION

ANTI-TETANUS SERUM



TRANSPORT, CCS



One of several views —

Cushing/Whitney Medical Library - Yale University

TYPICAL WWI
OPERATING
THEATER,
BASE
HOSPITAL,
FRANCE

OWEN RICHARDS, RAMC: “The pathology and treatment of gunshot wounds of the small intestine,”
Br Med J 1915; 2: pp213-15.

- ▶ **1905**: Clinical Professor, Surgery, Egyptian Government School of Medicine, Cairo
- ▶ **1914**: RAMC, Casualty Clearing Station 6, Arras, France
- ▶ **1915**: Richard’s Seminal Paper, Br Med J → 9 cases, 2 survived (Both, SB Injuries)
- ▶ Sir Anthony Bowlby, Consulting surgeon, BEF → trial, abdominal surgery
- ▶ Bowlby mandates early abdominal surgery for trauma in BEF

RICHARD'S CONCLUSIONS, 1915:

- ▶ TIME TO SURGERY AFTER WOUNDING IS PARAMOUNT
- ▶ AVAILABILITY, EXPERIENCE of SURGICAL TEAMS
- ▶ SELECTION OF PATIENTS
- ▶ SELECTION OF PROCEDURE(S)



SIR CUTHBERT SIDNEY WALLACE (1867-1944):

- ▶ FAMILIAR WITH WORK OF OWEN RICHARDS
- ▶ FAVORED EARLY LAPAROTOMY FOR ABD WDS
- ▶ URGED EARLY EVACUATION OF ABD WDS TO CCS
- ▶ AVG TIME FROM FIELD TO CCS WAS 6-10h
- ▶ APPROACHED SURGEON-GENERAL MACPHERSON TO ALLOW CLINICAL TRIALS



SURGEON-GENERAL Wm G. MACPHERSON, 1915:

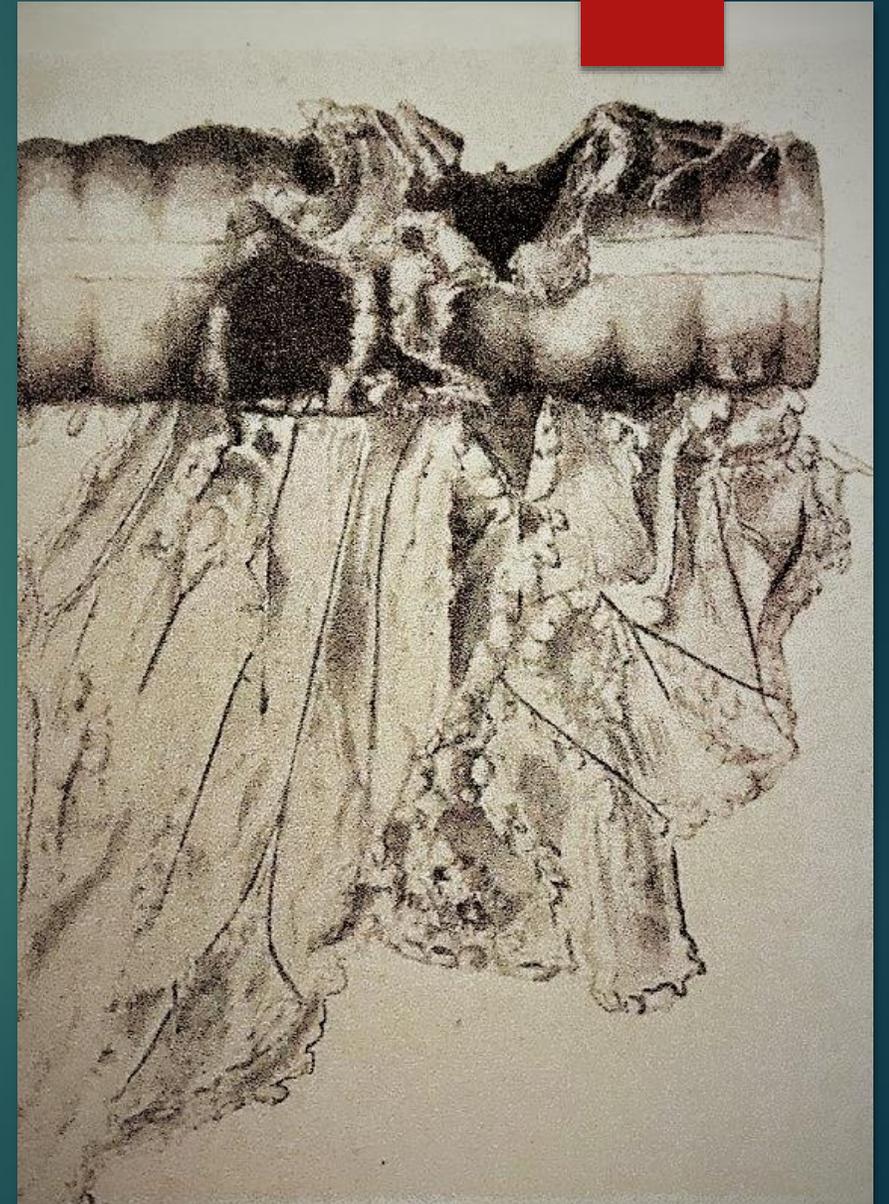
- ▶ CONVINCED BY WALLACE TO ALLOW CLINICAL TRIAL, 1914:
- ▶ AUTOPSIES to DETERMINE CAUSE OF DEATH IN ABD TRAUMA
- ▶ BOARD OF INQUIRY, MAY 1915
- ▶ JUNE 1915, MACPHERSON INSTITUTES POLICY OF IMMEDIATE TRANSPORT, ABDOMINAL TRAUMA, to CCS'S

