

Pirogov Russian National Research Medical University
Department of General surgery

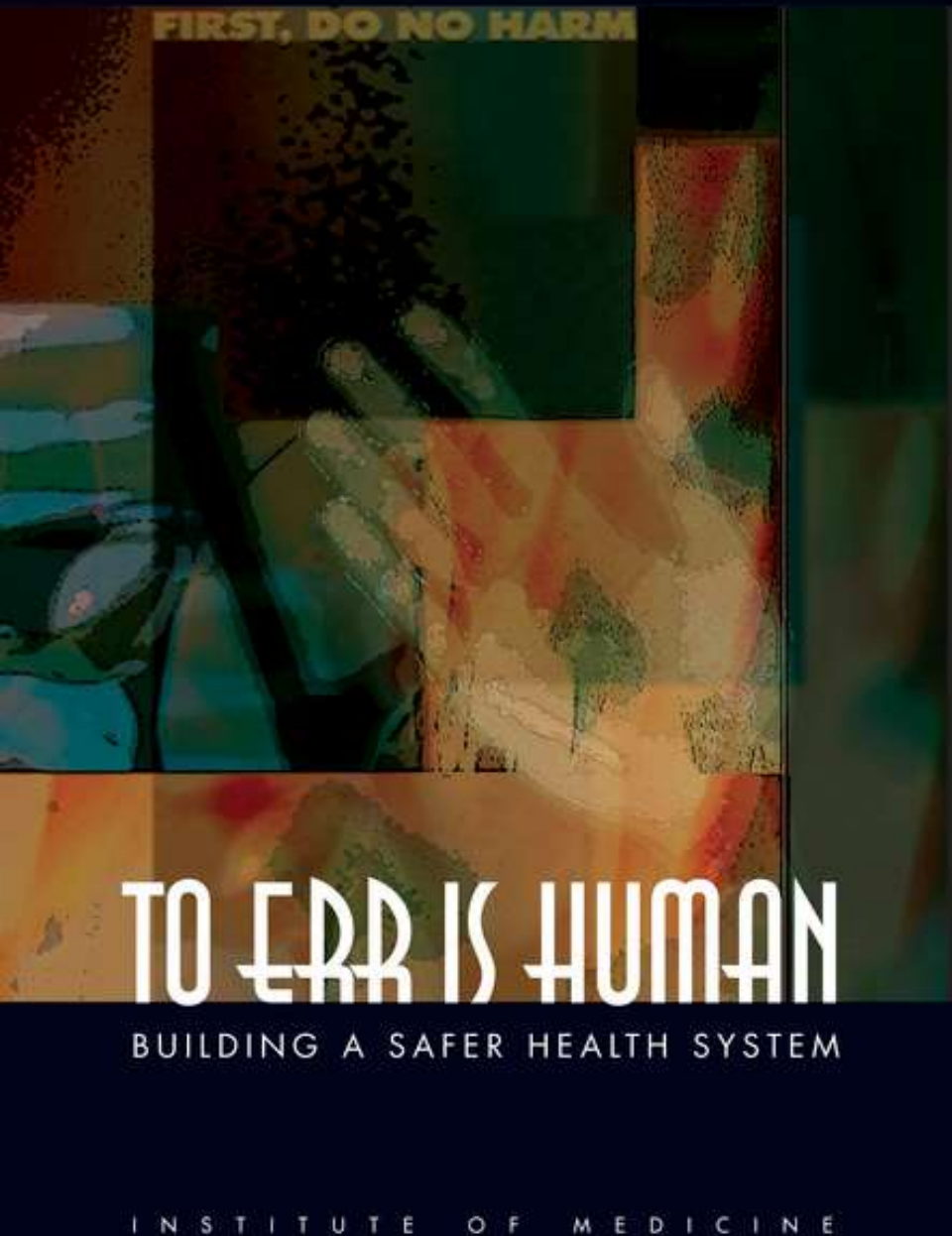


Perioperative management in surgery

Lecturer:
Kirill Lobastov

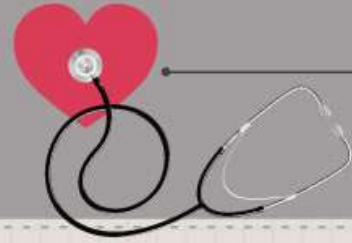
Perioperative period

- Perioperative period – period from the making decision on surgical intervention until full recovery after operation:
 - Preoperative period
 - Intraoperative
 - Postoperative period
- Perioperative management in surgery is the complex of measures provided in the perioperative period aimed to reduce the incidence of postoperative **complications (POCs)**.



Medical errors

- Experts estimate that as many as 98,000 people die in any given year from medical errors that occur in hospitals. That's more than die from motor vehicle accidents, breast cancer, or AIDS—three causes that receive far more public attention. Indeed, more people die annually from medication errors than from workplace injuries. Add the financial cost to the human tragedy, and medical error easily rises to the top ranks of urgent, widespread public problems



How Safe Are You in HOSPITALS

In America,
PREVENTABLE

- hospital errors lead to:



50 DEATHS EVERY HOUR



Sunday
31

1,200 DEATHS A DAY



X24



TWICE as many people die of
preventable hospital errors weekly as
the servicemen that died throughout
THE ENTIRE IRAQ WAR

January

8,400 DEATHS A WEEK



X168

January

34,000 DEATHS A MONTH



X680

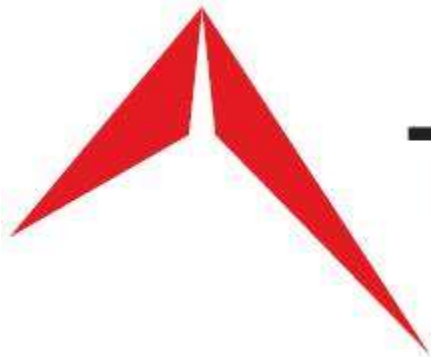
Excess Length of Stay, Charges, and Mortality Attributable to Medical Injuries During Hospitalization

Patient Safety Indicators	No. of Events	Risk Pool	Rate per 1000 Discharges at Risk
Accidental puncture or laceration	11810	5628112	3.32
Birth trauma, injury to neonate	4740	720021	6.53
Complications of anesthesia	1369	1933085	0.71
Decubitus ulcer	41440	1932676	21.51
Foreign body left during procedure	536	6572845	0.09
Iatrogenic pneumothorax	3919	5861689	0.67
Obstetric trauma, cesarean birth	1138	191227	6.97
Obstetric trauma, vaginal birth with instrumentation	12518	51225	224.21
Obstetric trauma, vaginal birth without instrumentation	51223	591752	86.61
Postoperative hemorrhage or hematoma	3494	1695495	2.06
Postoperative hip fracture	1068	1397898	0.77
Postoperative physiologic and metabolic derangement	799	801702	1.00
Postoperative pulmonary embolism or deep vein thrombosis	15704	1689662	9.34
Postoperative respiratory failure	2275	633855	3.58
Postoperative sepsis	2592	229853	11.25
Postoperative wound dehiscence	843	411099	2.05
Selected infection due to medical care	11449	5752102	1.99
Transfusion reaction	30	6572845	0.004

- The Agency for Healthcare Research and Quality (AHRQ) Patient Safety Indicators (PSIs) were used to identify medical injuries in **7.45 million hospital discharge abstracts from 994 acute-care hospitals across 28 states in 2000** in the AHRQ Healthcare Cost and Utilization Project Nationwide Inpatient Sample database.

Surgical errors

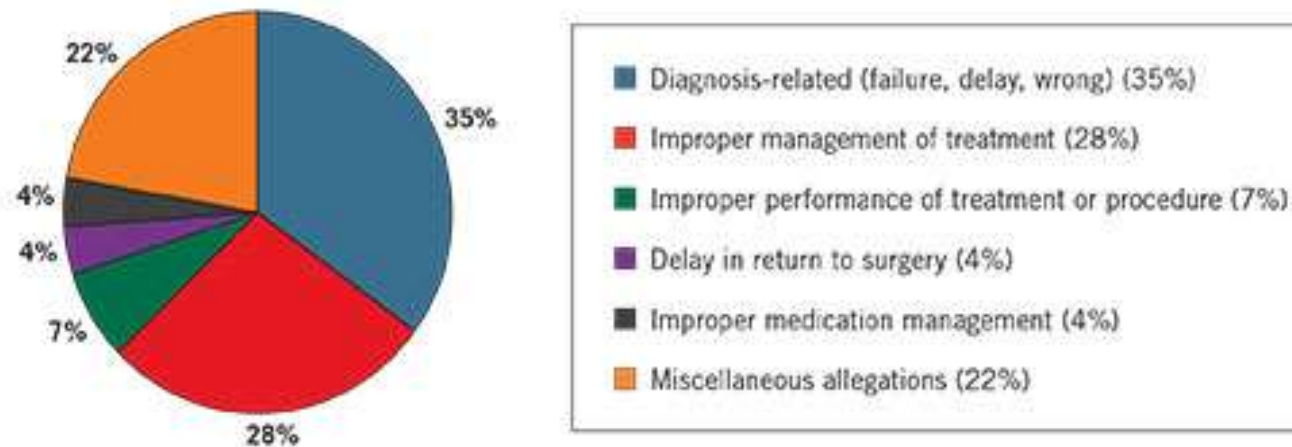
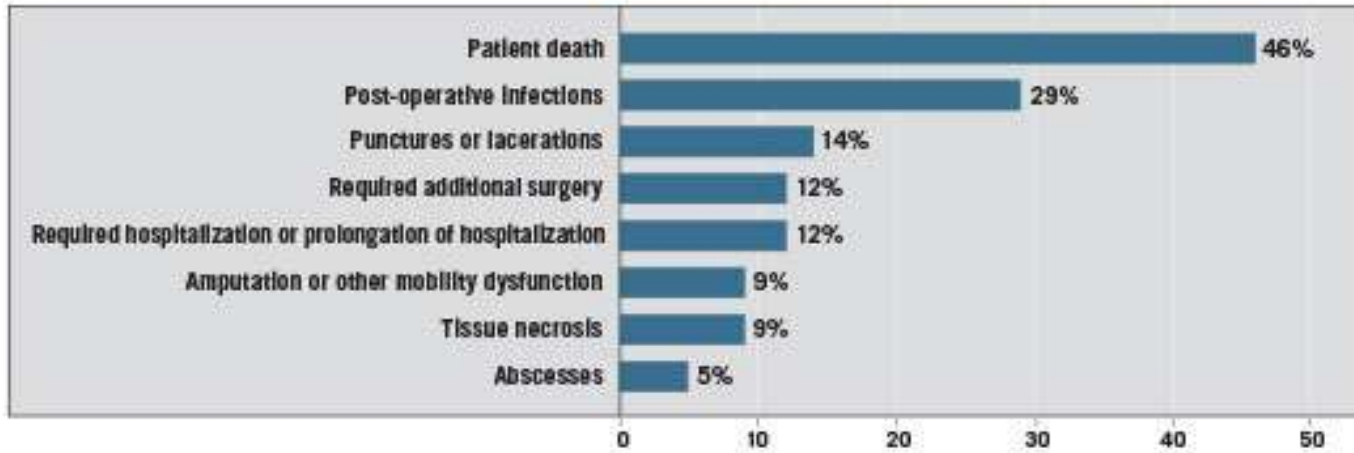
*Surgeons and their clinical teams are found responsible for errors across the entire surgical timeline—flawed decisions to operate, technical errors in the operating room and postoperative mismanagement during recovery. **Alarming, most of the scenarios are preventable.***



THE DOCTORS COMPANY

medical malpractice insurance company

The most common causes of legal action among the patients in USA in 2007-2012



by DONALD J. PALMISANO, MD, JD, FACS
AND DARRELL RANUM, JD, CPHRM,
PUBLISHED JUNE 1, 2013

Immediate common POCs

- Primary haemorrhage (starting during surgery) or reactionary haemorrhage (following postoperative increase in blood pressure) - replace blood loss and may require return to theatre to re-explore the wound.
- Basal atelectasis: minor lung collapse.
- Shock: blood loss, acute myocardial infarction, pulmonary embolism or septicemia.
- Low urine output: inadequate fluid replacement intra-operatively and postoperatively.

