
Stichting Oncowijs

# Abdominal Compartment Syndrome (ACS);

Rediscovering an Old syndrome to prevent further mortality

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# Disclosure belangen spreker

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| | |
|---|---|
| (potentiële) belangenverstrengeling | Geen |
| Voor bijeenkomst mogelijk relevante relaties met bedrijven | Geen |
| • Sponsoring of onderzoeksgeld<br>• Honorarium of andere (financiële) vergoeding<br>• Aandeelhouder<br>• Andere relatie, namelijk … | Geen<br>Geen<br>Geen<br>Geen |


ONS
Oncology Nursing Society

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**Friday**, April 29 • 9:45am - 11:00am
Show edit session link when on session permalink
Complex Issues in Care Management
Sign up or log in to save this event to your list and see who's attending!
http://sched.co/5EE3

"When Do We Treat Portal Vein Thrombosis in Patients With Gastrointestinal Malignancies? Educating for Better Patient Outcomes—Implications for Nursing," *Natasha Ramrup, RN, MSN, OCN®, AOCNS®*
"Nursing Considerations for Titration of Fentanyl Sublingual Spray to Effective Dose," *Sheila Ayers, BSN, MSN, ACNP-BC*
"Breakthrough Cancer Pain (BTCP): Putting Evidence Into Practice," *Jeannine Brant, PhD, APRN, AOCN®, FAAN*
"Abdominal Compartment Syndrome: Rediscovering an Old Syndrome to Prevent Further Mortality," *Karshook Wu, RN, BSN, OCN®*
"More Than Skin Deep: Assessing the Dermatologic Toxicities of Epidermal Growth Factor Receptor Inhibitors," *Sonia Sims, BSN, RN, OCN®*


# Klinisch beeld

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# Introductie

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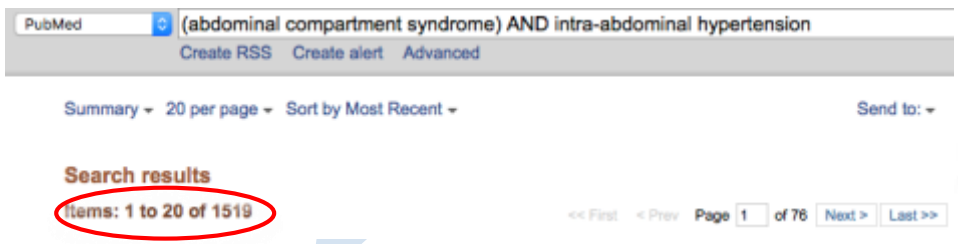
- Eerste beschrijvingen in 1863 door Marey en in 1870 door Burt [1]
- Vanaf 2000 flinke toename in onderzoeken naar Intra abdominale hypertensie (IAH) en ACS [5]



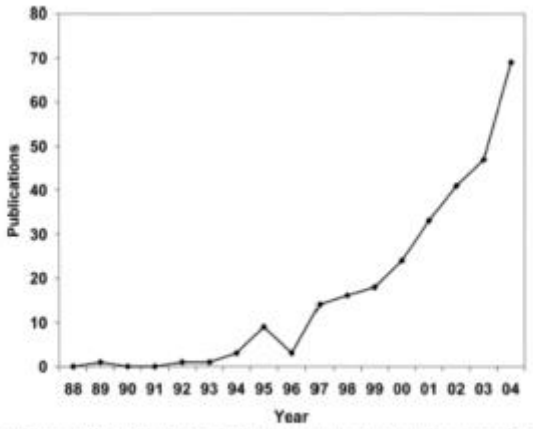




Figure 1. The number of publications listing "abdominal compartment syndrome" or "intra-abdominal hypertension" within the PubMed search criteria (limited by English language in human subjects), by publication years 1988 to 2004.


# Begrippen

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- IAP = intra abdominale pressure. Druk in de buikholte.
- IAH = intra abdominale hypertensie = IAP ≥ 12 mmHG
- ACS = abdominaal compartiment syndroom = aanhoudende IAP ≥ 20 mmHG met disfunctie van organen/ orgaanfalen