CUTHBERT WALLACE,

RAMC: “War surgery of the abdomen,” *The Lancet* 1917; I: pp. 561-68.

CONCLUSIONS:

- ▶ HEMMORRHAGE: CHIEF CAUSE OF DEATH
- ▶ ABD WDS, ESP. SMALL BOWEL, RARELY HEAL WITHOUT SURGERY
- ▶ EXPECTANT MANAGEMENT: WRONGLY FOCUSED ON INFECTION/PERITONITIS → OCCURS LATER
- ▶ BULLETS, CONTRARY TO PREVAILING OPINION, CAUSE:
 1. MULTIPLE PERFORATIONS OF STOMACH AND BOWEL
 2. EXTENSIVE WOUNDING



ENGLISH SURGEONS PROMOTING EARLY SURGERY FOR ABDOMINAL TRAUMA, WWI

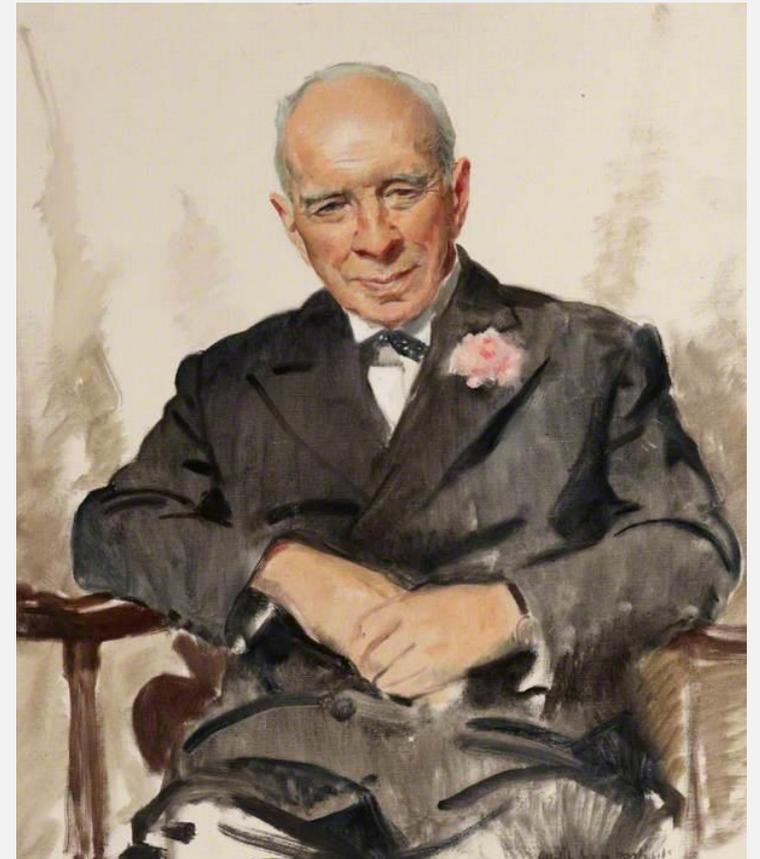
Sir Anthony Bowlby



Sir Cuthbert Sidney Wallace



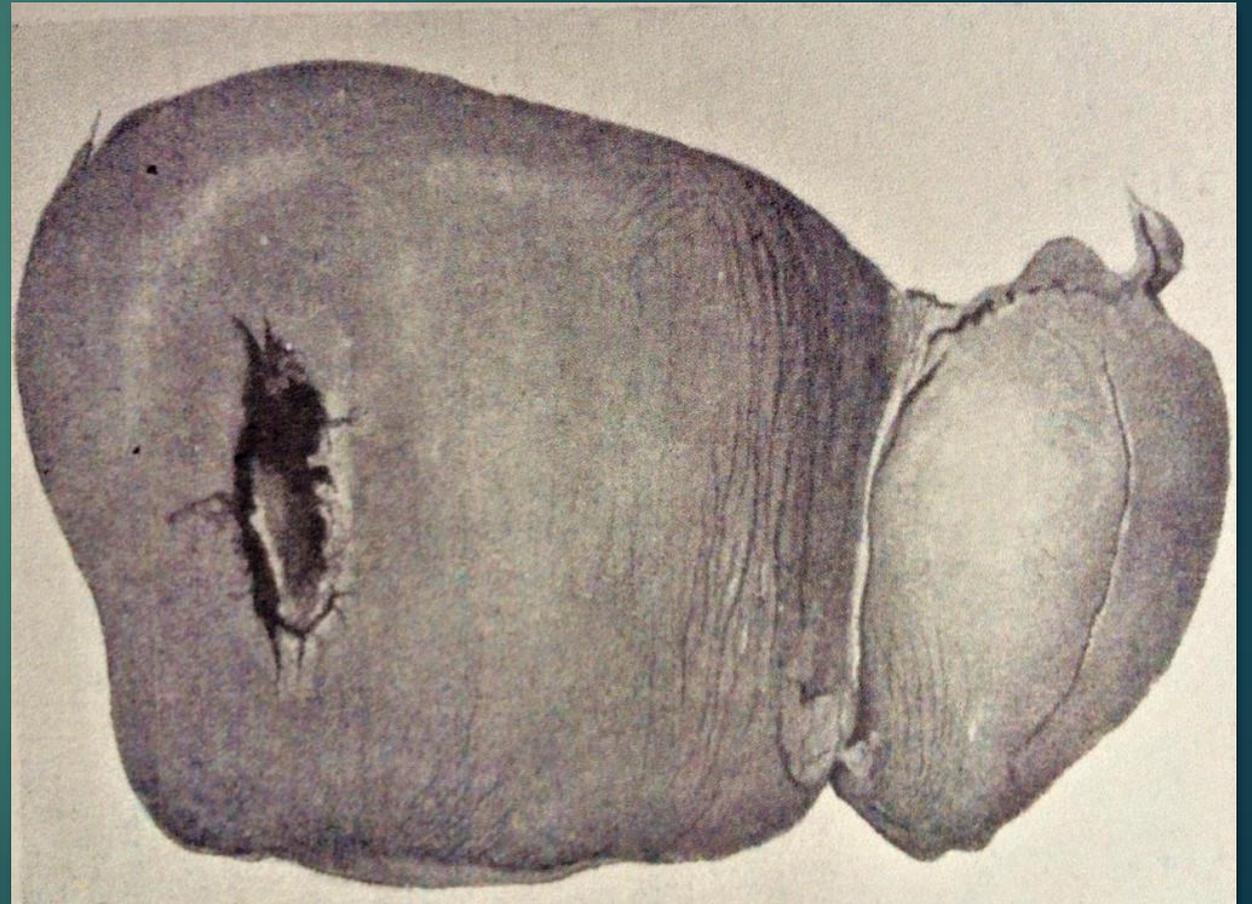
Sir Gordon Gordon-Taylor



RELATIVE CONTRAINDICATIONS, LAPAROTOMY, IN ABDOMINAL TRAUMA:

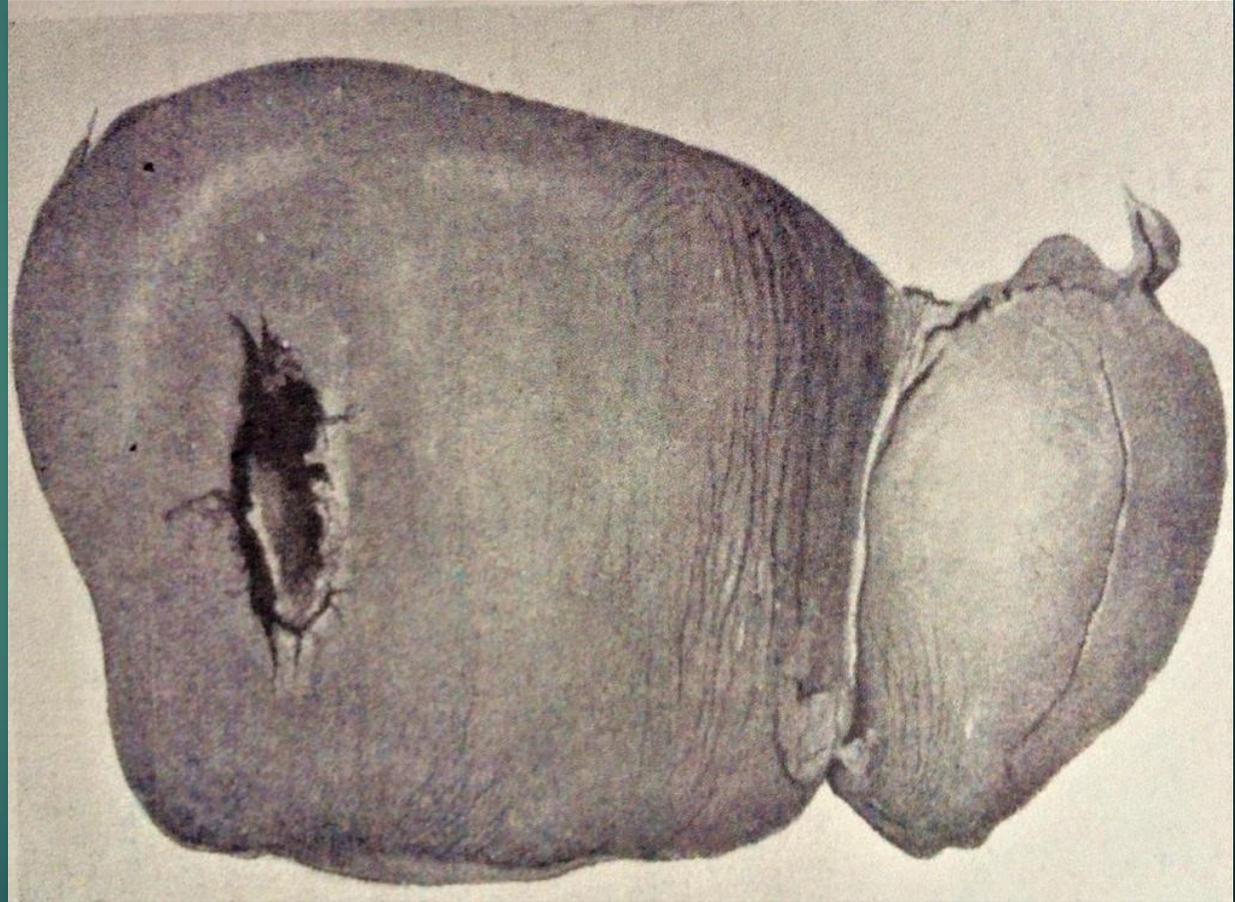
(RICHARDS AND GORDON-TAYLOR)

- ▶ IMMINENT DEATH
- ▶ PT STABLE, ASX
- ▶ RUQ ABDOMINAL INJURY
- ▶ LUQ ABD WD INVOLVING CHEST
- ▶ TIME INTERVAL, INJURY TO TREATMENT \geq 24h
- ▶ PULSE RATE $>$ 120, \uparrow 'd MORTALITY BY 50%



INDICATIONS FOR LAPAROTOMY IN ABDOMINAL TRAUMA: (FRASER AND DRUMMOND)

- ▶ PERFORATING ABDOMINAL INJURY, ESP. GSW
- ▶ ABDOMINAL RIGIDITY
- ▶ INCREASING PAIN



PREOPERATIVE
PREPARATION
OF THE
ABDOMINAL
TRAUMA
PATIENT:

- WARMING OF THE PATIENT
- TRENDELENBURG POSITION
- ETHER ANESTHESIA

-ADMINISTRATION OF SALINE OR ACACIA GUM SOLUTION DIRECTLY INTO VEINS, SQ, OR PER ANAL INFUSION

-ADMINISTRATION OF BICARBONATE SOLUTIONS IN ACIDOTIC PATIENT

- ONE MG PITUITARY EXTRACT (Fraser, et al.)
- MIDLINE INCISION, FULL EXPLORATION

H.H. SAMPSON, A. Don, et al.: GENERAL OBSERVATIONS, ABD TRAUMA, 1916:

1

ARREST of
HEMORRHAGE
IMPERATIVE, ↓
POSTOP
INFECTION

2

INFECTION
and
PERITONITIS
USUALLY
FATAL

3

MULITPLE
INJURIES
COMMON

4

FULL
EXPLORATION
OF ABDOMEN
MANDATORY

5

CCS RECORDS,
ABD SURGERY,
MOST COMPLETE
DATA for MED
RESEARCH
COMMITTEE

DETERMINANTS, OUTCOME of ABDOMINAL SURGERY for TRAUMA, WWI:

- ▶ FACILITY ACCESSIBLE WITHIN A HALF HOUR BY MOTOR AMBULANCE
- ▶ INTERVAL FROM WOUNDING TO DEFINITIVE MEDICAL CARE PREFERABLY < 12h, IDEALLY < 6h
- ▶ MAINTAIN CORE BODY TEMPERATURE
- ▶ MORPHINE $\leq \frac{1}{2}$ gr (32.5 mg) ADMINISTERED IN TRANSPORT
- ▶ EXPERIENCED SURGICAL, NURSING STAFF
- ▶ “SLOW” vs. “FAST” SURGEONS
- ▶ OPERATING THEATER AVAILABLE FOR IMMEDIATE USE
- ▶ NUMBER OF ARRIVING CASUALTIES
- ▶ FACILITY ABLE TO CONTINUE TREATMENT OF CASUALTY POSTOP

OUTCOME VS. MECHANISM and LOCATION OF ABDOMINAL TRAUMA:

- ▶ SMALL BOWEL WDS REQUIRING ONLY SUTURE REPAIR → **BEST PROGNOSIS**
- ▶ ABDOMINAL WDS ASSOC WITH INTRATHORACIC WDS → **WORST PROGNOSIS**
- ▶ **UPPER ABD WDS HAVE BETTER PROGNOSIS** THAN LOWER ABDOMINAL WDS (BELOW UMBILICUS)
- ▶ ABD WDS DUE TO **BULLETS AND SHELL/SHRAPNEL** HAD SIGNIFICANTLY GREATER MORTALITY THAN WDS DUE TO GRENADES AND BOMB FRAGMENTS

MARCH 10, 1917]

PERFORATING WOUNDS

A Clinical and Experimental Study
OF
THREE HUNDRED PERFORATING WOUNDS
OF THE ABDOMEN.