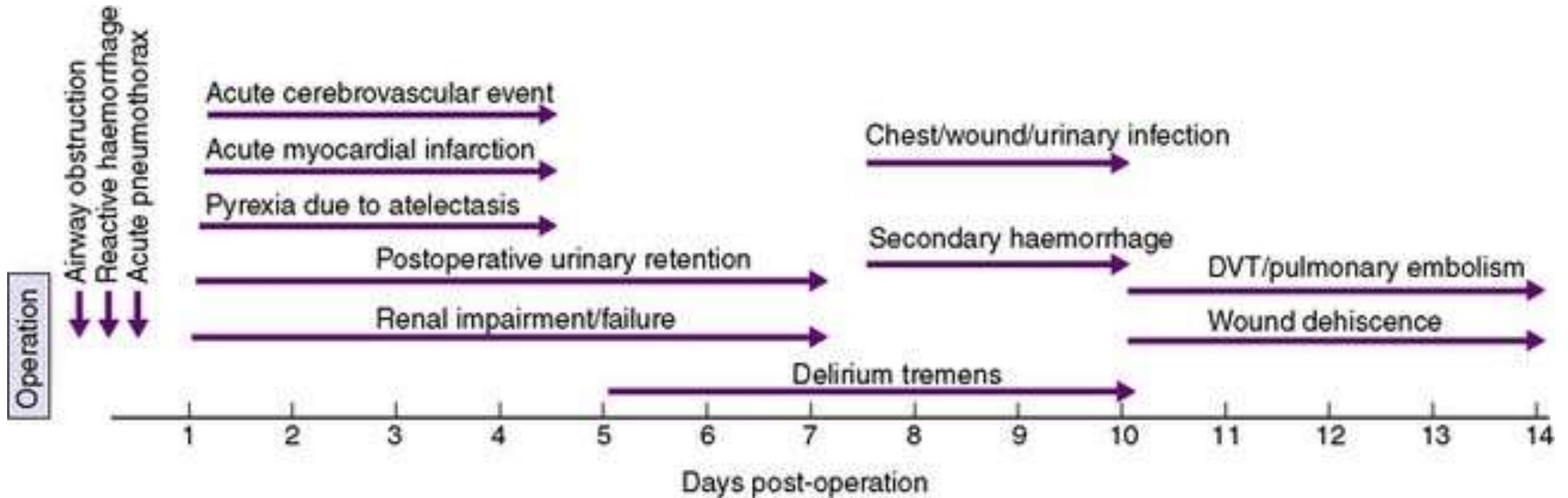
Early common POCs

- Pain.
- Acute confusion: exclude dehydration and sepsis. May also be due to other various causes, including pain, sleep disturbance, medication or metabolic disturbances.
- Nausea and vomiting: analgesia or anaesthetic-related; paralytic ileus.
- Fever
- Secondary haemorrhage: often as a result of infection.
- Pneumonia.
- Wound or anastomosis dehiscence.
- VTE
- Acute urinary retention.
- Urinary tract infection.
- Postoperative wound infection.
- Pressure sores.
- Bowel obstruction due to fibrinous adhesions.
- Paralytic Ileus.

Late common POCs

- Bowel obstruction due to fibrous adhesions.
- Incisional hernia.
- Recurrence of reason for surgery - eg, malignancy, hernia, varicose veins.
- Keloid formation.
- Cosmetic appearance.

Timeline of common POCs



The incidence of POCs

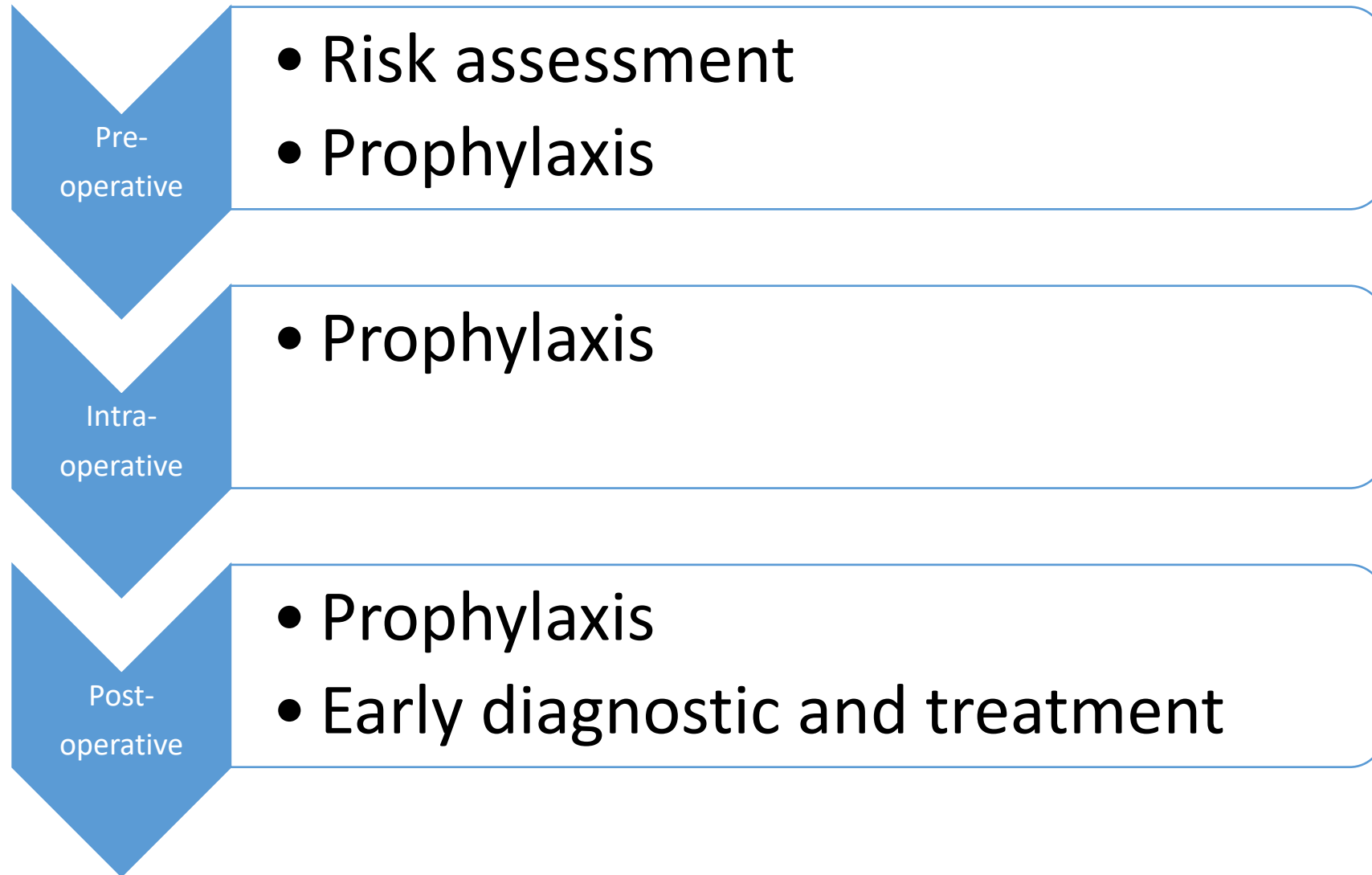
Table 4. Incidence of the 10 Most Common Complications

Complication	No. of Patients Affected	Incidence, %
Death*	128	2.70
Other miscellaneous	101	2.17
Wound infection	88	1.89
Readmission	74	1.59
Urinary tract infection	65	1.40
Pneumonia	60	1.29
Dysrhythmia or arrhythmia	55	1.18
Other gastrointestinal complication	52	1.12
Other vascular complication	40	0.86
Respiratory failure	37	0.79

The data for the respective groups (general surgery, vascular surgery, combined general surgery and trauma, and cardiothoracic surgery) are as follows. The number of patients was 1363, 978, 914, and 1403; **total complication rate, 30.3%, 42.4%, 32.3%, and 26.9%**; minor complication rate, 13.3%, 19.9%, 13.5%, and 13.0% (percentage of minor complications that were avoidable, 37.4%, 59.0%, 51.2%, and 49.5%); major complication rate, 16.2%, 21.1%, 18.1%, and 12.9% (percentage of major complications that were avoidable, 53.4%, 60.7%, 38.8%, and 38.7%); **and mortality rate, 1.83%, 3.33%, 2.28%, and 3.34%** (percentage of mortality that was avoidable, 28.0%, 44.1%, 19.0%, and 25.0%).

Arch Surg. 2002;137:611-618

Management of postoperative complications



Preoperative management

- Appropriate diagnostics
 - Indications/contraindications for surgery
 - Urgency
 - Type of surgery
- Risk assessment for common POCs
- Surgical preparation
 - Informed consent and motivation
 - Correction of comorbidities
 - Special preparation (e.g. selective colon decontamination)
 - Direct preparation

Indications and urgency of intervention

Indications	Urgency	Examples
Absolute: the disease could be treated only by surgery, without surgery patient will die	Emergent: the result of operation depend on time of intervention; the operation should be made immediately (1-2h)	Bleeding, asphyxia, acute purulent infection (including acute abdomen)
	Urgent: the result of operation depend on time of intervention, the operation should be made in reasonably short time frame (24-72h)	Bowel obstruction, mechanical jaundice, malignant tumor
Relative: the disease may be treated with surgical or non-surgical approach, no threat to life	Elective: the result of operation do not depend on the time of intervention; the operation is scheduled and should be made after appropriate preparation with minimal risk	Hernia repair, varicose veins, arterial bypass, gall bladder stones

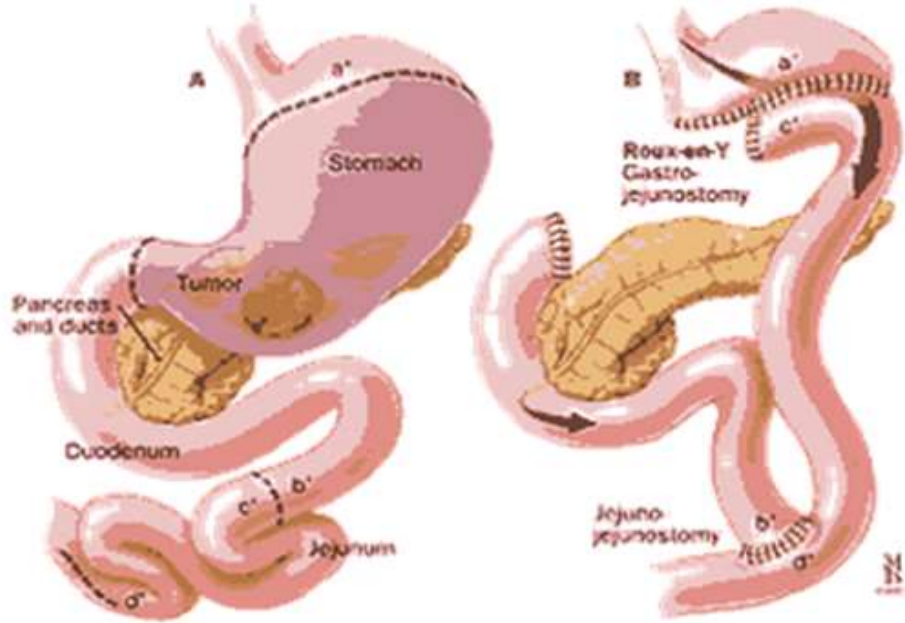
Types of surgery

- **Major:** requires hospitalization and specialized care, is usually prolonged (over 60 min), under general anesthesia has a higher degree of risk, involves major body organs or life-threatening situations, and has a greater risk for POCs (e.g. laparotomy, nephrectomy, hysterectomy).
- **Minor:** is usually brief (less than 60 min), under local or regional anesthesia, carries a low risk and results in few complications, mostly elective (laparoscopy, hernia repair, varicose veins).

