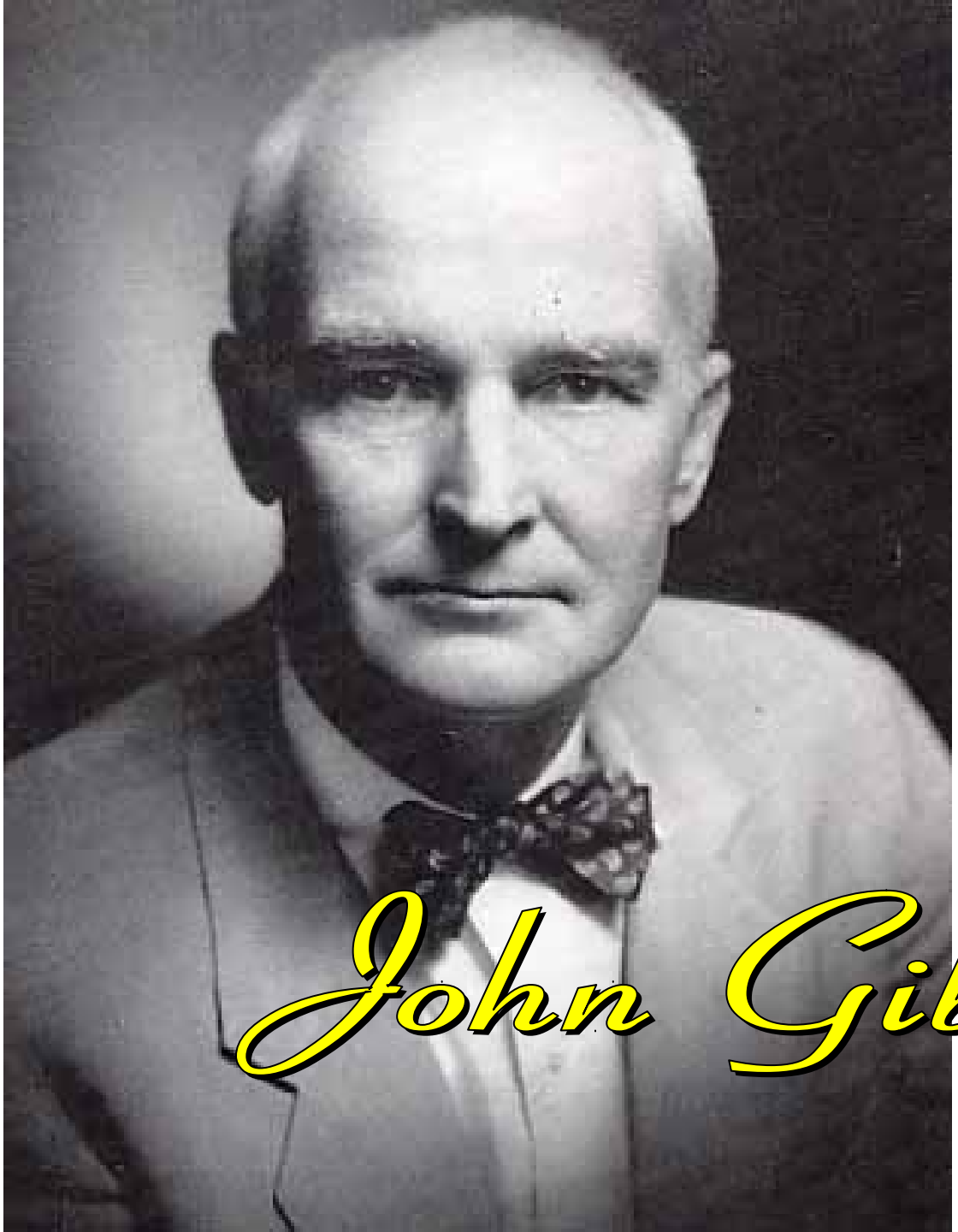
Intra-operative Effects of Cardiac Surgery

