Intraabdominal Pressure

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Results from the International Conference of Experts on Intra-Abdominal Hypertension (IAH) and Abdominal Compartment Syndrome (ACS)

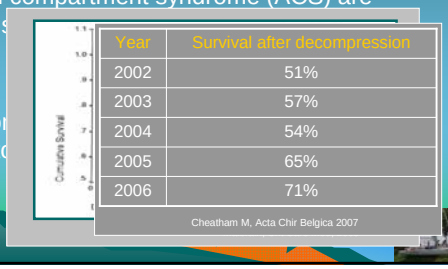
DEFINITIONS
RECOMMENDATIONS

The World Society of the Abdominal Compartment Syndrome www.WSACS.

Intensive Care Medicine 2007; 33(6): 951-962

INTRODUCTION

- Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) are causes of s
critically ill
- Intra-abdo
essential t



Year	Survival after decompression
2002	51%
2003	57%
2004	54%
2005	65%
2006	71%

Cheatham M, Acta Chir Belgica 2007

RISK FACTORS & SURVEILLANCE FOR IAH/ACS

Patients should be screened for IAH / ACS risk factors upon ICU admission and in the presence of new or progressive organ failure (Grade 1B)

Abdominal pressure:	Total Prevalence	MICU prevalence	SICU prevalence
IAP > 12	58.8%	54.4%	65%
IAP > 15	28.9%	29.8%	27.5%
IAP > 20 plus organ failure	8.2%	10.5%	5.0%

Malbrain, Intensive Care Medicine (2004)

Definitions WCACS, Antwerp Belgium 2007

- *Intra-abdominal Pressure (IAP):* Intrinsic pressure within the abdominal cavity
- *Intra-abdominal Hypertension (IAH):* A sustained IAP > 12 mm Hg (often causing occult ischemia) without obvious organ failure
- *Abdominal Compartment Syndrome (ACS):* IAH > 20 mm Hg with at least one organ dysfunction or failure

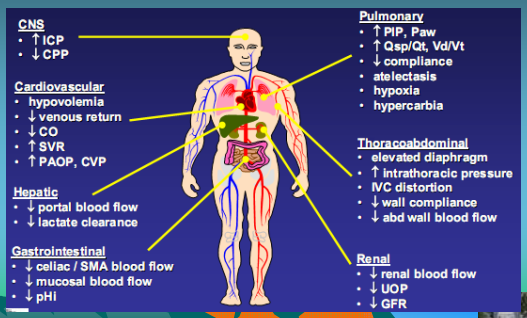
WHAT IS NORMAL IAP?

- *"Normal IAP is approximately 5-7 mmHg in critically ill adults."*
- IAP varies by disease severity:

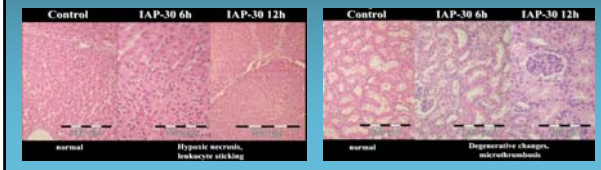
Normal adult	0-5 mmHg
Typical ICU patient	5-7 mmHg
Post-laparotomy patient	10-15 mmHg
Patient with septic shock	15-25 mmHg
Patient with acute abdomen	25-40 mmHg

- An IAP in excess of 15 mmHg can cause significant end-organ dysfunction, failure, and patient death.