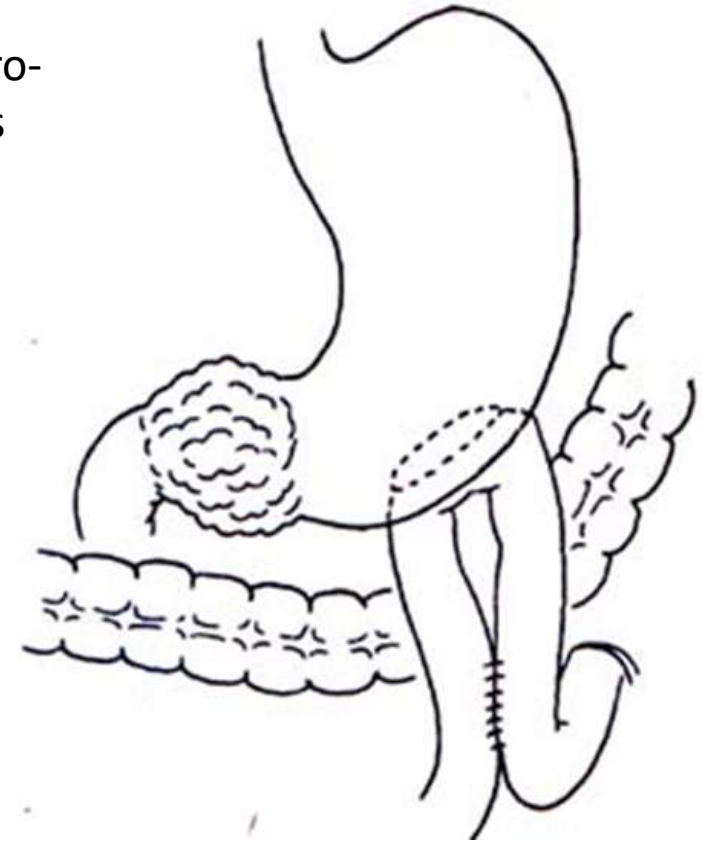
Types of surgery

Type	Explanation	Example
Diagnostic	Surgery to make or confirm a diagnosis	Biopsy, laparoscopy
Ablative	Surgery to remove an affected tissues, organs or body parts	Gastrectomy, appendectomy, mastectomy, amputation
Palliative	Surgery to relieve or reduce intensity of an illness but not to cure the disease	Gastro-intestinal bypass, colostomy, nerve ablation
Reconstructive	Surgeries to restore function of traumatized or malfunctioning tissues or to improve self concept	Colon anastomosis, internal fixation of a fracture, breast reconstruction
Transplantation	Surgery to replace organs or structures that are diseased or malfunctioning	Kidney, liver, heart transplantation
Constructive	Surgery to restore functions in congenital anomalies	Closure of Atrial Septal Defect

Radical
subtotal
resection



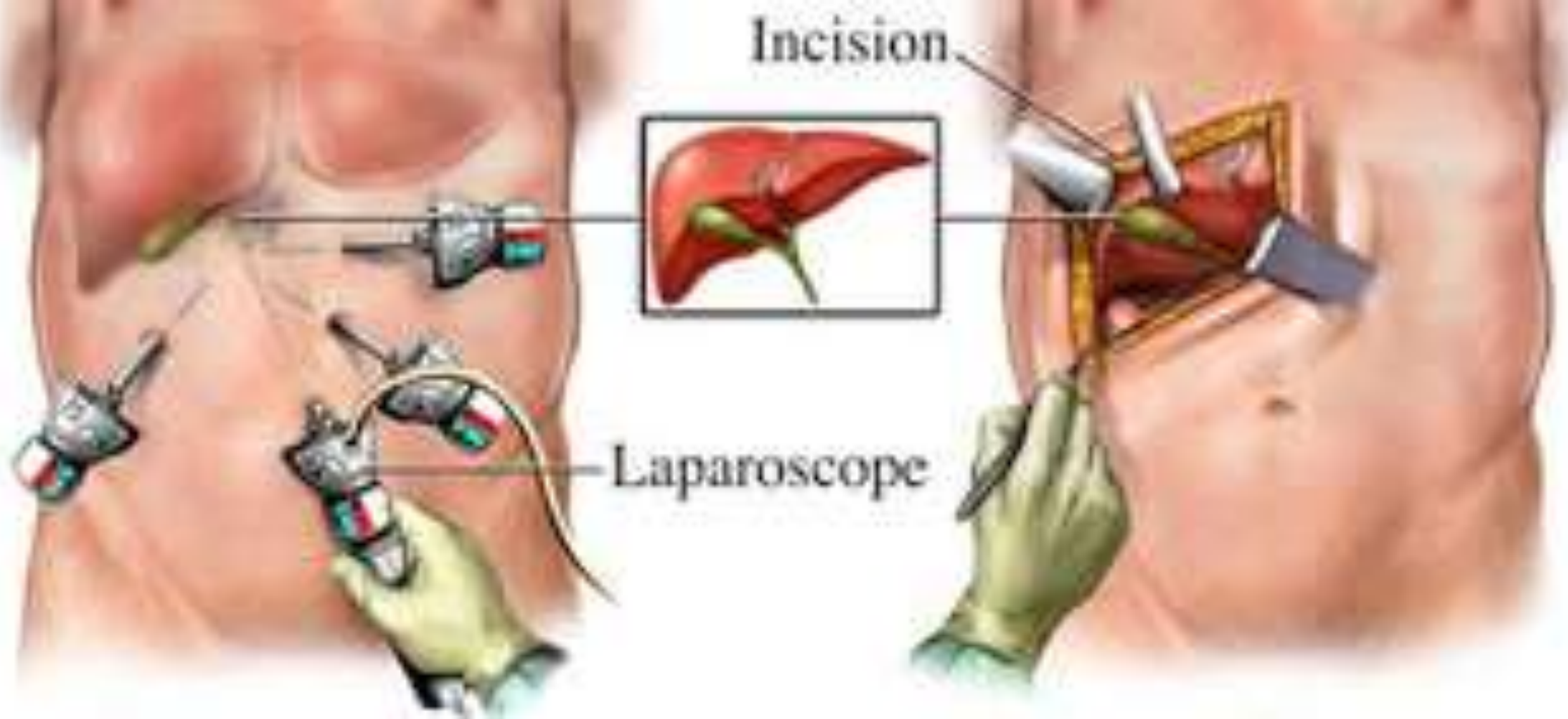
Palliative
gastro-entero-
anastomosis



Types of surgery: gastric cancer

Types of surgery

- Tissue incision:
 - Open
 - Mini-invasive
 - Endoscopic
 - Endovascular
 - Hybrid
- Steps:
 - One-step
 - Two or more steps
- Number of surgical procedures during one anesthesia
 - Combined: several procedures to treat one disease
 - Simultaneous: several procedures to treat several diseases



Open and laparoscopic surgery

Risk for wound infection

Type of procedure	Definition	Wound infection rate (%)	Example	Need for prophylaxis
Clean	Atraumatic; no inflammation encountered, no break in technique; gastro-intestinal, genitourinary and respiratory tracts not entered	1.5–4.2	Inguinal hernia repair	Not usually required
Clean-contaminated	Gastro-intestinal or respiratory tract entered but without spillage; oropharynx, appendectomy, sterile genitourinary or biliary tract entered; minor break in technique	<10	Cholecystectomy (no spillage)	Usually required
Contaminated	Acute inflammation; infected bile or urine; gross spillage from gastro-intestinal tract; major lapse in technique; fresh traumatic wound (12–24h)	10–20	Appendicectomy	Required
Dirty and infected	Established infection; transection of clean tissues to enable collection of pus; traumatic wound with retained devitalised tissue; faecal contamination; delayed treatment	20–40	Sigmoid colectomy (Hartmann's procedure) for faecal peritonitis	Treatment required (not prophylaxis)

Direct preparation for surgery

Elective surgery		Urgent surgery
Shower, shaving, clean dress	Surgical field	Dry shaving
12h starvation	Stomach	Stomach drain if necessary
Enema in the evening	Colon	No preparation
Urination before surgery	Urinary bladder	Catheterization
Full	Premedication	Partial



Risk assessment and
prevention of POCs

American Society of Anesthesiologists (ASA) Physical Status Classification System

ASA PS Classification	Definition	Examples, including, but not limited to:
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use
ASA II	A Patient with mild system disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity ($30 < \text{BMI} < 40$), well-controlled DM/HTN, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity ($\text{BMI} \geq 40$), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks, history (>3 months) of MI, CVA, TIA, or CAD/stents.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (<3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are begin removed for donor purposes	

POCs

0.41/1,000



9.6/1,000

Preoperative investigation

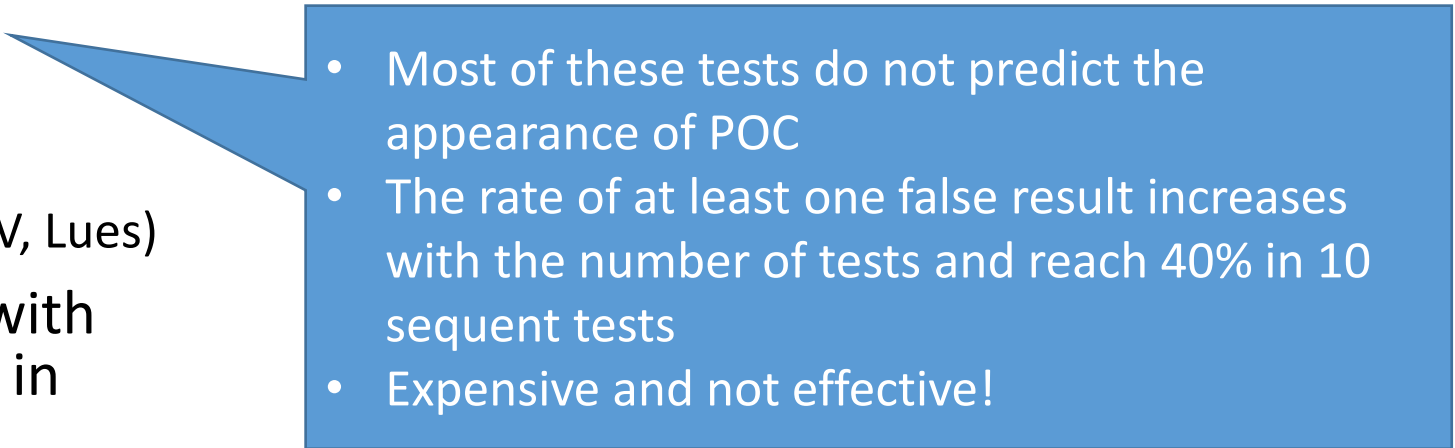
- **Russian approach** - clinical evaluation plus standard tests for all patients:

- Full blood count
- Urinalysis
- Blood glucose
- Liver function tests
- Renal function
- Electrolytes
- Tests of hemostasis
- Electrocardiogram
- Chest radiograph
- Blood type
- Blood infections (HIV, HCV, HBV, Lues)

- Additional tests for patients with comorbidities and deviations in standard tests

- **Evidence Based Medicine (EBM) approach:**

- Clinical examination for all patients
- Clinical assessment of the risk for POCs
- **No additional testing in healthy patients**
- Additional testing in patients at risk
- Pregnancy testing in all reproductive-age women

- 
- Most of these tests do not predict the appearance of POC
 - The rate of at least one false result increases with the number of tests and reach 40% in 10 sequent tests
 - Expensive and not effective!

Preoperative investigation

Table I. Reference values, action limits, and abnormal results.