Influence on Post-operative care

Richard A Perryman

Intra-operative Effects of Cardiac Surgery

- Cardiopulmonary Bypass
- Hypothermia
- Cannulation events
- Myocardial preservation



John Gibbon

APPLICATION OF A MECHANICAL HEART AND LUNG APPARATUS TO CARDIAC SURGERY

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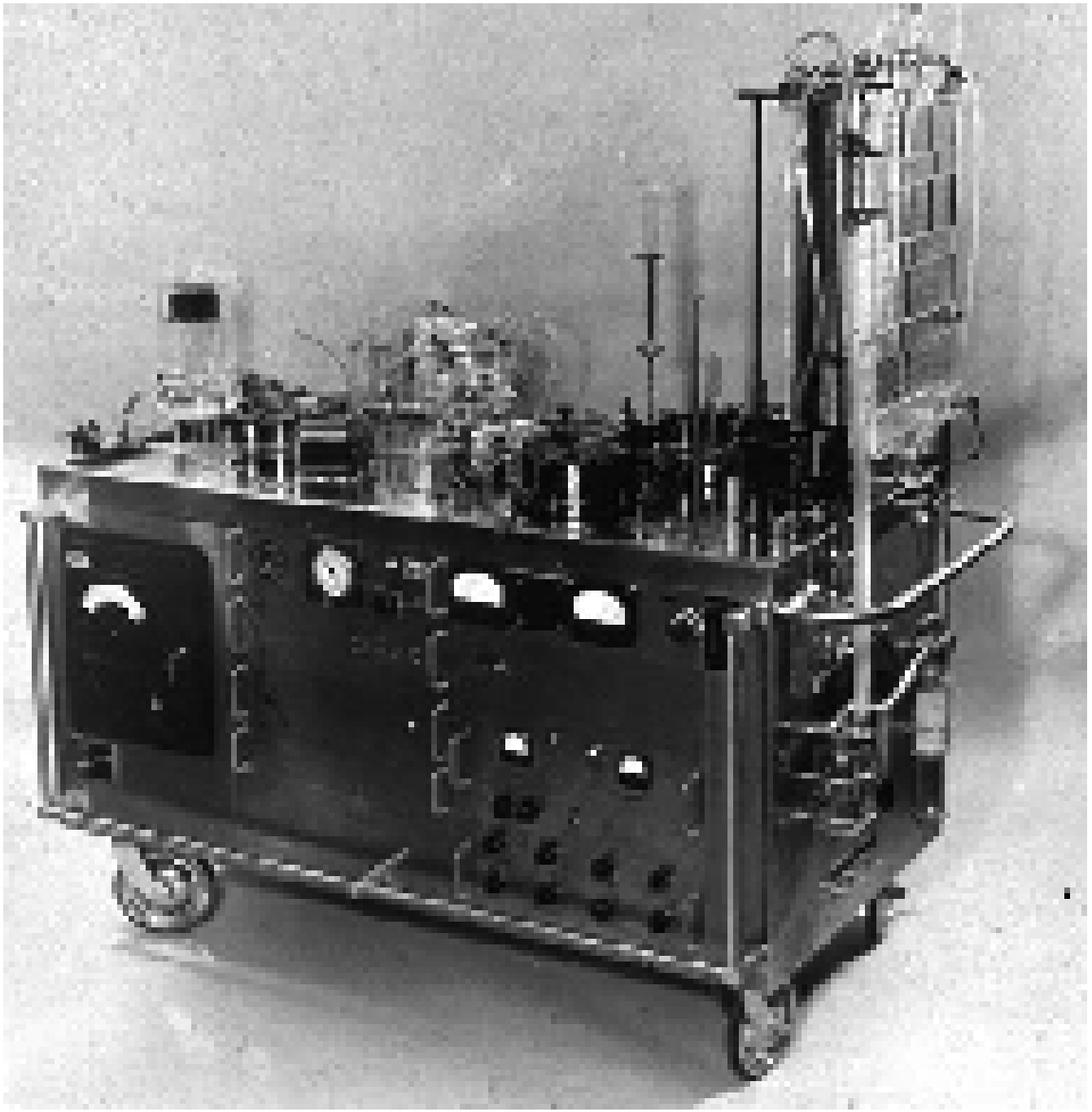
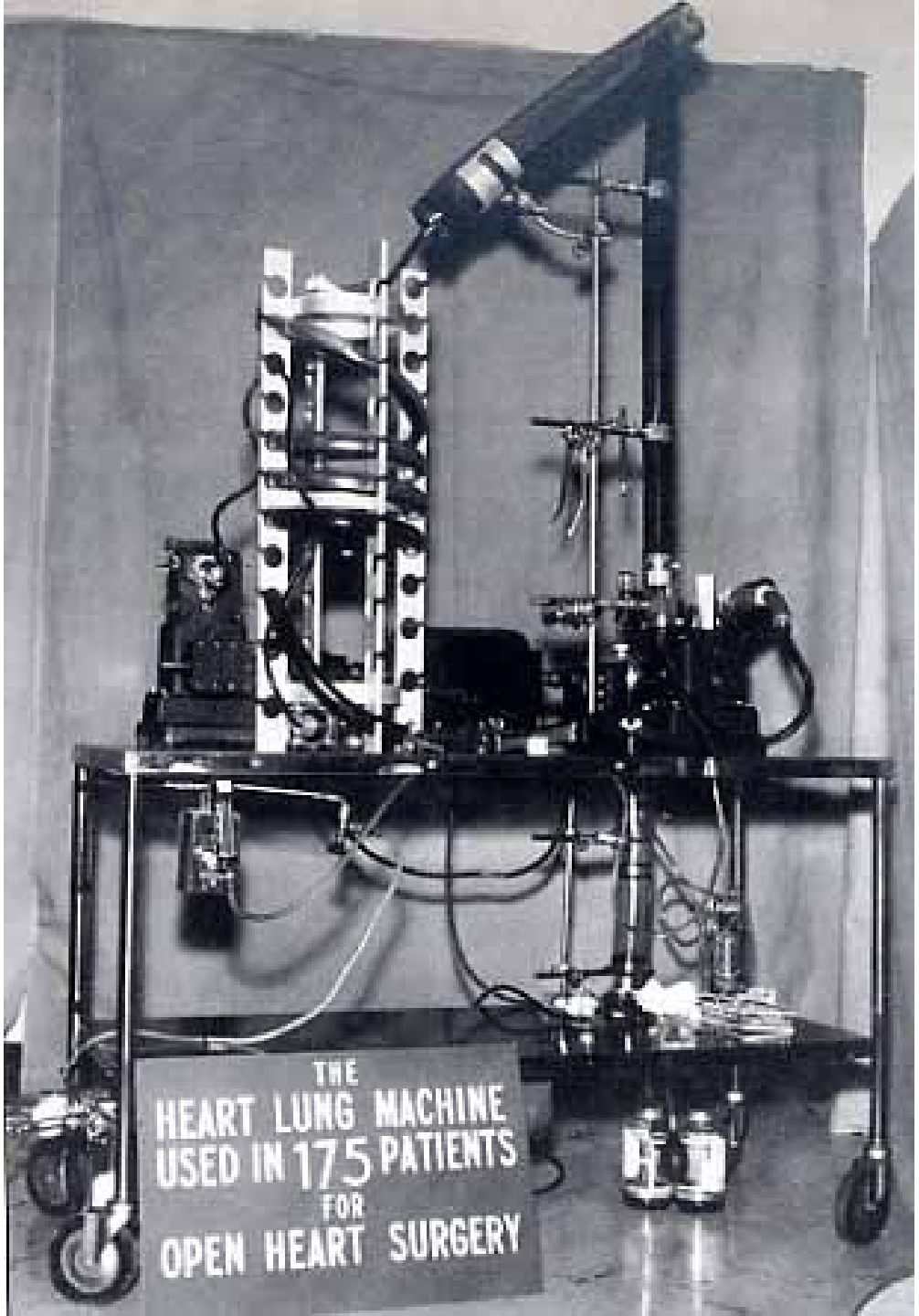
IT IS A PLEASURE to be here and to talk about a subject in which I have been interested for many years. The ultimate objective of my work in this field has been to be able to operate inside the heart under direct vision. From the beginning, I have not only been interested in the substitution of a mechanical device for the heart, but also for the lung. We have always considered congenital abnormalities of the heart the most suitable lesions for operative repair. Many of these abnormalities are septal defects. In the presence of a septal defect, shunting the flow of blood around one side of the heart with a pump, will not provide a bloodless field for operative closure of the defect. An apparatus which em-