BY

J. FRASER, M.D., F.R.C.S.E., CAPTAIN R.A.M.C.,

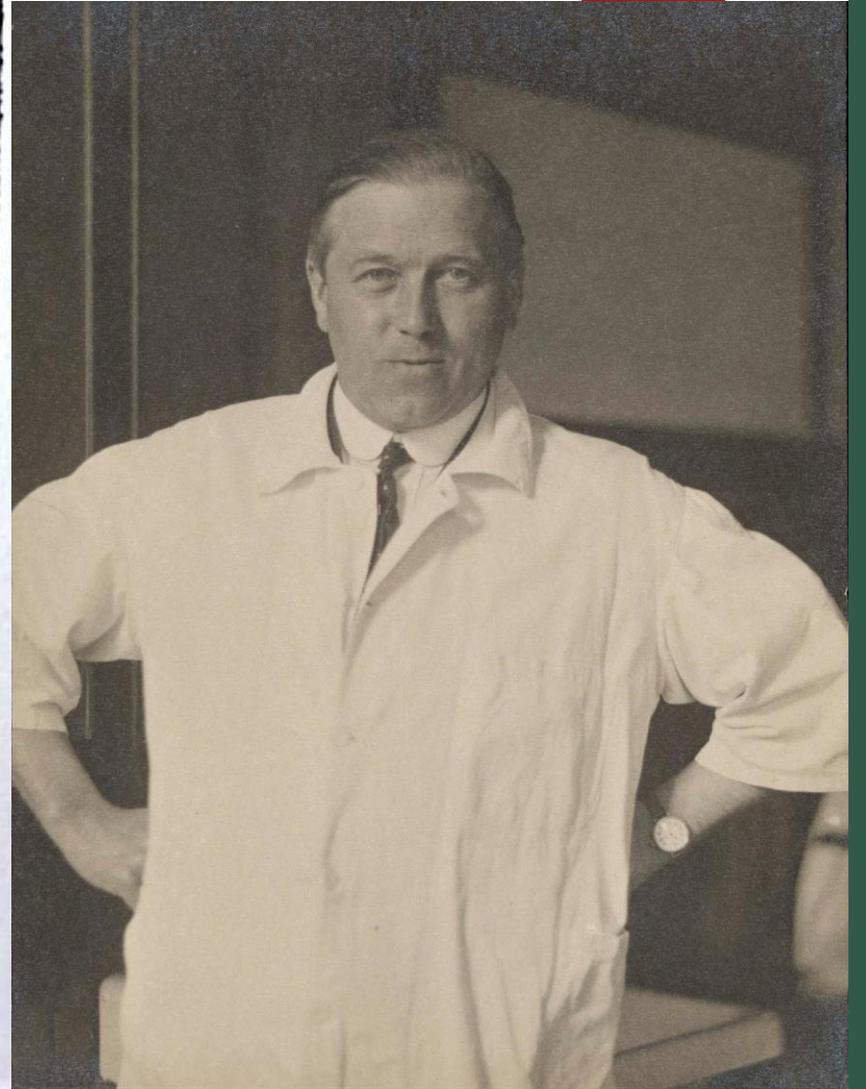
AND

HAMILTON DRUMMOND, M.B., F.R.C.S.E.,
CAPTAIN R.A.M.C.

(Report to the Medical Research Committee.)

[WITH SPECIAL PLATE.]

SOME time ago we published a summary of some seventy cases of perforating wounds of the abdominal cavity. We have had an opportunity of increasing our experience of these cases, and the following article is an embodiment of