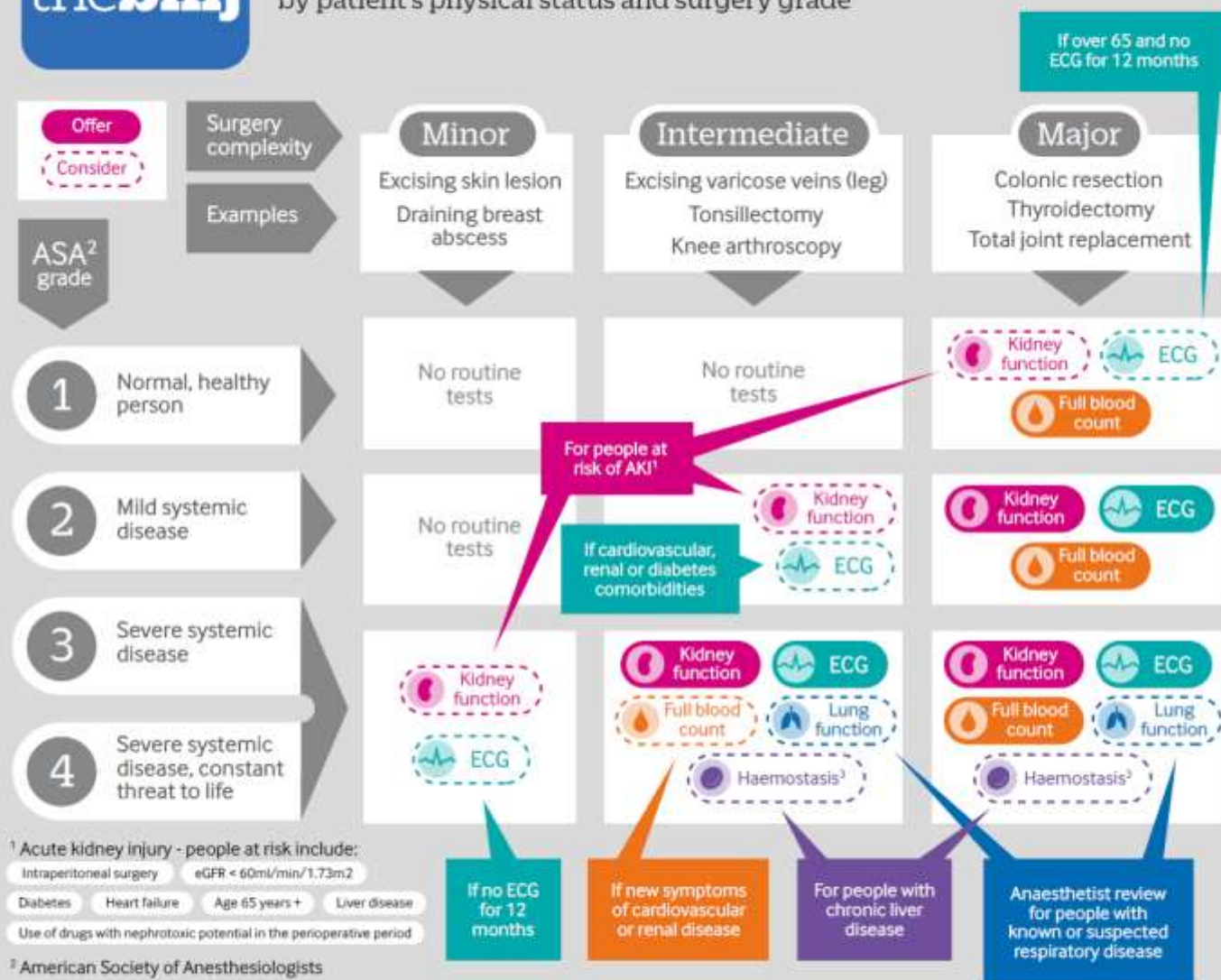
Test	N tests	% abnormal test results according to reference values (95% CI)	Action limits	% markedly abnormal test results according to action limits (95% CI)
ALAT (U/l)	440	10% (8%–13%)	<70	3% (1%–4%)
Cholesterol (mmol/l)	584	38% (34%–41%)	<8.0	3% (1%–4%)
Creatinine clearance (ml/min/1.73 m ²) ¹	780	61% (58%–65%)	<60	21% (18%–24%)
CRP (mg/l)	175	38% (31%–45%)	<50	5% (1%–8%)
ESR (mm/hr)	877	22% (19%–25%)	<40	5% (3%–6%)
Ferritin (µg/l)	57	47% (34%–60%)	15–1000	35% (23%–47%)
Gamma GT (U/l)	239	24% (19%–30%)	<90	6% (3%–9%)
Glucose (mmol/l)	949	8% (6%–9%)	3.0–11.0	2% (1%–3%)
Hemoglobin (mmol/l)	878	13% (11%–16%)	♀6.5–10.5, ♂ 7.5–11.5	2% (1%–3%)
Leukocytes (*10e9/l)	574	13% (10%–25%)	2.5–15.0	2% (1%–3%)
MCV (fl)	716	6% (5%–8%)	75–105	1% (0%–2%)
Potassium (mmol/l)	334	16% (12%–20%)	3.0–5.5	1% (0%–3%)
Sodium (mmol/l)	137	7% (2%–11%)	130–150	0%
TSH (mU/l)	660	11% (9%–13%)	0.1–8.0	5% (3%–7%)

Note: ¹MDRD formula, adjusted to the laboratory method for creatinine measurement (jaffe/enzymatic).

Theory of probabilities

Number of tests	Probability of results to be in the reference interval	Probability of one result to be out of the reference interval
1	0,95	$1 - 0,95 = 0,05$ — 5%
2	$0,95 \times 0,95 = 0,90$	$1 - 0,90 = 0,1$ — 10%
3	$0,95 \times 0,95 \times 0,95 = 0,86$	$1 - 0,86 = 0,14$ — 14%
5	$0,95^5 = 0,77$	$1 - 0,77 = 0,23$ — 23%
10	$0,95^{10} = 0,60$	$1 - 0,60 = 0,4$ — 40%
15	$0,95^{15} = 0,46$	$1 - 0,46 = 0,54$ — 54%
20	$0,95^{20} = 0,36$	$1 - 0,36 = 0,64$ — 64%
25	$0,95^{25} = 0,28$	$1 - 0,28 = 0,72$ — 72%

Recommended tests before elective surgery



Preoperative medical evaluation questions for a healthy patient

1. Do you usually get chest pain or breathlessness when you climb up two flights of stairs at normal speed?
2. Do you have kidney disease?
3. Has anyone in your family (blood relatives) had a problem following an anaesthetic?
4. Have you ever had a heart attack?
5. Have you ever been diagnosed with an irregular heartbeat?
6. Have you ever had a stroke?
7. If you have been put to sleep for an operation were there any anaesthetic problems?
8. Do you suffer from epilepsy or seizures?
9. Do you have any problems with pain, stiffness or arthritis in your neck or jaw?
10. Do you have thyroid disease?
11. Do you suffer from angina?
12. Do you have liver disease?
13. Have you ever been diagnosed with heart failure?
14. Do you suffer from asthma?
15. Do you have diabetes that requires insulin?
16. Do you have diabetes that requires tablets only?
17. Do you suffer from bronchitis?

17 “NO” – no additional tests

Clinical evaluation: risk factors

- **Age:** increase the number of comorbidities as risk factors, the independent risk factor only for pulmonary complications
- **Exercise capacity:** predicts the risk for cardiac complications
- **Medication use:** specific drug-mediated complications (eg, bleeding for NSAIDs and aspirin)
- **Obesity:** the risk factor only for pulmonary embolism
- **Obstructive sleep apnea:** the risk factor for pulmonary complications
- **Alcohol misuse:** risk factor for all POCs
- **Smoking:** risk factor for pulmonary complications
- **Personal or family history of anesthetic complications**

Exercise capacity

- Exercise capacity is an important determinant of overall perioperative risk; patients with good exercise tolerance generally have low risk.
- Functional status can be expressed in metabolic equivalents (1 MET is defined as 3.5 mL O₂ uptake/kg per min, which is the resting oxygen uptake in a sitting position)
- ≥ 4 METs associated with low rate of POCs
- The inability to climb two flights of stairs or walk four blocks associated with high risk of cardiopulmonary POCs

- Can take care of self, such as eat, dress, or use the toilet (1 MET)
- Can walk up a flight of steps or a hill or walk on level ground at 3 to 4 mph (4 METs)
- Can do heavy work around the house such as scrubbing floors or lifting or moving heavy furniture or climb two flights of stairs (between 4 and 10 METs).
- Can participate in strenuous sports such as swimming, singles tennis, football, basketball, and skiing (>10 METs)

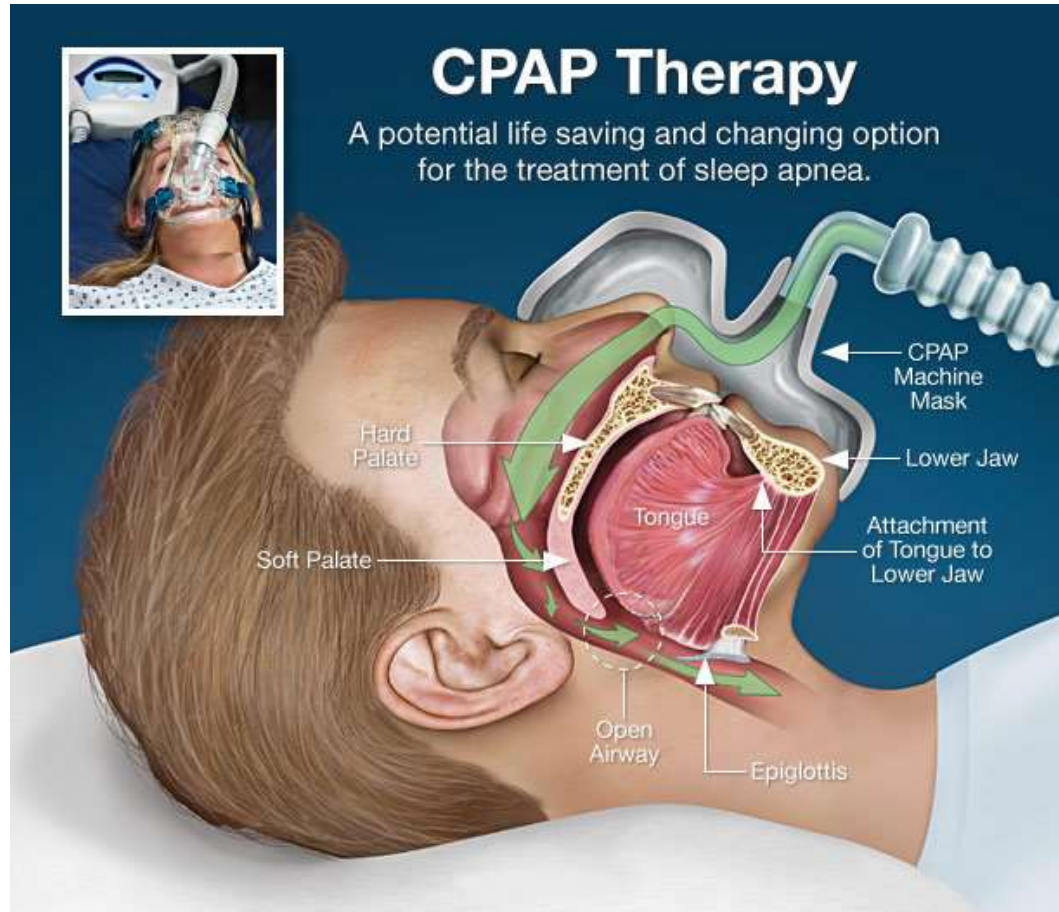
Obstructive sleep apnea

- Obstructive sleep apnea (OSA) is a disorder characterized by repetitive episodes of apnea or reduced inspiratory airflow due to upper airway obstruction during sleep.
- OSA is the most common type of sleep-disordered breathing, with an estimated prevalence of 1 in 4 males and 1 in 10 females for mild OSA, and 1 in 9 males and 1 in 20 females for moderate OSA
- Patients with obstructive sleep apnea (OSA) are at higher risk for complications from procedures with sedation, opioid analgesia, and/or anesthesia.
- Pulmonary complications
 - acute respiratory failure
 - hypoxemia
 - aspiration pneumonia
 - respiratory distress syndrome
- Cardiac events (blood pressure fluctuations, myocardial ischemia and cardiac arrhythmias)
- Acute renal failure
- Wound hematomas or seromas
- Postoperative delirium
- Additional risk in major surgery, general anesthesia, opioid analgesia