# Intra-Abdominale hypertensie

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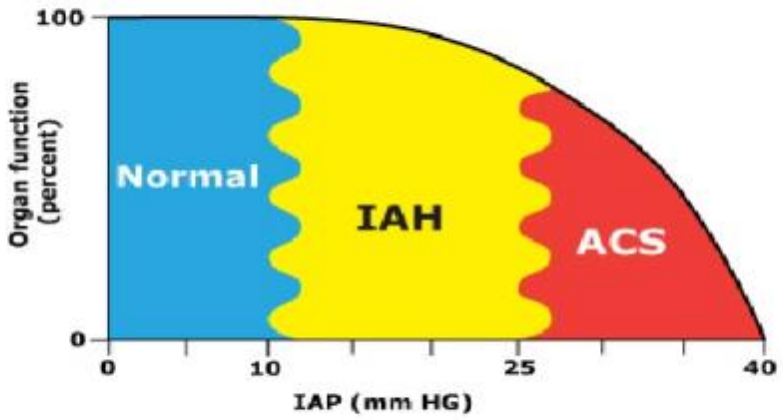
**Intraabdominal hypertension and abdominal compartment syndrome**




Intraabdominal hypertension (IAH) is defined as a sustained intraabdominal pressure >12 mmHg. Abdominal compartment syndrome (ACS) is defined as a sustained intraabdominal pressure>20 mmHg that is associated with new organ dysfunction.
*Based on information from: Abdominal perfusion pressure. AdominalCompartmentSyndrome.org*


# Intra-Abdominale hypertensie (2)

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Definitie IAH:

Aanhoudende of herhaalde intra-abdominale druk van > 12 mmHG

- Graad 1 12-15mmHg
- Graad 2 16-20mmHg
- Graad 3 21-25mmHg
- Graad 4 ≥ 25mmHg

- IAH heeft een prevalentie van zeker 50% bij ernstig zieke patiënten en is een onafhankelijke risicofactor voor overlijden[9]


# Definitie vlgs WSACS

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Abdominal Compartment Syndrome (ACS) is defined as a sustained Intra abdominal pressure (IAP) > 20 mmHg that is associated with new organ dysfunction / failure [5]


# Soorten ACS

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- Primair:
  abdominale schade door trauma of ziekte in de abdominale ruimte waardoor de druk oploopt en vaak interventie geïndiceerd is[2]
- Secundair;
  drukverhoging ten gevolge van oorzaken buiten de abdominale ruimte[2]
- Terugkerend:
  na eerdere behandeling van IAH of ACS [2]
- Chronische IAH:
  ontstaat geleidelijk (obesitas, cirrose, intra-abdominale massa) [2]


# Hoog risicogroepen voor IAH en ACS [2,8]

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| Primair | Secundair/ chronisch |
|---|---|
| Grote abdominale operaties | Grote hoeveelheden vochttoediening |
| Acuut abdominaal aneurysma (AAA) | Sepsis |
| Postoperatieve bloeding | Ernstige brandwonden |
| Pancreatitis | |
| Mechanische obstructie darmen | |
| Na sluiten van de buik onder spanning | **Chronisch** |
| Abcessen | Langdurige peritoneale dialyse |
| Stomp en penetrerend letsel | Ernstige obestitas/ zwangerschap |
| Ernstige intra abdominale infecties | |
| Ileus, ascites | |

Volledige tabel in Kirkpatrick et al [2]


# Incidentie en mortaliteit IAH/ACS

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| Studie | N= | IAH (>12 mmHG) | ACS |
|---|---|---|---|
| Vidal et al (2oo8): | 83 | 32% | 12% |
| Reintam et al (2008): | 257 | 28% | nb |
| Malbrain et al (2014): | 1669 | 27,7% | 2,7% |
| Manu et al (2005) | 265 | 32,1% | 4,2% |
| Iver et al (2014) | 403 | 39% | 2% |
| Kim et al (2012) | 100 | 42% | 2% |

IAH is verschillende studies een onafhankelijke voorspeller voor mortaliteit [4]

Mortaliteit ACS; onbehandeld 100%!! [3] , behandeld tussen de 25-75%


# Systematic review Malbrain et al 2014

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TABLE II.—*Patient's characteristics at admission in all population and between patients with and without intra-abdominal hypertension.*