apparatus is a suitable pumping mechanism to move the venous blood from the subject, through the apparatus, and back into an artery of the subject. There is no real problem about a pumping apparatus. There are many ways of moving blood through tubing without producing significant amounts of hemolysis. We have used for many years a roller type of pump which does not contain any internal valves. Such pumps are extremely simple. Because of the absence of valves, the blood circuit is easy to clean and there are no stagnate regions where fibrin might be apt to form. There are many other advantages in this type of pump such as the simple and rapid control of the rate of blood flow. The pumps cause no significant hemolysis. In human patients in which




THE
HEART LUNG MACHINE
USED IN 175 PATIENTS
FOR
OPEN HEART SURGERY

Heart Surgery

Heart Surgery

Intra-operative Effects of Cardiac Surgery

Cardiopulmonary bypass

- Inflammatory response
- Hemodilution
- Platelet adhesion and aggregation
- Affects of non-pulsatile blood flow
- Capillary leak syndrome
- Acid-base balance

Intra-operative Effects of Cardiac Surgery

Cardiopulmonary bypass

Inflammatory response

- Complement activation
- Fibrinolysis cascade activation
- Kallikrein, interleukins,etc
- Platelet activation
- Capillary leak syndrome
- Pulmonary effects
- Renal effects

Intra-operative Effects of Cardiopulmonary Bypass

Pulmonary

- Leukocyte and complement activation
- Surfactant loss and atelectasis
- Reduction in lung compliance
- Increase in alveolar-arterial (A-a) gradient
- Capillary leak into alveolar-capillary membrane
- Leucocyte degranulation and capillary membrane injury
- Increased pulmonary vascular resistance

Intra-operative Effects of Cardiopulmonary Bypass

Renal

- Renin, angiotensin, ADH and catecholamines produced
- Renal vasoconstriction and decreased renal blood flow

Intra-operative Effects of Cardiac Surgery

Hypothermia

- Moderate hypothermia
  - Permits reduced CPB flows
  - Protects end organ function
  - Ameliorates effects of non-pulsatile flow
- Profound hypothermia
  - Permits low flow or circulatory arrest
  - Permits procedures on pulmonary veins and aortic arch

Intra-operative Effects of Cardiac Surgery

Hypothermia

- Increased bleeding tendency
- Can prolong bypass time
- Increased risk of neurological injury

Intra-operative Effects of Cardiac Surgery

Cardioplegia

- Cold blood
  - Replenishes substrate and oxygen
  - Allows longer cross-clamp times
- Cold crystalloid
- Warm continuous blood – adults only

Intra-operative Effects of Cardiac Surgery

Cardioplegia

- Cardiac edema – low cardiac output
- Diastolic ventricular dysfunction
- Rt ventricular dysfunction from surface warming

Intra-operative Effects of Cardiac Surgery

Net Effects

- Relative low cardiac output
- Systemic vasoconstriction
- Decreased pulmonary compliance
- Potential for pulmonary hypertension
- Relative renal insufficiency
- Increased total body water and edema
- Relatively immuno-deficient

Complications of CPB

- Bleeding
- Respiratory insufficiency
- Low cardiac output
- Renal insufficiency
- Arrhythmias