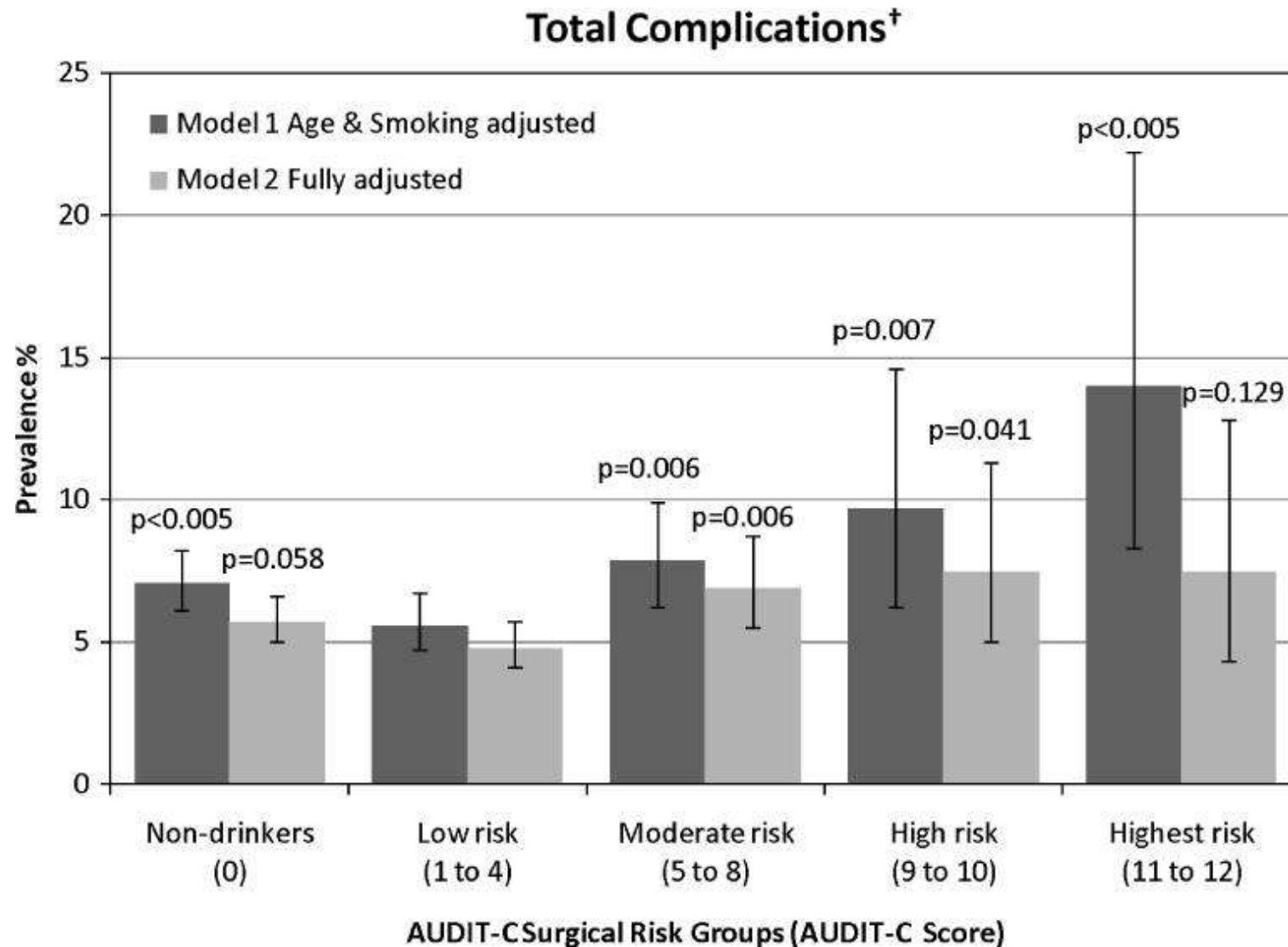
STOP-Bang questionnaire for OSA

Yes	No	Snoring? Do you snore loudly (loud enough to be heard through closed doors, or your bed partner elbows you for snoring at night)?
Yes	No	Tired? Do you often feel tired, fatigued, or sleepy during the daytime (such as falling asleep during driving)?
Yes	No	Observed? Has anyone observed you stop breathing or choking/gasping during your sleep?
Yes	No	Pressure? Do you have or are being treated for high blood pressure ?
Yes	No	Body mass index more than 35 kg/m²?
Yes	No	Age older than 50 years old?
Yes	No	Neck size large? (measured around Adam's apple) For male, is your shirt collar 17 inches or larger? For female, is your shirt collar 16 inches or larger?
Yes	No	Gender = Male?
Scoring criteria*:		
For general population		
Low risk of OSA: Yes to 0 to 2 questions		
Intermediate risk of OSA: Yes to 3 to 4 questions		
High risk of OSA: Yes to 5 to 8 questions		

Continuous positive airway pressure (CPAP) for treatment of OSA

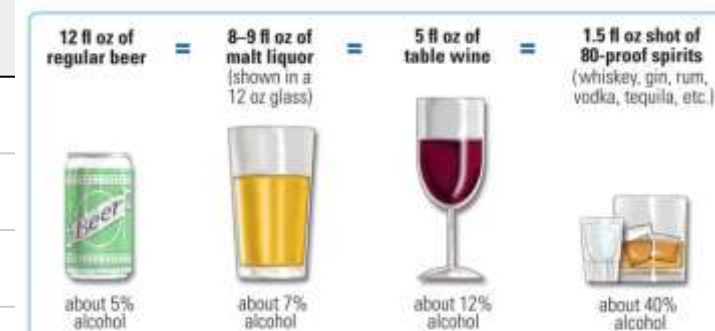


Alcohol misuse



Question #1: How often did you have a drink containing alcohol in the past year?

• Never	(0 points)
• Monthly or less	(1 point)
• Two to four times a month	(2 points)
• Two to three times per week	(3 points)
• Four or more times a week	(4 points)



in the United States, a standard drink contains about 14 grams of alcohol

Question #2: How many drinks did you have on a typical day when you were drinking in the past year?

• 1 or 2	(0 points)
• 3 or 4	(1 point)
• 5 or 6	(2 points)
• 7 to 9	(3 points)
• 10 or more	(4 points)

Question #3: How often did you have six or more drinks on one occasion in the past year?

• Never	(0 points)
• Less than monthly	(1 point)
• Monthly	(2 points)
• Weekly	(3 points)
• Daily or almost daily	(4 points)

The **AUDIT-C** is scored on a scale of 0 to 12 (scores of 0 reflect no alcohol use). In men, a score of 4 or more is considered positive; in women, a score of 3 or more is considered positive.

Additional tests

- **Hemoglobin/hematocrit:**

- all patients 65 years of age or older who are undergoing major surgery
- younger patients undergoing major surgery that is expected to result in significant blood loss
- The history of anemia

- **Platelets:** neuraxial anesthesia

- **Serum creatinine:**

- Patients over the age of 50 with cardiac risk (inside RCRI)
- Younger patients suspected of having renal disease, when hypotension is likely during surgery, or when nephrotoxic medications will be used

- **Blood glucose, electrolytes, liver function tests, tests of hemostasis, urinalysis:** not recommended in healthy patients, only in known or suggested disease or history of abnormalities

- **ECG:**

- patients with known heart disease, except for those undergoing low-risk surgery
- asymptomatic patients undergoing surgery with elevated cardiac risk

- **Chest radiographs:**

- patients with cardiopulmonary disease
- Patients older than 50 years of age who are undergoing abdominal aortic aneurysm surgery or upper abdominal/thoracic surgery



CARDIOVASCULAR COMPLICATIONS

- myocardial infarction,
- pulmonary edema,
- ventricular fibrillation,
- primary cardiac arrest
- complete heart block
- cardiac death
- Among unselected patients over age 40:
Perioperative MI in **1.4** percent and cardiac death in **1.0** percent
- Among consecutive surgical patients with CAD:
Perioperative MI in **3.2** percent and cardiac death in **1.7** percent

Risk for cardiac POCs

Patient-dependent

Revised cardiac risk index (RCRI)

- High-risk type of surgery (examples include vascular surgery and any open intraperitoneal or intrathoracic procedures)
- History of ischemic heart disease (history of MI or a positive exercise test, current complaint of chest pain considered to be secondary to myocardial ischemia, use of nitrate therapy, or ECG with pathological Q waves; do not count prior coronary revascularization procedure unless one of the other criteria for ischemic heart disease is present)
- History of HF
- History of cerebrovascular disease
- Diabetes mellitus requiring treatment with insulin
- Preoperative serum creatinine >2.0 mg/dL (177 micromol/L)

Rate of cardiac death, nonfatal myocardial infarction, and nonfatal cardiac arrest according to the number of predictors

No risk factors – 0.4 percent (95% CI: 0.1-0.8)

One risk factor – 1.0 percent (95% CI: 0.5-1.4)

Two risk factors – 2.4 percent (95% CI: 1.3-3.5)

Three or more risk factors – 5.4 percent (95% CI: 2.8-7.9)

Surgery-dependent

High risk (reported risk of cardiac death or nonfatal myocardial infarction [MI] often greater than 5%)

- Aortic and other major vascular surgery
- Peripheral artery surgery

Intermediate risk (reported risk of cardiac death or nonfatal MI generally 1 to 5%)

- Carotid endarterectomy
- Head and neck surgery
- Intraperitoneal and intrathoracic surgery
- Orthopedic surgery
- Prostate surgery

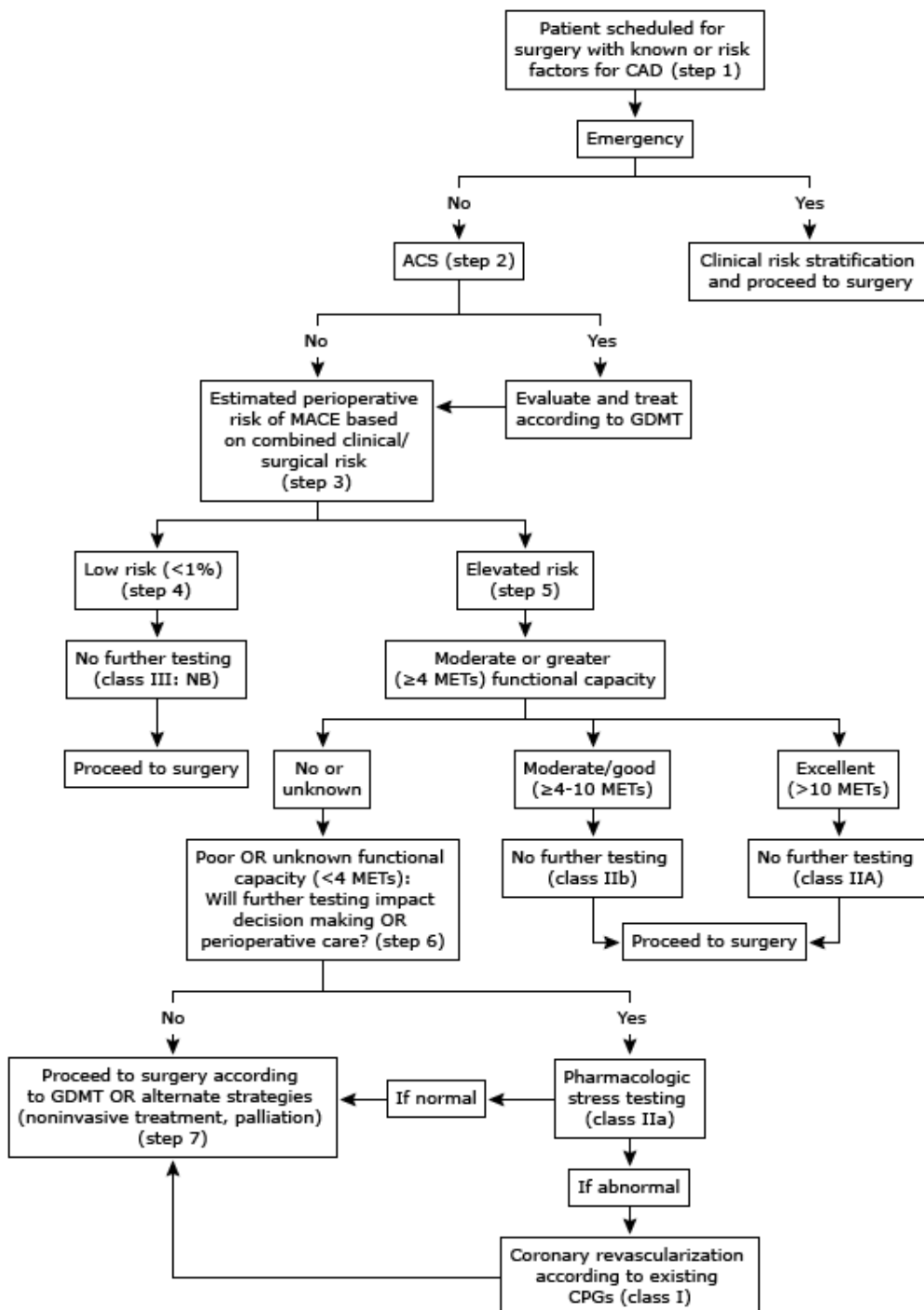
Low risk* (reported risk of cardiac death or nonfatal MI generally less than 1%)