Organ dysfunction



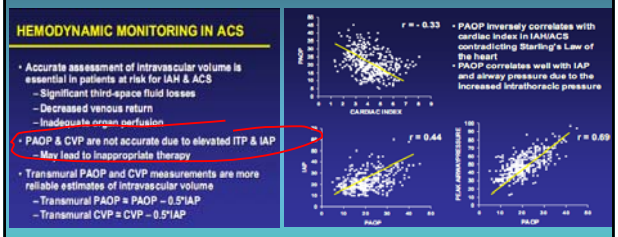
LIVER and KIDNEY



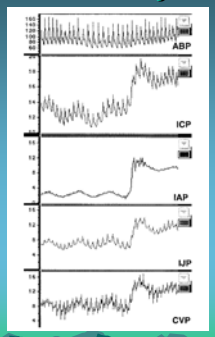
Liver Kidney

Schachtrupp, Shock 2005

Hemodynamic



Physiologic Sequelae



Direct impact of IAP on pressure measurements:

- IAP elevation causes immediate increases in ICP, IJP and CVP (also in PAOP)

15 liter bag placed on abdomen

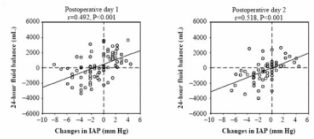
Citerio, 2001

Fluid Resuscitation ?

- IAH and ca

- IAH and fluids

Fluid balance and IAH in postoperative patients



Serpytis M et al., Medicina (Kaunas) 2008; 44: 421-7.

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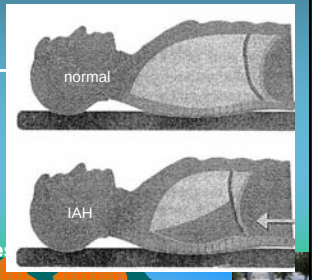
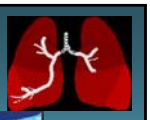
Schachtrupp, Shock 2005

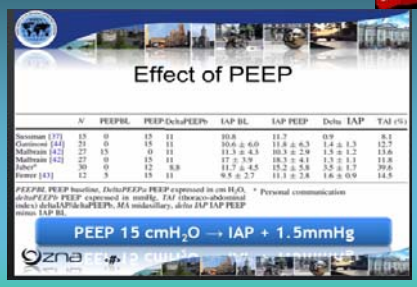
IAH and Respiration

- increased intraabdominal pressure
  - **Elevation of Diaphragm**
  - **FRC ↓**
  - **Reduced compliance of diaphragm**
  - **Atelectasis at lower lobes**



Respiration / PEEP





Methods

- IAP measurements
  - direct - intraabdominal catheter
  - indirect
    - intravesicular
    - intragastric
    - intracolonic
    - intrauterine
    - vena cava inferior
    - CT

HOW SHOULD IAP BE MEASURED?

- *"IAP should be expressed in mmHg and measured at end-expiration in the complete supine position after ensuring that abdominal muscle contractions are absent and with the transducer zeroed at the level of the midaxillary line."*

- Physical exam is inaccurate in predicting IAP
  - Sensitivity 40-61%
  - Positive predictive value 45-76%
- IAP measurements are essential to the diagnosis of elevated IAP and the management of IAH
- A variety of techniques may be used to measure IAP

WHAT IS THE REFERENCE STANDARD FOR IAP?

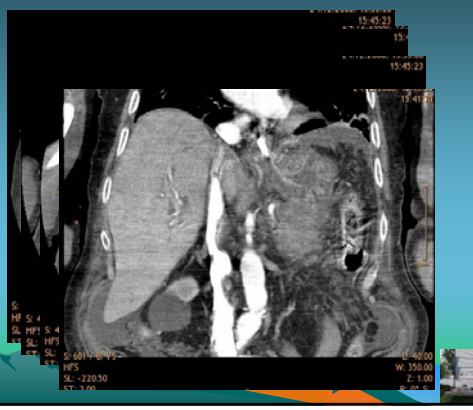
- "The reference standard for intermittent IAP measurement is via the bladder with a maximal instillation volume of 25ml sterile saline."

