OBJECTIVES

✓ CPMT SYNDROME
  • ABDOMEN
  • EXTREMITY
OBJECTIVES

✓ CPMT SYNDROME
  • ABDOMEN
  • EXTREMITY
Abdominal Compartment Syndrome

- Described in 19th century
- Became increasingly problematic with increasing resuscitation
- Continues to impact critically ill patients today
Abdominal Compartment Syndrome

- Definitions
- Clinical presentation
- Measurement
- Treatment
Abdominal Compartment Syndrome

- Definitions
- Clinical presentation
- Measurement
- Treatment
Results from the International Conference of Experts on Intra-abdominal Hypertension and Abdominal Compartment Syndrome.

I. Definitions

II. Recommendations
IAH/ACS Definitions

✓ **IAP**: pressure within abdominal cavity (mmHg)

✓ Normal is 5-7 mmHg, higher if obese

✓ **IAH**: sustained elevation >12 mmHg
  
  – Gr I: 12-15 mmHg
  – Gr 2: 16-20 mmHg
  – Gr 3: 21-25 mmHg
  – Gr 4: >25 mmHg
IAH/ACS Definitions

✓ IAP: pressure within abdominal cavity (mmHg)
✓ Normal is 5-7 mmHg, higher if obese
✓ **IAH:** sustained elevation >12 mmHg
  - Gr I: 12-15 mmHg
  - Gr 2: 16-20 mmHg
  - Gr 3: 21-25 mmHg
  - Gr 4: >25 mmHg
INCREASED IAP

What Happens to the Body’s Organs?
A Vicious Cycle

Fluid resuscitation for critical illness

Total body fluid thickening/spacing/edema
Elevated intra-abdominal pressure due to bowel edema
Vena cava compression

Brain:
Elevated intra-cranial pressure

Lungs:
Barotrauma (pneumothorax, edema, hypoxia)

Intestines:
Edema, ischemia, necrosis

Kidneys:
Decreased blood flow to kidneys, renal venous congestion, decreased UOP, Renal failure

Heart:
Reduced cardiac output, false elevations in CVP and wedge

Multi-system organ dysfunction/failure

Reduced blood flow to organs
Reduced cardiac output
Reduced blood return to heart (preload)
IAH/ACS Definitions

**ACS:** IAP >20 mmHg + Organ Dysfunction
- Renal failure-decreased u/o
- Cardiac failure-hypotension
- Respiratory failure-high peak and plateau P

**Primary:** injury or disease in abdomen

**Secondary:** conditions that do not originate within abdomen

**Recurrent:** redevelops following previous surgical or medical treatment
IAH/ACS Definitions

**ACS:** IAP >20 mmHg + Organ Dysfunction
- Renal failure-decreased u/o
- Cardiac failure-hypotension
- Respiratory failure-high peak and plateau P

**Primary:** injury or disease in abdomen

**Secondary:** conditions that do not originate within abdomen

**Recurrent:** redevelops following previous surgical or medical treatment
MANY CAUSES...

- Trauma
- Post-Surgery
- Burns
- Ascites
- Resuscitation
- Ileus
- Colonic pseudo-obstruction
- Pancreatitis
Diagnosis-Measuring Pressure

- Physical exam insensitive
- Imaging not useful
  - Plain films
  - CT
  - MRI
Diagnosis-Measuring Pressure

- Water column or transduction
- Bladder most common, gastric rare
Diagnosis
Standard Foley
3-way stopcock
20cc syringe
To Water Column
Measuring IAP

- Supine
- End-expiration, relaxed
- Zero at iliac crest mid-axillary line
- Expressed as mmHg (1 mmHg = 1.36 cmH₂O)
Measuring IAP

- Use <25 mL or 1 mL/kg max of 20 mL water
- 30-60 seconds after water instilled
- Wait for equilibration
- Repeat as required
TREATMENT

✓ Minimize crystalloid resuscitation
✓ HOB @ 20-30 degrees
✓ Decompress stomach with NG
✓ Sedation / analgesia
✓ NMB
TREATMENT