| | Total population | IAH | No IAH | P value |
|---|---|---|---|---|
| No. of patients | 1669 | 463 (27.7%) | 1206 (72.3%) | - |
| Age (years) | 65.0 (51-75) | 65.0 (51-75) | 65.5 (50-75) | NS |
| Male gender, n (%) | | | | 0.0168 |
| BMI (kg/m$^2$) | 25.1 (22.6-27.8) | 26.9(24.2-31.0) | 24.5 (22.2-27.6) | <0.0001 |
| SAPS II score | 42 (31-55) | 47 (35-60) | 40 (30-54) | <0.0001 |
| SOFA score | 7 (4-10) | 8 (6-11) | 6 (3-9) | <0.0001 |
| Mean arterial pressure (mmHg) | 70 (61-83) | 67.8 (58-79) | 71 (63-85) | <0.0001 |
| Admission causes: | | | | <0.0001 |
| Medical (%) | 42.3% | 34.8% | 45.1% | |
| Elective surgery (%) | 26.9% | 23.5% | 28.1% | |
| Emergency surgery (%) | 23.1% | 36.2% | 18.2% | |
| Trauma (%) | 7.7% | 5.4% | 8.5% | |
| Fluid balance (L) | 1.5 (0.3-3.5) | 2.2 (0.7-4.7) | 1.3 (0.3-3.0) | <0.0001 |
| Urinary output (L/day) | 1.5 (0.8-2.5) | 1.3 (0.7-2.3) | 1.6 (0.8-2.6) | 0.0007 |
| Duration of ICU stay (days) | 7 (4-18) | 10 (4-24) | 7 (4-16) | 0.0165 |
| ICU mortality, N. (%) | 514 (30.1%) | 185 (40%) | 329 (27.3%) | <0.0001 |
| Duration of hospital stay (days) | 22 (11-42) | 23 (12-41) | 22 (11-42) | NS |
| Hospital mortality, N. (%) | 628 (37.6%) | 205 (44.3%) | 423 (35.1%) | <0.0001 |

Data are expressed as median and first and third quartiles.
IAH: intra-abdominal hypertension; NS: not significant; BMI: Body Mass Index; SAPS II: Simplified Acute Physiology Score II; SOFA: Sepsis-related Organ Failure Assessment; IAP: intra-abdominal pressure; ICU: intensive care unit.


# Klinische verschijnselen

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| |
|---|
| Gespannen bolle buik |
| Oligurie |
| Acute pulmonale decompensatie |
| Hypotensie, tachycardie, hypothermie |
| Verhoogde veneuze druk jugularis |
| Metabole acidose |
| Hypoxie |