SURGICAL MORTALITY RATES PER

ABD ORGAN WOUNDED: WWI (Based in part

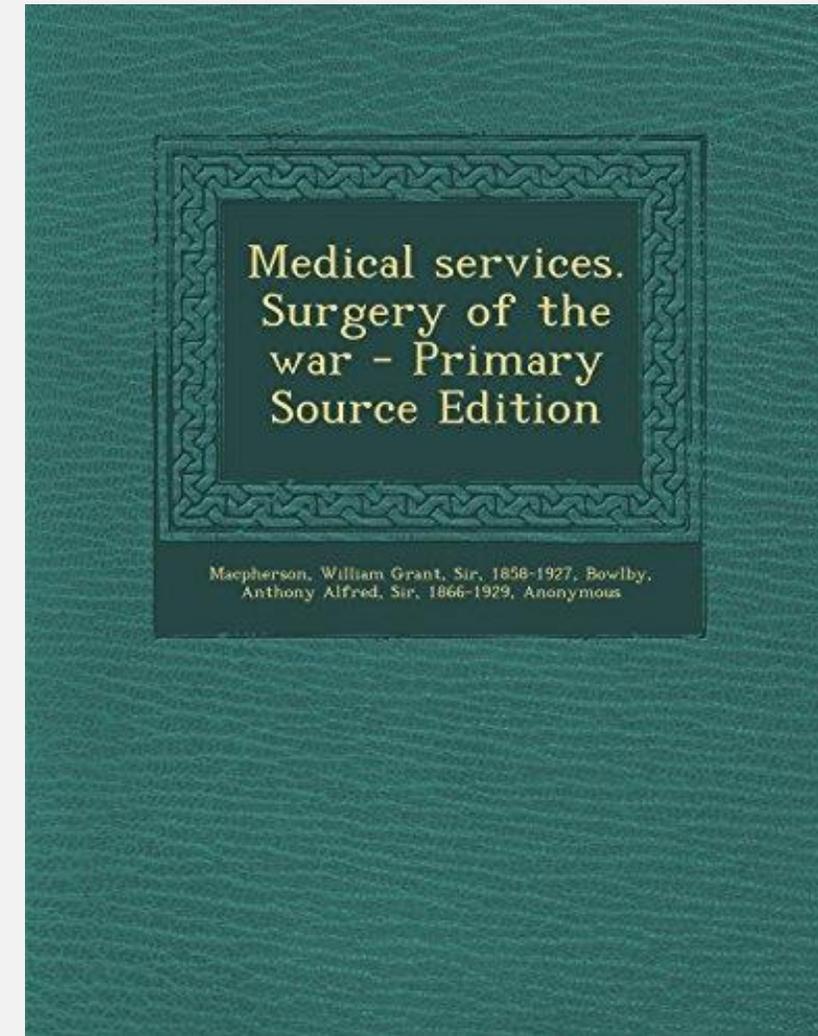