✓ Burns-Percutaneous decompression if intraperitoneal fluid

✓ Surgical decompression
SUMMARY ACS

- High index of suspicion in pts with risk factors and distended abdomen
- IAP > 12 mmHg = IAH
- IAP > 20 mmHg + organ dysfunction = ACS
- Hypotension, urine output, peak/plateaus
- Rx = medical +/- drainage +/- laparotomy
EXTREMITY COMPARTMENT SYNDROME
• Volkmann (1830-1889)
• Described sequelae of untreated compartment syndrome
GENERAL

- Compartment pressure exceeds perfusion
- External-reduced volume
- Internal-increased content
GENERAL

- Compartment pressure exceeds perfusion
- *External* - reduced volume
  - cast/dressings
  - burn
GENERAL

- Compartment pressure exceeds perfusion
- *Internal* - increased content
  - exercise
  - fracture
  - crush, hematoma
  - vascular injury
  - iatrogenic
Incidence and predictors for the need for fasciotomy after extremity trauma: A 10-year review in a mature level I trauma centre

Bernardino C. Branco, Kenji Inaba *, Galinos Barmparas, Beat Schnüriger, Thomas Lustenberger, Peep Talving, Lydia Lam, Demetrios Demetriades

✅ 10 yr review
✅ 10,315 extremities
✅ 2.8% fasciotomy rate
Incidence and predictors for the need for fasciotomy after extremity trauma: A 10-year review in a mature level I trauma centre

Bernardino C. Branco, Kenji Inaba *, Galinos Barmparas, Beat Schnüriger, Thomas Lustenberger, Peep Talving, Lydia Lam, Demetrios Demetriades
Incidence and predictors for the need for fasciotomy after extremity trauma: A 10-year review in a mature level I trauma centre

Bernardino C. Branco, Kenji Inaba*, Galinos Barmparas, Beat Schnüriger, Thomas Lustenberger, Peep Talving, Lydia Lam, Demetrios Demetriades
Incidence and predictors for the need for fasciotomy after extremity trauma: A 10-year review in a mature level I trauma centre

Bernardino C. Branco, Kenji Inaba*, Galinos Barmparas, Beat Schnüriger, Thomas Lustenberger, Peep Talving, Lydia Lam, Demetrios Demetriades

2011
Incidence and predictors for the need for fasciotomy after extremity trauma: A 10-year review in a mature level I trauma centre

Bernardino C. Branco, Kenji Inaba *, Galinos Barmparas, Beat Schnüriger, Thomas Lustenberger, Peep Talving, Lydia Lam, Demetrios Demetriades
Incidence and predictors for the need for fasciotomy after extremity trauma: A 10-year review in a mature level I trauma centre

Bernardino C. Branco, Kenji Inaba*, Galinos Barmparas, Beat Schnüriger, Thomas Lustenberger, Peep Talving, Lydia Lam, Demetrios Demetriades

✓ 0.1% with NO extremity injury
DIAGNOSIS

✓ UN-EVALUABLE
✓ EVALUABLE
UN-EVALUABLE

✓ NO Imaging
✓ NO Serologic markers
✓ NIRS-not yet...
✓ Direct Compartment Pressure Measure
UN-EVALUABLE

✓ NO Imaging
✓ NO Serologic markers
✓ NIRS-not yet...
✓ Direct Compartment Pressure Measure
MEASURING

- All compartments, not just anterior
- Within 5cm of fracture site
Elevated Intramuscular Compartment Pressures Do Not Influence Outcome after Tibial Fracture

Timothy O. White, BMedSci, AFRCS, Glyn E. D. Howell, FRCS, Elizabeth M. Will, MCSP, Charles M. Court-Brown, MD, FRCS, and Margaret M. McQueen, MD, FRCS

- Normal 0-5mmHg
- Absolute P > 20-30mmHg
- Delta P (DBP-compartment P) < 30
Elevated Intramuscular Compartment Pressures Do Not Influence Outcome after Tibial Fracture