- Intra-vesicular or "bladder" pressure measurement represents a safe, rapid, and cost-effective method for monitoring IAP.
- Bladder pressure measurements can be performed in any ICU using commonly available equipment.
- The recommended instillation volume has been decreased.
  - Larger volumes of saline can lead to falsely elevated IAP measurements

Effect of body position

	N (observations)	Supine	HOB 15	HOB 30	HOB 45	Lateral	Reverse trendelenberg
Malbrain [13]*	37 (79)	8.8 ± 3.9	NA	NA	17.1 ± 6.1	6.6 ± 2.9	13.3 ± 4.8
Chiumb [29]*	58 (174)	7 (0.7–13.2)	NA	8.5 (2.2–14)	10.3 (2.9–16.2)	NA	NA
McBeth [45]*	37 (300)	13.4 ± 4.2	NA	18.4 ± 4.8	21.5 ± 5.0	NA	NA
Vasquez [47]*	45 (675)	10.2 (8.7–11.8)	12.4 (10.7–14.1)	14.0 (12.3–15.8)	16.7 (14.8–18.5)	NA	19.3 (16.8–21.8)
Cheatham [46]*	132 (396)	11.8 (11.4–12.2)	13.3 (12.8–13.8)	15.4 (14.9–15.9)	NA	NA	NA
De Keulenaer [58]*	10 (60)	6.6 ± 2.9	NA	NA	NA	11.2 ± 3.3	NA
Cobb [49]*	20 (180)	1.8 ± 2.0	NA	NA	16.7	NA	NA
Chiomello [55]*	11 (60)	8.8 ± 2.1	NA	NA	NA	NA	NA
Hering [53]*	12 (24)	10 ± 3	NA	NA	NA	NA	NA

HOB 45° → IAP + 5-15 mmHg



Physiology

PERFUSION PRESSURE

- The pressure difference across an organ or anatomic compartment
- Dependent upon three factors:
  1) Arterial inflow pressure
  2) Venous outflow pressure
  3) Compliance of the compartment

Perfusion pressure = $Pressure_{inflow} - Pressure_{outflow}$

Cerebral PP = MAP - ICP

Coronary PP = DBP - PAOP

FILTRATION GRADIENT

- The filtration gradient (FG) is the mechanical force across the renal glomerulus
- Calculated as glomerular filtration pressure (GFP) – proximal tubular pressure (PTP)
  - GFP = APP = MAP – IAP
  - PTP = IAP in the presence of IAH
  - FG = MAP – IAP – IAP or MAP – 2*IAP
- Changes in IAP have a greater impact upon renal function and urine production than changes in MAP
  - Oliguria is one of the first signs of elevated IAP

Surgical Management of Compartment Syndromes

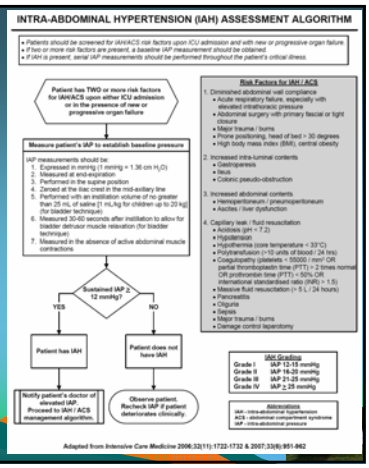
Compartment	Pathophysiology	Surgical Management
Cranium	ICP elevation	Craniotomy, etc..
Chest	Tension pneumothorax	Chest tube
Pericardium	Cardiac tamponade	Pericardiocentesis
Limb	Extremity compartment syndrome	Fasciotomy

- Hatten Sie jemals einen Patienten der nach massiver Flüssigkeitsgabe zunehmend *ödematös* und *aufgetrieben* war?
- Hat je einer Ihrer ICU Patienten ein *akutes Nierenversagen* mit Hämofiltrationspflichtigkeit entwickelt?
- Haben Sie jemals einen Patienten ein *Multiples Organ Versagen* entwickeln und daran sterben gesehen?

What was their intra-abdominal pressure?

IAH ASSESSMENT ALGORITHM

www.wsacs.org



IAH/ACS MANAGEMENT ALGORITHM

www.wsacs.org