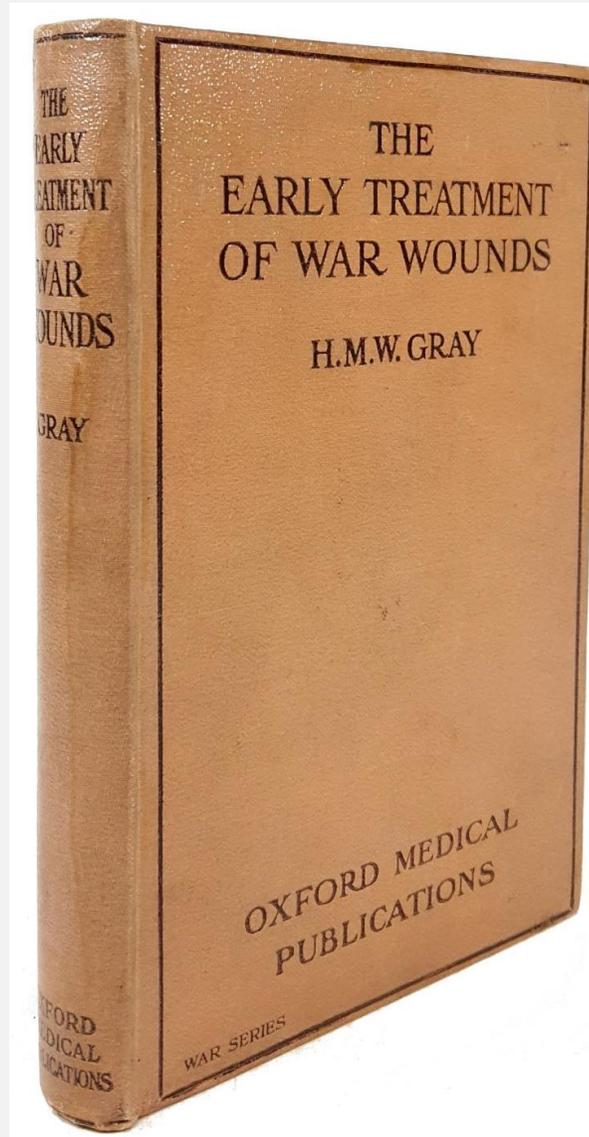
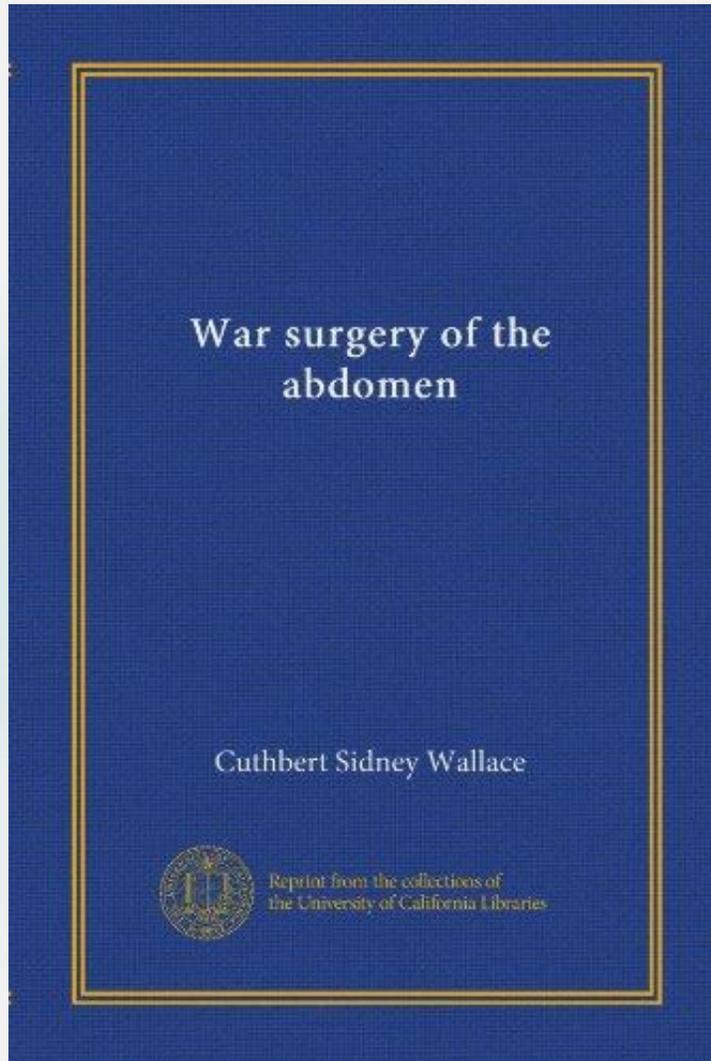
on Fraser & Drummond, 1917)