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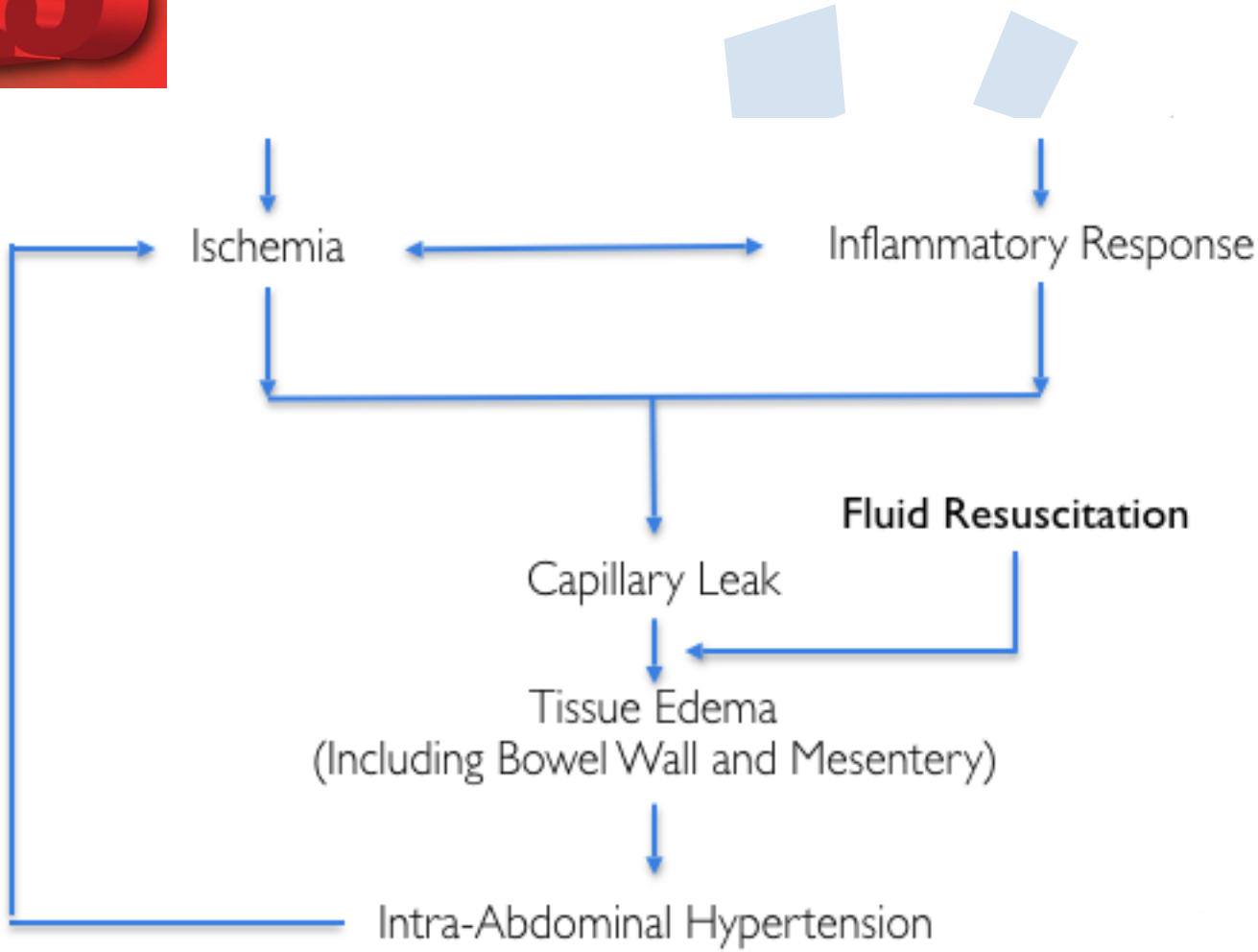
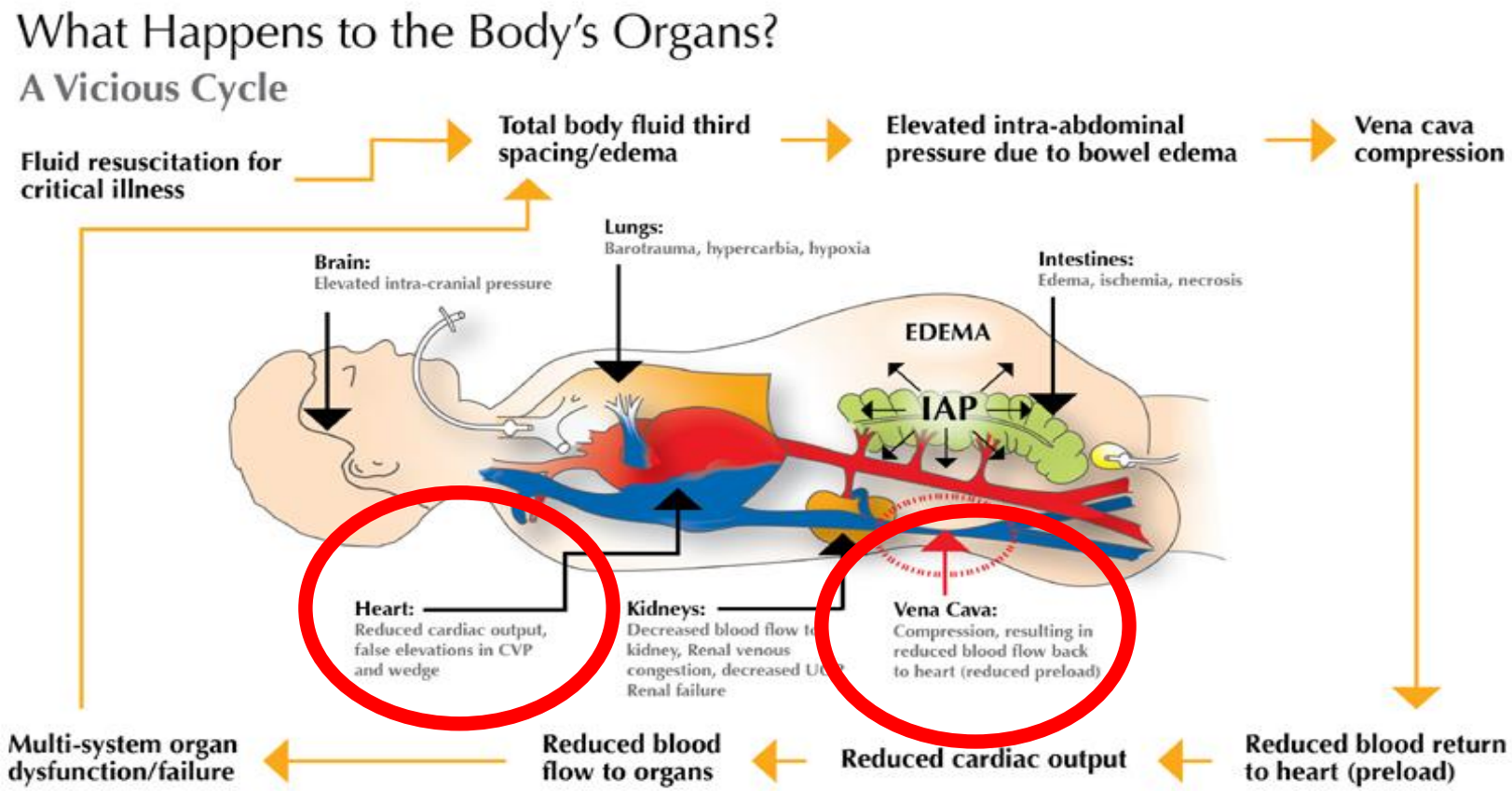