- Ambulatory surgery[†]
- Endoscopic procedures
- Superficial procedures
- Cataract surgery
- Breast surgery

Risk assessment for cardiac POCs

- **Additional testing:**

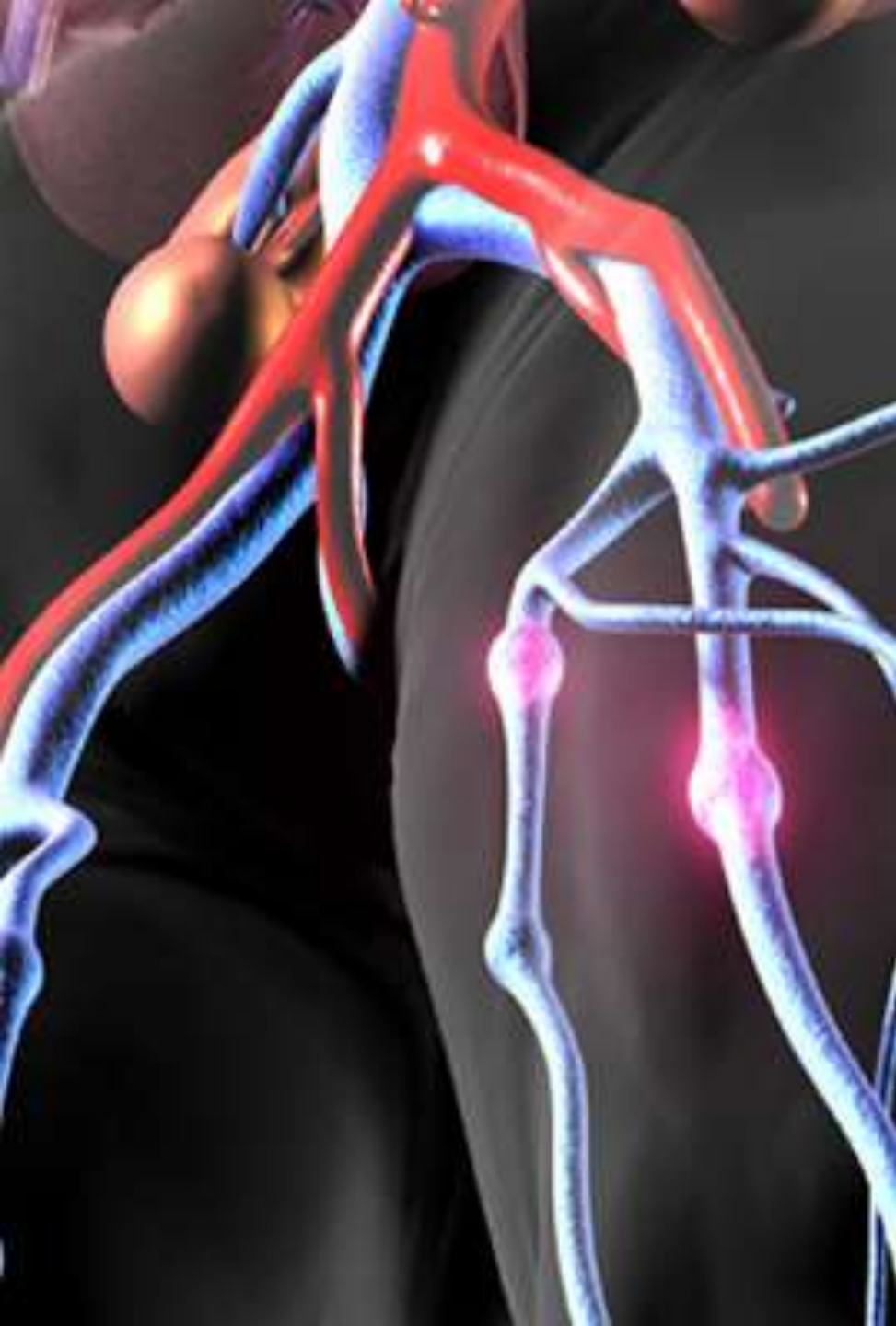
- **Stress testing** with exercises and pharmacology for heart ischemia
- **Resting echocardiography** for left ventricular dysfunction and valvular disease
- **24-hour ambulatory monitoring** for severe arrhythmia
- **Troponin and BNP** for chronic heart failure



ACS: acute coronary syndrome; CABG: coronary artery bypass graft surgery; CAD: coronary artery disease; CPG: clinical practice guideline; DASI: Duke Activity Status Index; GDMT: guideline-directed therapy; HF: heart failure; MACE: major adverse cardiac event; MET: metabolic equivalent; NB: no benefit; NSQIP: National Surgical Quality Improvement Program; PCI: percutaneous coronary intervention; RCRI: Revised Cardiac Risk Index; STEMI: ST elevation myocardial infarction; UA/NSTEMI: unstable angina/non-ST elevation myocardial infarction; VHD: valvular heart disease.

Perioperative prevention of cardiac POCs

- **Low risk** (less than 1%):
 - no specific prophylaxis, but monitoring
- **Elevated risk** (more than 1%):
 - **Should be continued** previously started statins and beta-blockers
 - **Should be started:**
 - statins in all patient as soon as possible,
 - beta-blockers – case to case (low blood pressure and heart rate are the risk for p/o ischemic stroke and death)
 - **Should be hold:** aspirin 5-7 days prior to surgery
 - **May be performed** revascularization in individual patients with high-risk features on noninvasive testing (eg, reversible large anterior wall defect, multiple reversible defects, ischemia occurring at a low heart rate, extensive stress-induced wall motion abnormalities, transient ischemic dilatation)



VENOUS THROMBOEMBOLISM

- Deep vein thrombosis
- Superficial vein thrombosis
- Pulmonary embolism
- In hospital:
 - 9,6 VTE episodes per 1000 patients annually
 - DVT – **1,3%**; PE – **0,4%**
 - Fatal PE – **0,3-0,5%**; 10-35% among all lethal outcomes

Risk assessment for VTE

Moderate risk factors (odds ratio 2–9)

- Arthroscopic knee surgery
- Central venous lines
- Chemotherapy
- Congestive heart or respiratory failure
- Hormone replacement therapy
- Malignancy
- Oral contraceptive therapy
- Paralytic stroke
- Pregnancy/, postpartum
- Previous venous thromboembolism
- Thrombophilia

Strong risk factors (odds ratio 10)

- Fracture (hip or leg)
- Hip or knee replacement
- Major general surgery
- Major trauma
- Spinal cord injury

Weak risk factors (odds ratio 2)

- Bed rest 3 days
- Immobility due to sitting (e.g. prolonged car or air travel)
- Increasing age
- Laparoscopic surgery (e.g. cholecystectomy)
- Obesity
- Pregnancy/, antepartum
- Varicose veins

Thrombosis Risk Factor Assessment

Patient's Name: _____ Age: ____ Sex: ____ Wgt: ____ lbs

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Choose All That Apply

Each Risk Factor Represents 1 Point

- ☐ Age 41-60 years
- ☐ Minor surgery planned
- ☐ History of prior major surgery (< 1 month)
- ☐ Varicose veins
- ☐ History of inflammatory bowel disease
- ☐ Swollen legs (current)
- ☐ Obesity (BMI > 25)
- ☐ Acute myocardial infarction
- ☐ Congestive heart failure (< 1 month)
- ☐ Sepsis (< 1 month)
- ☐ Serious lung disease incl. pneumonia (< 1 month)
- ☐ Abnormal pulmonary function (COPD)
- ☐ Medical patient currently at bed rest
- ☐ Other risk factors _____

Each Risk Factor Represents 3 Points

- ☐ Age over 75 years
- ☐ History of DVT/PE
- ☐ **Family history of thrombosis***
- ☐ Positive Factor V Leiden
- ☐ Positive Prothrombin 20210A
- ☐ Elevated serum homocysteine
- ☐ Positive lupus anticoagulant
- ☐ Elevated anticardiolipin antibodies
- ☐ Heparin-induced thrombocytopenia (HIT)
- ☐ Other congenital or acquired thrombophilia

If yes:
Type _____
*most frequently missed risk factor

Each Risk Factor Represents 2 Points

- ☐ Age 60-74 years
- ☐ Arthroscopic surgery
- ☐ Malignancy (present or previous)
- ☐ Major surgery (> 45 minutes)
- ☐ Laparoscopic surgery (> 45 minutes)
- ☐ Patient confined to bed (> 72 hours)
- ☐ Immobilizing plaster cast (< 1 month)
- ☐ Central venous access

Each Risk Factor Represents 5 Points

- ☐ Elective major lower extremity arthroplasty
- ☐ Hip, pelvis or leg fracture (< 1 month)
- ☐ Stroke (< 1 month)
- ☐ Multiple trauma (< 1 month)
- ☐ Acute spinal cord injury (paralysis)(< 1 month)

For Women Only (Each Represents 1 Point)

- ☐ Oral contraceptives or hormone replacement therapy
- ☐ Pregnancy or postpartum (<1 month)
- ☐ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score

Caprini score

- 39 individual risk factors
- Taking into the account the sum of scores and calculating the total risk:
 - 0-2 – Low (less than 10%)
 - 3-4 - Moderate (10-20%)
 - 5-8– High (20-40%)
 - 8-10 –Very high (40-80%)
 - 11+ - Extremely high (30-50% at the background of prophylaxis)

Perioperative prevention of VTE

- **Low risk (scores 0-2):**
 - Early ambulation
- **Moderate risk (scores 3-4):**
 - Compression stockings or UFH or LMWH or IPC or EMS
- **High risk (scores 5-8):**
 - Compression stockings + UFH/LMWH or IPC/EMS
- **Very high risk (scores 8-10):**
 - Compression stockings + UFH/LMWH (higher doses) or IPC/EMS
- **Extremely high risk (scores 11+):**
 - Compression stockings + UFH/LMWH (higher doses) + IPC/EMS

RESPIRATORY COMPLICATIONS

- Atelectasis
- Infection, including bronchitis and pneumonia
- Respiratory failure (mechanical ventilation for >48 hours after surgery or unplanned reintubation)
- Hypoxemia
- Exacerbation of underlying chronic obstructive pulmonary disease (COPD) or asthma
- Postoperative pulmonary complications occurred in **6%** of patients who underwent major abdominal surgery