Timothy O. White, BMEdSci, AFRCs, Glyn E. D. Howell, FRCS, Elizabeth M. Will, MCSP, Charles M. Court-Brown, MD, FRCS, and Margaret M. McQueen, MD, FRCS

- Normal 0-5mmHg
- Absolute P > 20-30mmHg
- Delta P (DBP-compartment P) < 30
Elevated Intramuscular Compartment Pressures Do Not Influence Outcome after Tibial Fracture

Timothy O. White, BMedSci, AFRCS, Glyn E. D. Howell, FRCS, Elizabeth M. Will, MCSP, Charles M. Court-Brown, MD, FRCS, and Margaret M. McQueen, MD, FRCS

- Normal 0-5mmHg
- Absolute $P > 20-30$mmHg
- Delta $P$ (DBP-compartment $P$) $< 30$
Elevated Intramuscular Compartment Pressures Do Not Influence Outcome after Tibial Fracture

Timothy O. White, BMedSci, AFRCS, Glyn E. D. Howell, FRCS, Elizabeth M. Will, MCSP, Charles M. Court-Brown, MD, FRCS, and Margaret M. McQueen, MD, FRCS

- Tibia fractures
- Isolated >30mmHg vs Delta P
- As long as Delta P does not fall below 30, isolated P as high as 70mmHg tolerated
DIAGNOSIS

✓ UN-EVALUABLE
✓ EVALUABLE
EVALUABLE

✓ PAIN
✓ PALLOR
✓ POIKILOTHERMIA
✓ PARASTHESIA/PARALYSIS
✓ PULSELESSNESS
EVALUABLE

Tense, swollen extremity +

UNRELENTING PAIN
PAIN AT REST
PAIN ON PALPATION
PAIN WITH PASSIVE STRETCH
BAD PAIN....
Even in the evaluable patient...
EVALUABLE

✓ Dynamic process, may progress
✓ Repeat clinical evaluation
✓ Repeat pressure measurement
TREATMENT

SURGERY
ANTERIOR

DEEP POSTERIOR

SUPERFICIAL POSTERIOR

LATERAL

Deep posterior compartment

Fascia encloses the compartments

Tibia (shinbone)

Anterior compartment

Lateral compartment

Fibula

Superficial posterior compartment
SUPERFICIAL POSTERIOR

DEEP POSTERIOR

TIBIA

SUPERFICIAL POSTERIOR
POST-OP

- Negative Pressure Therapy
- Sequential attempts at closure
- One side better than none
- 1 week-continue versus graft
SUMMARY

• Common complication
• Pain is key clinical finding
• Liberal use of pressure monitoring
• Isolated P>20-30 mmHg
• Delta P<30 mmHg
• Watch for missed ANTERIOR and DEEP POSTERIOR
POST-OP

- Follow CKs
- Check muscle
MYOGLOBINURIA

- Muscle breakdown = myoglobin release
- Damages Renal Tubules
- ATN-like
- Classic Dx: Urine dip+ but no RBC on micro
MYOGLOBINURIA

• Practical Dx: muscle enzymes
  ✓ Creatinine Phosphokinase
  ✓ Lactate Dehydrogenase
  ✓ Aldolase Enzyme

• CK > 5000 U/L or upgoing trend

• Treatment is inexpensive and low risk so err on side of caution
TREATMENT

- Crystalloid volume infusion
- UOP > 1 cc/kg
- Follow K and Phosphate levels
- Poor evidence to support either Bicarbonate or Mannitol infusion
SUMMARY ACS

✓ High index of suspicion in pts with risk factors and distended abdomen
✓ IAP > 12 mmHg = IAH
✓ IAP > 20 mmHg + organ dysfunction = ACS
✓ Hypotension, urine output, peak/plateaus
✓ Rx = medical +/- drainage +/- laparotomy
SUMMARY EXTREMITY CPMT

✓ Common complication
✓ Pain is key clinical finding
✓ Liberal use of pressure monitoring
✓ Isolated $P>20-30$ mmHg
✓ Delta $P<30$ mmHg
✓ Watch for missed ANTERIOR and DEEP POSTERIOR