# Pathofysiologie

Stichting Oncowijs




# Gevolgen cardiovasculair:

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- Vena cava gecomprimeerd—>verminderde preload m.a.g ook verminderde cardiac output en lagere tensie
- Druk op abd. aorta—-> vasculaire weerstand —-> reductie cardiac output
- Verhoogde IAP—> diafragma omhoog—>verhoging intra thoracale druk -> cardiac output ook weer minder door minder veneuze retour naar hart en weerstand pulmonaal wordt hoger.
- Verhoogde IAP→ druk op vena femoralis→ kans op trombose/ LE


# Pathofysiologie

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## What Happens to the Body's Organs?

### A Vicious Cycle

Fluid resuscitation for critical illness

Total body fluid third spacing/edema

Elevated intra-abdominal pressure due to bowel edema

Vena cava compression

**Brain:**
Elevated intra-cranial pressure

**Lungs:**
Barotrauma, hypercarbia, hypoxia

**Intestines:**
Edema, ischemia, necrosis

EDEMA

IAP

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

**Kidneys:**
Decreased blood flow to kidney, Renal venous congestion, decreased UOP Renal failure

**Vena Cava:**
Compression, resulting in reduced blood flow back to heart (reduced preload)

Multi-system organ dysfunction/failure

Reduced blood flow to organs

Reduced cardiac output

Reduced blood return to heart (preload)


# Gevolgen respiratoir

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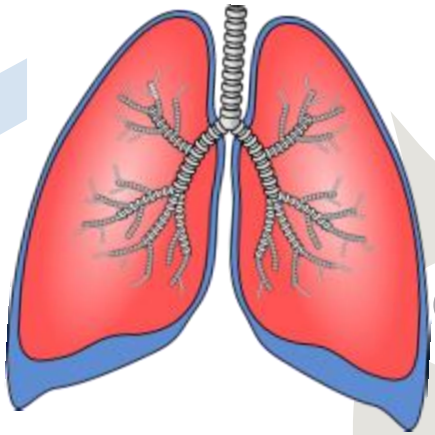

- Diafragma omhoog
- Verhoogde intra thoracale druk—-> alveolaire collaps —> Atelectase → ventilatie/perfusie verstoord
- Hypoxemie
- Hypercapnie
- Door capillaire lekkage (longoedeem) gestoorde O2 opname
- Verhoogde druk op vena cava inferior→ stuwing→ kans op trombo-embolie


# Pathofysiologie

Stichting Oncowijs

## What Happens to the Body's Organs?

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Fluid resuscitation for critical illness → Total body fluid third spacing/edema → Elevated intra-abdominal pressure due to bowel edema → Vena cava compression → Reduced blood return to heart (preload) → Reduced cardiac output → Reduced blood flow to organs → Multi-system organ dysfunction/failure

**Brain:** Elevated intra-cranial pressure

**Lungs:** Barotrauma, hypercarbia, hypoxia

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EDEMA

IAP

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

**Kidneys:** Decreased blood flow to kidney, Renal venous congestion, decreased UOP Renal failure

**Vena Cava:** Compression, resulting in reduced blood flow back to heart (reduced preload)


# Gevolgen gastrointestinaal en hepatobilair

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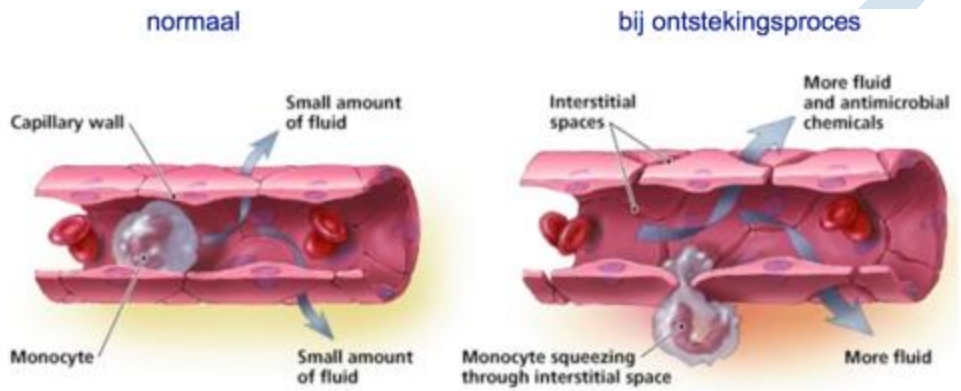
- Verminderde bloedflow in abdomen——> ischemie—->capillaire lekkage --> oedeem—-> IAP stijgt verder
- Ischemie darm—-> translocatie bacteriën—> sepsis
- Lever: gecompromitteerde bloedtoevoer—-> langdurig -- >leverfalen