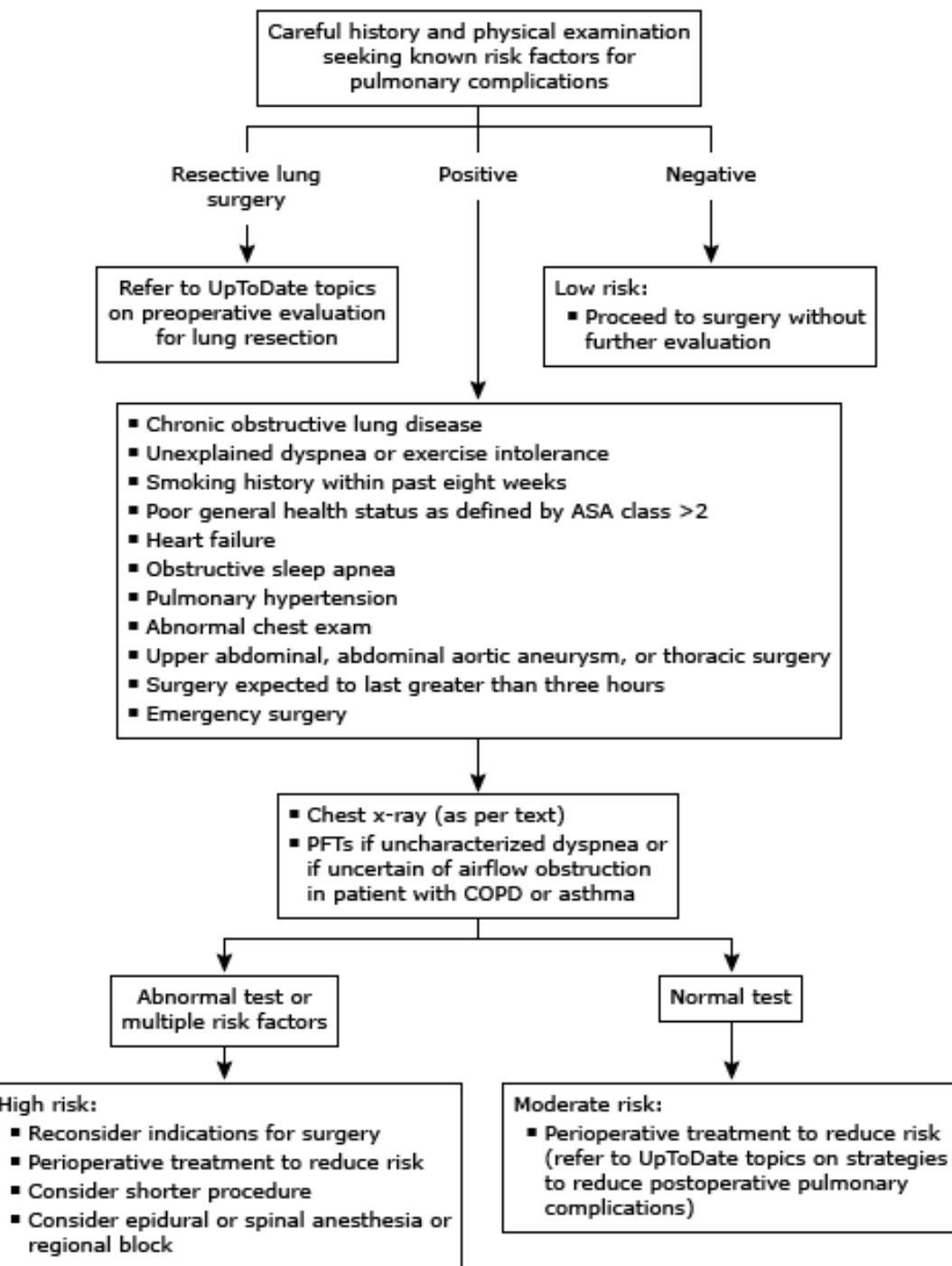
Risk factors of respiratory POCs

Patient-dependent factors

- Age
- Chronic obstructive pulmonary disease
- Asthma
- Smoking
- General health status (ASA>2)
- Obesity
- Obstructive sleep apnea
- Pulmonary hypertension
- Heart failure
- Upper-respiratory infection
- Metabolic and nutritional factors

Surgical-dependent factors

- Surgical site: distance from surgical incision to diaphragm (thorax > upper abdomen > head and neck)
- Duration of surgery: >3h
- Type of anesthesia: general > neuraxial
- Type of neuromuscular blockade: long-acting > short-acting



Additional tests

- Chest X-ray
 - patients undergoing high-risk surgery who are over age 50 years, or who have cardiac or pulmonary disease suggested by the clinical evaluation
- Pulmonary function testing
 - patients with uncharacterized dyspnea or exercise intolerance
 - Patients with chronic obstructive pulmonary disease (COPD) or asthma where clinical evaluation cannot determine if airflow obstruction has been optimally reduced
- Cardiopulmonary exercise testing (CPET)
 - patients with abnormal PFTs to determine the safety of planned lung resection surgery
 - evaluation of patients with unexplained dyspnea who are undergoing major surgery.

Calculator: ARISCAT (Canet) preoperative pulmonary risk index

Age

- ☐ ≤50 years old (0 points)
- ☐ 51 to 80 years old (3 points)
- ☐ >80 years old (16 points)

Preoperative oxygen saturation

- ☐ ≥96% (0 points)
- ☐ 91 to 95% (8 points)
- ☐ ≤90% (24 points)

Other clinical risk factors

- ☐ Respiratory infection in the last month (17 points)
- ☐ Preoperative anemia with hemoglobin ≤10 g/dL (11 points)
- ☐ Emergency surgery (8 points)

Surgical incision

- ☐ Upper abdominal (15 points)
- ☐ Intrathoracic (24 points)

Duration of surgery

- ☐ ≤2 hours (0 points)
- ☐ 2 to 3 hours (16 points)
- ☐ >3 hours (23 points)

0 to 25 points: Low risk: 1.6% pulmonary complication rate
26 to 44 points: Intermediate risk: 13.3% pulmonary complication rate
45 to 123 points: High risk: 42.1% pulmonary complication rate

Preoperative strategy to reduce the risk of pulmonary POCs

- Smoking cessation: preferably more than **8 weeks** prior to surgery (however, briefer periods of cessation are not harmful)
- For patients with COPD or asthma, optimize control with inhaled bronchodilators and possibly inhaled glucocorticoids, and possibly systemic glucocorticoids as per guidelines in the nonoperative setting
- For patients with a flare of COPD or asthma, administer systemic glucocorticoids (eg, prednisone 40 mg/day for five days) and delay elective surgery until COPD/asthma is under good control and has returned to baseline
- Reserve preoperative antibiotics for patients with symptoms and signs of lower respiratory infection
- Delay elective surgery in patients with COPD or asthma, if respiratory infection present
- Provide preoperative education regarding lung expansion maneuvers
- Initiate chest physical therapy (eg, aerobic exercises, breathing exercises, inspiratory muscle training)

Intraoperative strategy to reduce the risk of pulmonary POCs

- Choose shorter procedure (less than three hours), when possible
- Choose less invasive procedure, when possible (e.g., laparoscopic), as long as operative time not prolonged
- Consider neuraxial anesthesia rather than general anesthesia
- Regional anesthesia (nerve block) when this is an option
- For patients with COPD or asthma, administer inhaled short-acting beta-adrenergic (e.g., albuterol) 2 to 4 puffs within 30 minutes before intubation
- Avoid long-acting neuromuscular blocking agents for induction or during procedure
- Avoid pulmonary artery catheterization, unless clearly indicated for procedure (e.g., patient with congenital heart disease and pulmonary hypertension)

Postoperative strategy to reduce the risk of pulmonary POCs

- Initiate deep breathing exercises or incentive spirometry in high-risk patients
- Use epidural analgesia in place of parenteral opioids, as appropriate
- For patients with asthma and Aspirin-Exacerbated Respiratory Disease, **avoid** using NSAIDS for pain control (e.g., ketorolac, ibuprofen)
- CPAP (eg, 10 cm H₂O via nasal or face mask for four to six hours) may reduce the incidence of hypoxemia, pneumonia, reintubation, and ICU admission in high-risk patients
- Avoiding use of nasogastric tubes after abdominal surgery (unless needed for symptom control) may reduce pulmonary complications

Lung expansion

- Deep breathing and incentive spirometry
- Intermittent positive pressure breathing (IPPB)
- Continuous positive airway pressure (CPAP)



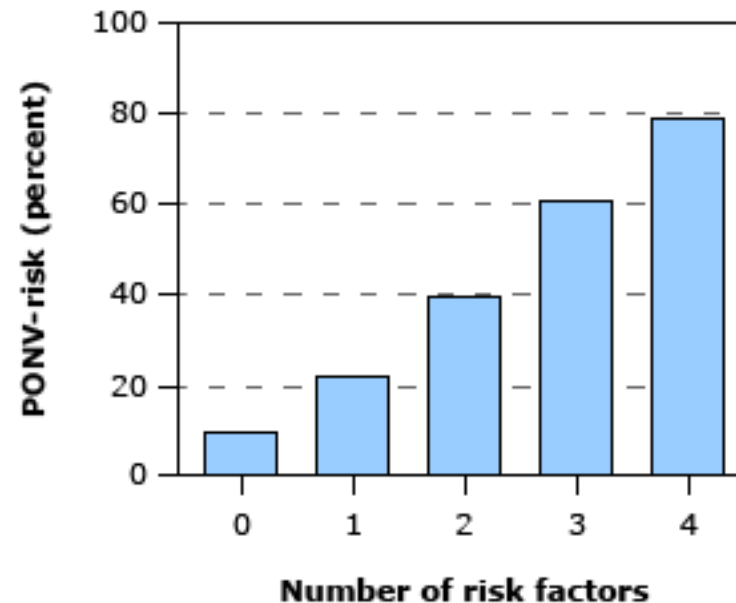
POSTOPERATIVE NAUSEA AND VOMITING (PONV)

- The incidence following anesthesia ranges between 10 and 30 percent.
- Risk factors:
 - female gender,
 - history of motion sickness,
 - absence of a history of smoking,
 - prior PONV,
 - type of surgery, including neurological, head or neck, abdominal, and possibly breast surgery

A

PONV in adults

Risk factors	Points
Female gender	1
Non-smoker	1
History of PONV	1
Postoperative opioids	1
Sum =	0...4



Prevention of PONV

- Antiemetic drugs for patients with 1+ risk factors:
 - 1 risk factor – 1 drug
 - 2+ risk factors – several drugs
- Antiemetic drugs:
 - selective serotonin-receptor (5-HT₃) antagonists ondansetron, dolasetron, granisetron, palonosetron)
 - Glucocorticoids (Dexamethasone)
 - Anticholinergics (Scopolamine, atropine)
 - Neurokinin-receptor antagonists (Aprepitant)
 - Benzodiazepine – Midazolam
 - Dopamine-receptor (D₂) agonist - Metoclopramide

POSTOPERATIVE FEVER

Days 0-2

Mild fever (temperature $<38^{\circ}\text{C}$) (common):

- Tissue damage and necrosis at the operation site.
- Hematoma.

Persistent fever (temperature $>38^{\circ}\text{C}$):

- Atelectasis: the collapsed lung may become secondarily infected.
- Specific infections related to the surgery - e.g., biliary infection following biliary surgery, UTI following urological surgery.
- Blood transfusion or drug reaction.

POSTOPERATIVE FEVER

Days 3-5

- Bronchopneumonia.
- Sepsis.
- Wound infection.
- Drip site infection or phlebitis.
- Abscess formation - e.g., subphrenic or pelvic, depending on the surgery involved.
- DVT.

After 5 days

- Specific complications related to surgery - e.g., bowel anastomosis breakdown, fistula formation.
- After the first week:
 - Wound infection.
 - Distant sites of infection - e.g., UTI, chest infection.
 - DVT, pulmonary embolism.

POSTOPERATIVE INABILITY TO VOID

Risk factors:

- Patient: Advanced age, male gender, pre-existing neurologic disease (eg, cerebral palsy, neuropathy, multiple sclerosis)
- Procedure: Anorectal surgery, joint arthroplasty, hernia repair
- Anesthesia
 - Medications (anticholinergic agents, beta-blockers, sympathomimetics)
 - Prolonged duration of anesthesia
 - Excessive fluid administration
 - Mode of anesthesia; neuraxial anesthesia is more likely to cause POUR compared with general anesthesia (inhaled or intravenous [IV])

Inability to void is common following anesthesia. The incidence varies widely, ranging from 5 to 70 percent depending upon patient, procedure, and anesthesia-specific factors. Patients with more than one risk factor for urinary retention should undergo assessment of urinary volume to determine if one-time catheterization is needed prior to discharge. Patients with more than 600 cc of urine should undergo one-time catheterization, after which ambulatory patients may be discharged.