ORGAN WOUNDED	COMMENTS	SURGICAL MORTALITY RATE
STOMACH	1/3 SUSTAIN ASSOC. INJURIES, NEED TO CHECK POST. WALL	54%
SMALL BOWEL	SINGLE OR MULTIPLE PERF'S: SUTURE OR RESECTION	64%
LARGE BOWEL	CLOSURE OF PERFORATION, PRIMARY RESECTION, ± PROX. COLOSTOMY, ± ANASTOMOSIS	56%
RECTUM	DEBRIDE, DRAIN, DIVERT; (NO ANTIBIOTICS → INC. MORTALITY)	70%
LIVER, GALLBLADDER	MAJORITY MOST LIKELY KIA; SIMPLE LAC'S SUTURED	42%

SURGICAL MORTALITY RATES PER ABD ORGAN WOUNDED: WWI

ORGAN WOUNDED	COMMENTS	SURGICAL MORTALITY RATE
SPLEEN	EXPECTANT VS. SPLENECTOMY OR REPAIR	35%
PANCREAS	DRAINAGE ± RESECTION OF DAMAGED SECTION	INSUFFICIENT DATA (unrecognized?)
KIDNEY	SUTURE OF LAC VS. NEPHRECTOMY, DRAINAGE; R>L KIDNEY MORTALITY	40%
BLADDER	SUTURE, URETHRAL CATH, SUPRUPUBIC CATH	41% (Fraser, 71%)
MEAN MORTALITY RATE	UNRELIABLE: ? NUMBER OF CASES/ORGAN; ASSOC. INJURIES ?	50%

SEMINAL WORKS ON TRAUMA SURGERY, SURGERY OF ABDOMINAL WOUNDS, WWI:



SIR HENRY M.W. GRAY: *THE EARLY TREATMENT OF WAR WOUNDS*, Aug, 1918, *preface*:

- ▶ “I have written nothing on abdominal wounds. . . A surgeon who has mastered the technique of successful excision of an ulcerating cancer of the colon is capable of obtaining as good results as possible if he applies the same principles in the treatment of war wounds of the abdominal organs coupled with those used in combatting spreading peritonitis.”

SUMMARY AND CONCLUSIONS, I:

- ▶ ANESTHESIA AND ANTISEPTIC TECHNIQUES/GERM THEORY PARAMOUNT FOR EVOLUTION OF ABDOMINAL SURGERY
- ▶ MILITARY SURGERY FOR ABDOMINAL TRAUMA INITIALLY BEHIND THE CURVE
- ▶ APPROACH TO SURGERY FOR ABDOMINAL TRAUMA INITIALLY CONSTRAINED BY PRIOR DATA AND ORTHODOXY
- ▶ CONCOMITANT ADVANCES, WWI: TRANSFUSIONS, TETANUS, TRANSPORT/“GOLDEN HOUR”
- ▶ SPECIALIZED MD’s and CCS’s

SUMMARY AND CONCLUSIONS, II:

- ▶ ABD SURGERY IN BEF ALONE RESULTED IN EST. 50-150,000 LIVES SAVED
- ▶ TOTAL NUMBER, ACTUAL LAPARTOMIES PERFORMED, UNKNOWN
- ▶ INNOVATIONS DEVELOPED IN DEALING WITH ABDOMINAL TRAUMA IN WWI WOULD HAVE REQUIRED A FAR LONGER EVOLUTION IN THE CIVILIAN SECTOR
- ▶ LESSONS LEARNED USED SUCCESSFULLY IN COMING CONFLICTS
- ▶ LESSONS LEARNED WERE DIRECTLY APPLICABLE TO CIVILIAN SECTOR → EVEN MORE SO TODAY