# Pathofysiologie

Stichting Oncowijs

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EDEMA

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**Kidneys:** Decreased blood flow to kidney, Renal venous congestion, decreased UOP Renal failure

**Ve a Cava:** Co pression, resulting in re uced blood flow back heart (reduced preload)


# Gevolgen renaal

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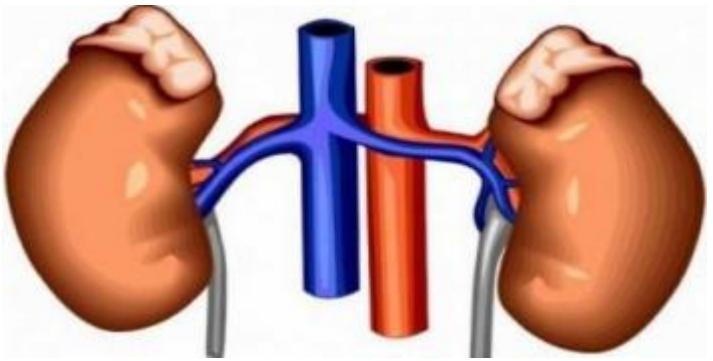
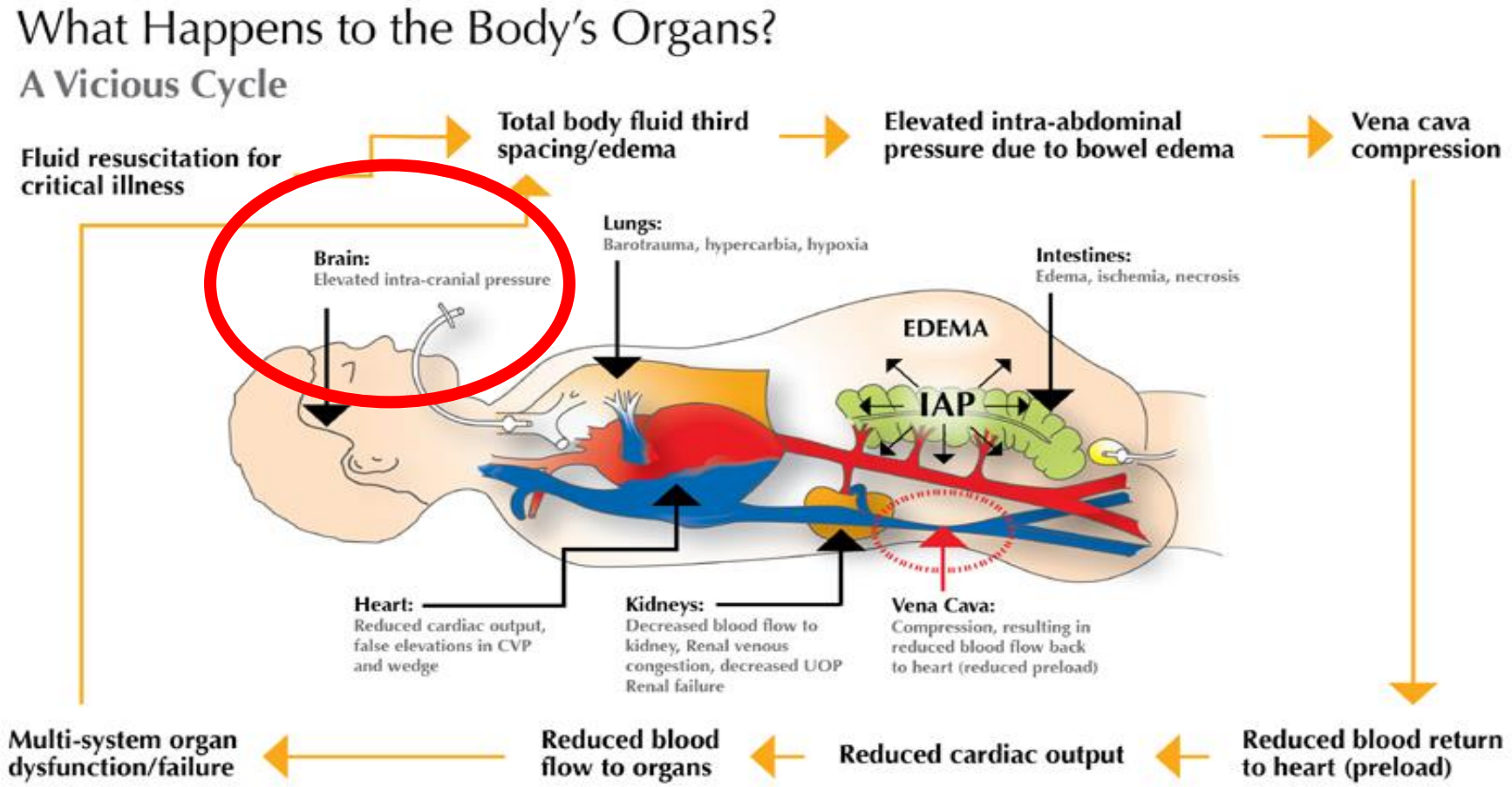
- Door druk—> meer ADH—> meer vochtresorptie
- Minder cardiac output—> minder bloedtoevoer naar nieren
- Compressie renale venen—->verminderde afvloed
- Nierfalen
- Oligurie/Anurie