Bleeding following Cardiopulmonary Bypass

- Hemodilution of clotting factors
- Inflammatory response to cardiopulmonary bypass
- Duration of cardiopulmonary bypass
- Profound hypothermia and circulatory arrest

Heart Surgery
Hemostasis

- Against

  Anti-platelet drugs –Plavix, Aggrestat, Aspirin

  Long – acting heparins eg. Lovenox

Heart Surgery
Hemostasis

- For

  Anti-inflammatory – steroids

  Improved cardiopulmonary bypass

  Avoid cardiopulmonary bypass

  Anti-fibrinolytics – Amicar, Trasylol, etc

  Topical clot substrates

  Topical clot enhancers

  Biological glues

Bleeding following Cardiopulmonary Bypass

Surgical Bleeding

- Occurs in face of normal coagulation
- Increases with complexity of operation
- Increases in redo operations
- Can be attenuated by surgical modification
  - Topical coagulation matrix
  - Topical procoagulants
  - Topical “glues”

Bleeding following Cardiopulmonary Bypass

Peri-operative strategies

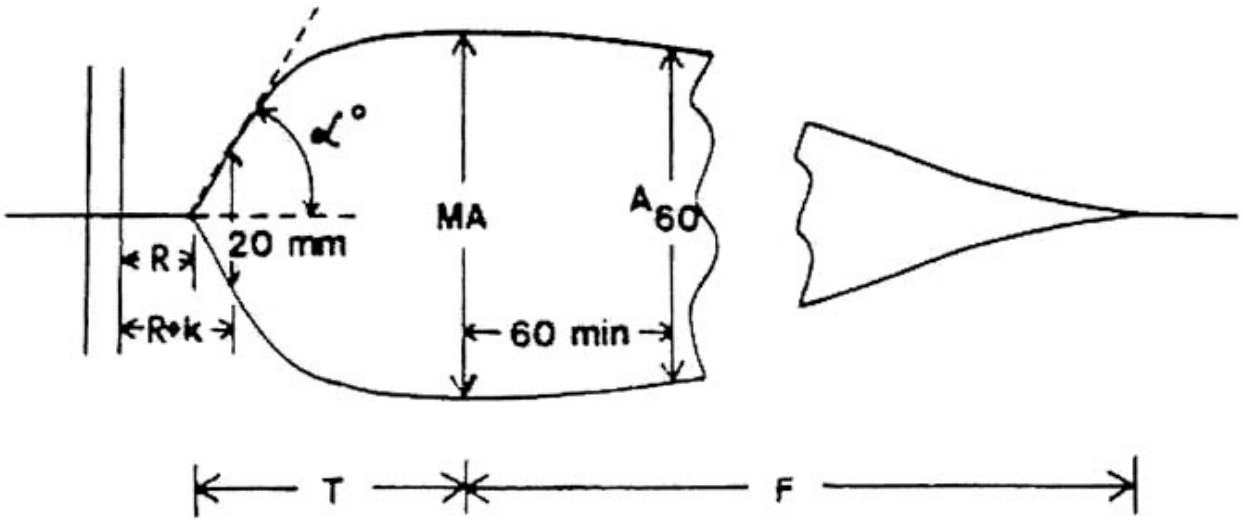
- Aprotinin
- Desmopressin
- Fresh whole blood
- Synthetic anti-fibrinolysins
  - Transanemic acid
  - e-aminocaproic acid
- Coated CPB circuits

Bleeding following Cardiopulmonary Bypass

On-site Coagulation Monitoring

- Platelet count
- Hematocrit
- Thromboelastogram TEG
- Heparin levels
- Calculated heparin neutralization
- Coagulation parameters

Thromboelastogram
TEG



Low Cardiac Output

- Post op circulatory support
  - Intra-aortic balloon pump
  - ECMO
  - Ventricular assist devices
  - Cardiac transplantation

Anticipation

“What should I expect?”