WOUND COMPLICATIONS

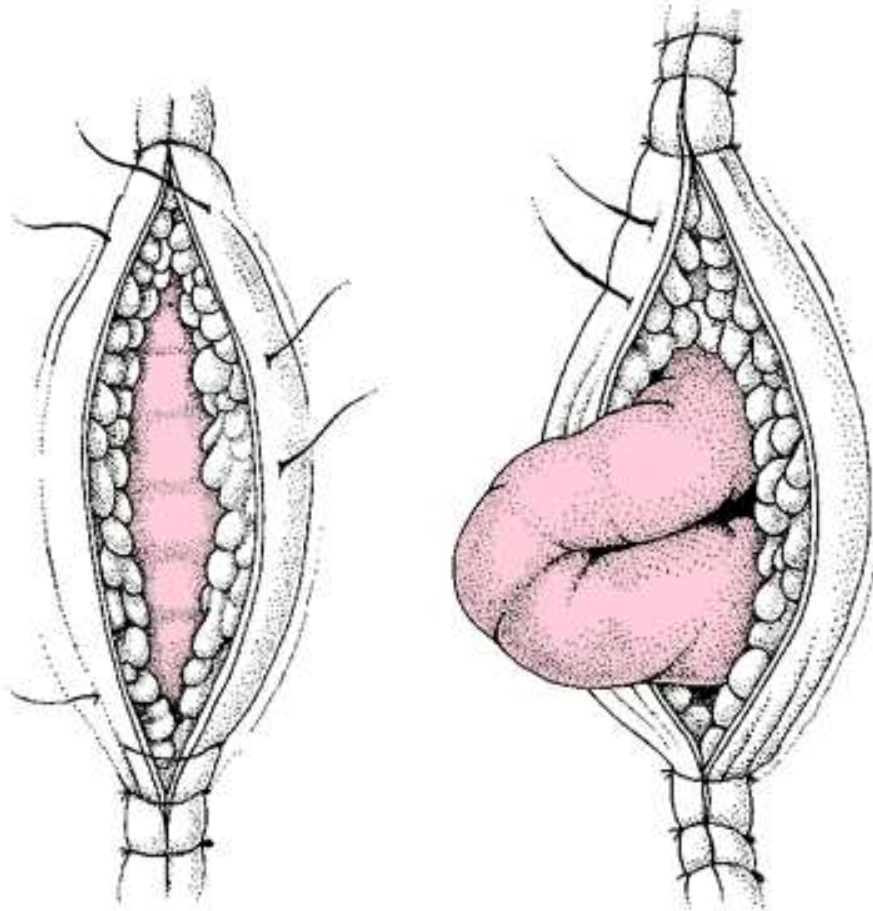
- Wound infection: the most common form is superficial wound infection occurring within the first week, presenting as localized pain, redness and slight discharge usually caused by skin staphylococci.
- Cellulitis and abscesses:
 - Usually occur after bowel-related surgery.
 - Most present within the first week but can be seen as late as the third postoperative week, even after leaving hospital.
 - Present with pyrexia and spreading cellulitis or abscess.
 - Cellulitis is treated with antibiotics.
 - Abscess requires suture removal and probing of the wound, but deeper abscess may require surgical re-exploration. The wound is left open in both cases to heal by secondary intention.
- Gas gangrene is uncommon and life-threatening.
- Wound sinus is a late infectious complication from a deep chronic abscess that can occur after apparently normal healing. It usually needs re-exploration to remove non-absorbable suture or mesh, which is often the underlying cause.
- Prophylaxis: assessing the risk for infection and perioperative administration of antibiotics (contaminated, clean-contaminated surgery)



Wound dehiscence

- This affects about 2% of midline laparotomy wounds.
- It is a serious complication with a mortality of up to 30%.
- It is due to failure of wound closure technique.
- It usually occurs between 7 and 10 days postoperatively.
- Often, it is heralded by serosanguinous discharge from the wound.
- It should be assumed that the defect involves the whole of the wound.
- Initial management includes opiate analgesia, sterile dressing to the wound, fluid resuscitation and early return to theatre for re-suture under general anaesthesia.

Evisceration



Dehiscence

Evisceration





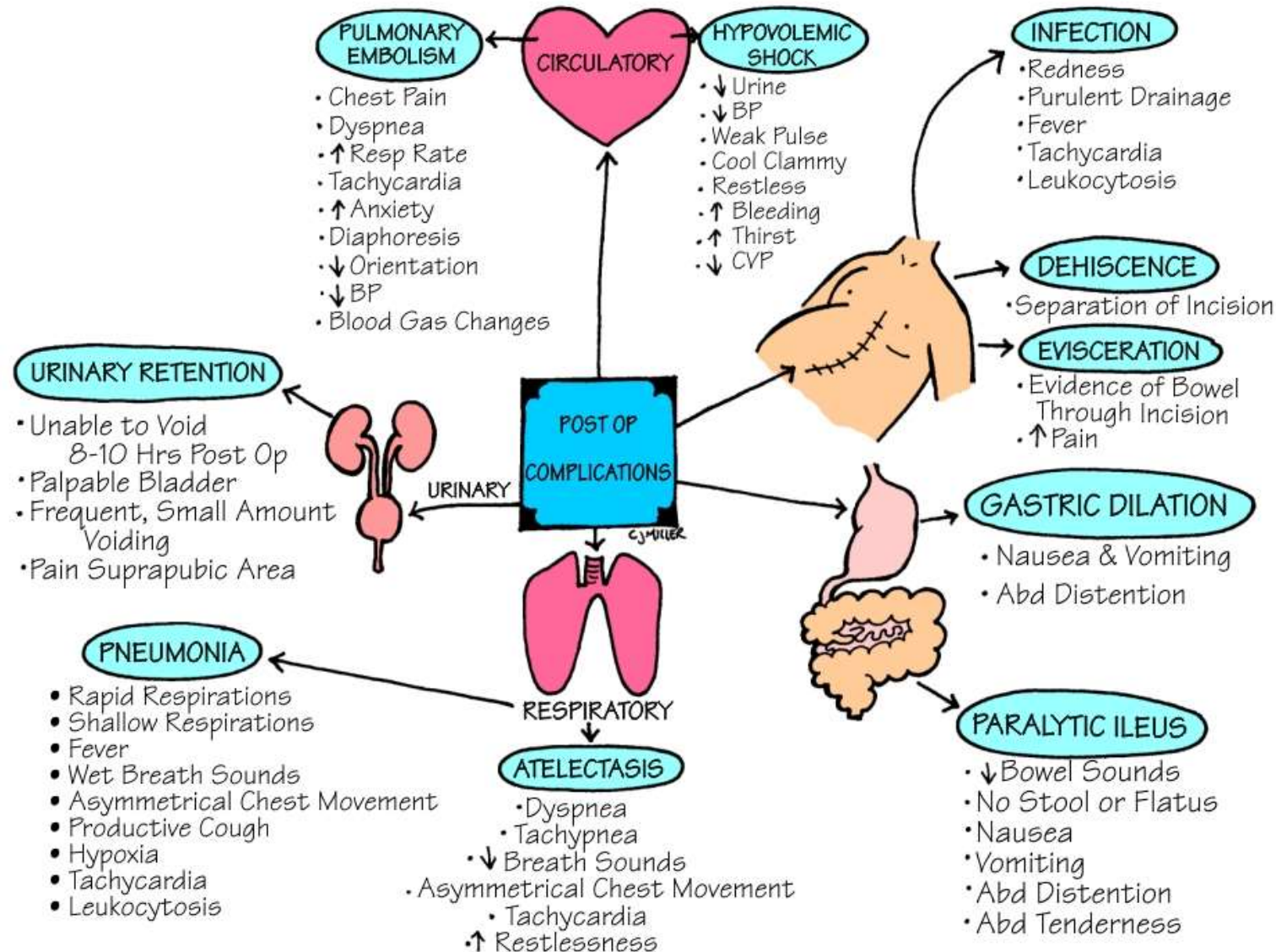
Incisional hernia

- This occurs in 10-15% of abdominal wounds, usually appearing within the first year but can be delayed by up to 15 years after surgery.
- Risk factors include obesity, distension and poor muscle tone, wound infection and multiple use of the same incision site.
- It presents as a bulge in the abdominal wall close to a previous wound. It is usually asymptomatic but there may be pain, especially if strangulation occurs. It tends to enlarge over time and become an nuisance.
- Management: surgical repair where there is pain, strangulation or nuisance. The use of laparoscopic techniques and biosynthetic mesh is being evaluated.

COMPLICATIONS OF BOWEL SURGERY

- Delayed return of function:
 - Temporary disruption of peristalsis: the patient may complain of nausea, anorexia and vomiting and it usually appears with the re-introduction of fluids. It is often described as ileus.
 - The more prolonged extensive form with vomiting and intolerance to oral intake is called adynamic obstruction and needs to be distinguished from mechanical obstruction. It involves the large bowel and is usually described as pseudo-obstruction. It is diagnosed by instant barium enema.
- Mechanical obstruction
- Anastomotic leakage or breakdown

The most common POCs



Enter Patient and Surgical Information

Procedure

43621 - Gastrectomy, total, with Roux-en-Y reconstruction

Clear

Begin by entering the procedure name or CPT code. One or more procedures will appear below the procedure box. You will need to click on the desired procedure to properly select it. You may also search using two words (or two partial words) by placing a "*" in between, for example: "cholecystectomy + cholangiography"

Reset All Selections

Are there other potential appropriate treatment options? ☐ Other Surgical Options ☐ Other Non-operative options ☒ None

Please enter as much of the following information as you can to receive the best risk estimates.
A rough estimate will still be generated if you cannot provide all of the information below.

Age Group

65-74 years

Sex

Male

Functional Status

Independent

Emergency Case

No

ASA Class

Mild systemic disease

Steroid use for chronic condition

No

Ascites within 30 days prior to surgery

No

Systemic Sepsis within 48 hours prior to surgery

None

Ventilator Dependent

No

Disseminated Cancer

No

Diabetes

No

Hypertension requiring medication

Yes

Congestive Heart Failure in 30 days prior to surgery

No

Dyspnea

No

Current Smoker within 1 Year

No

History of Severe COPD

No

Dialysis

No

Acute Renal Failure

No

BMI Calculation:

Height: 69 in / 175 cm

Weight: 167 lb / 75 kg

Back

Continue

Step 2 of 4

Procedure: 43621 - Gastrectomy, total, with Roux-en-Y reconstruction

Risk Factors: 65-74 years, HTN

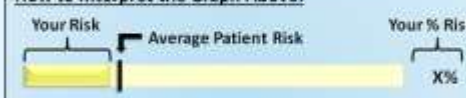
Change Patient Risk Factors

Outcomes

	Your Risk	Average Risk	Chance of Outcome
Serious Complication	20.8%	27.8%	Below Average
Any Complication	23.4%	31.1%	Below Average
Pneumonia	3.6%	6.8%	Below Average
Cardiac Complication	0.6%	1.0%	Below Average
Surgical Site Infection	10.3%	14.8%	Below Average
Urinary Tract Infection	3.6%	3.3%	Average
Venous Thromboembolism	1.1%	1.7%	Below Average
Renal Failure	0.6%	1.4%	Below Average
Readmission	8.4%	11.7%	Below Average
Return to OR	7.0%	9.2%	Below Average
Death	0.7%	1.7%	Below Average
Discharge to Nursing or Rehab Facility	7.8%	7.7%	Average

Predicted Length of Hospital Stay: 8.5 days

How to Interpret the Graph Above:



Surgeon Adjustment of Risks

This will need to be used infrequently, but surgeons may adjust the estimated risks if they feel the calculated risks are underestimated. This should only be done if the reason for the increased risks was NOT already entered into the risk calculator.

1 - No adjustment necessary

Back

Continue

Step 3 of 4

Basic principles of modern perioperative management to improve patient outcome

Preoperative

Informed consent and motivation

Interdisciplinary risk assessment

Optimal physical condition and medication

Intraoperative

Atraumatic surgical techniques

Regional or combined anesthesia

Optimized airway management and ventilation

Glucose control in major surgery

Optimal fluid management

Avoidance of hypothermia

Postoperative

Modern opioid-sparing analgesia

Early mobilization

VTE prevention

Extended lung expansion exercises

Early removal of catheters, tubes and drains

Early oral nutrition