# Pathofysiologie






# Gevolgen cerebraal

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- Verhoogd IAP → verhoogde intra thoracale druk → verminderde cerebrale veneuze outflow uit hersenen→ verhoging intra cerebrale druk


# Abdominale wand/ wondgenezing

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- Door druk verminderde doorbloeding (20% van normaal) m.a.g slechte wondgenezing en abdominale wondcomplicaties


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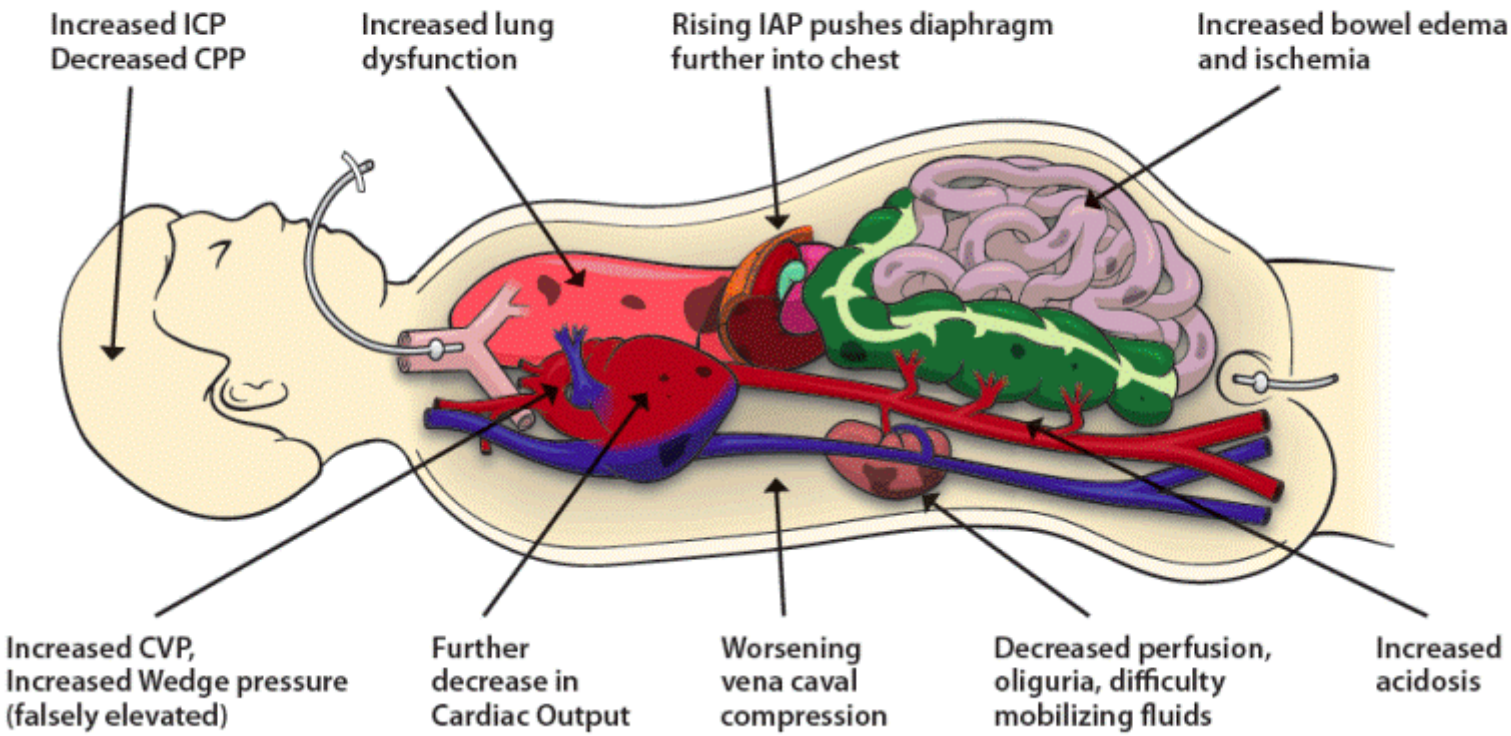
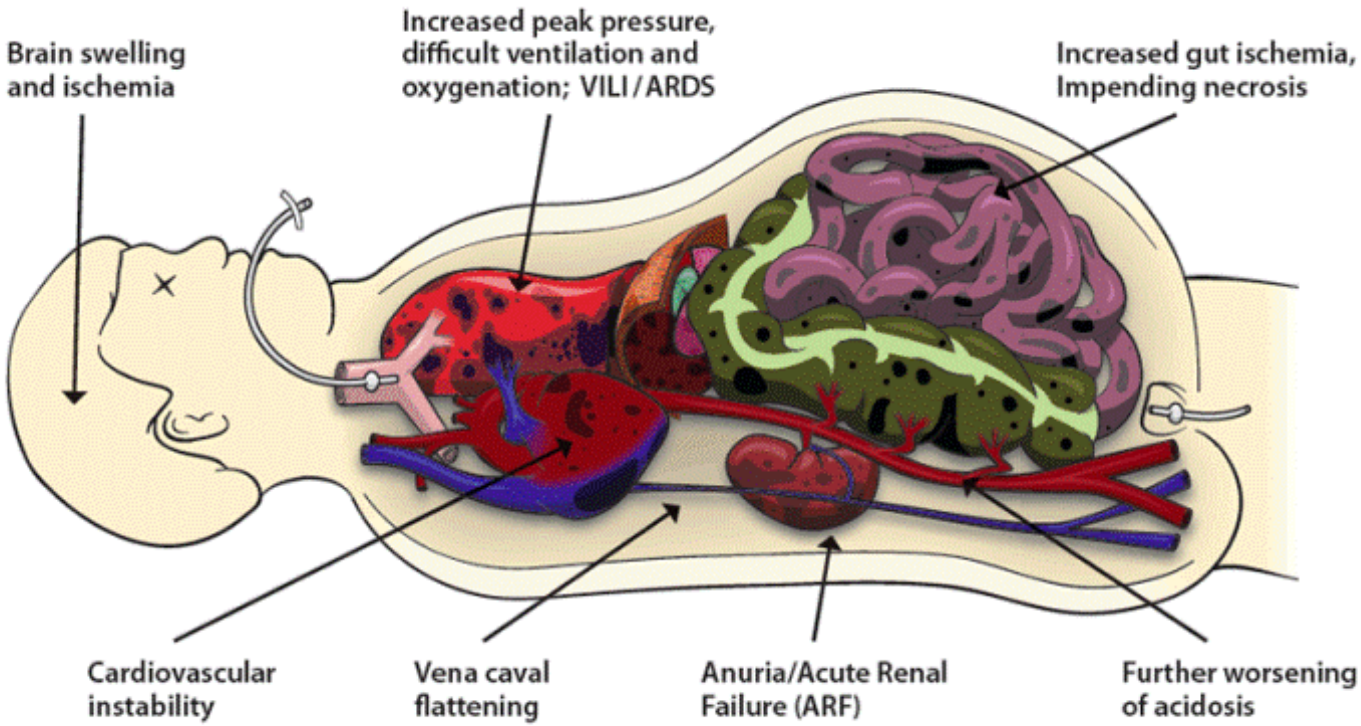
# Occult Organ Ischemia
# IAP 16 – 20 mmHg



# Onset of Multiple Organ Dysfunction Syndrome (MODS)
# IAP > 20 mmHg




# Gevolgen ACS op de systemen

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**CENTRAL NERVOUS SYSTEM**
Intracranial pressure ↑
Cerebral perfusion pressure↓
Idiopathic intracranial hypertension in morbid obesity

**CARDIOVASCULAR SYSTEM**[1]
Difficult preload assessment
Pulmonary artery occlusion pressure ↑
Central venous pressure ↑
Transmural filling pressure =↘
Intra thoracic blood volume index =↘
Global end-diastolic blood volume index =↘
Extra vascular lung water =↗
Stroke volume variation =↗
Pulse pressure variation =↗
Right ventricular end-diastolic volume =↘
Cardiac output ↓
Venous return ↓
Systemic vascular resistance ↑
Venous thrombosis ↑
Pulmonary embolism ↑
Heart rate ↗ =
Mean arterial pressure ↗ =↘
Pulmonary artery pressure ↑
Left ventricular compliance ↓
Left ventricle regional wall motion ↓

**HEPATIC SYSTEM**
Hepatic arterial flow ↓
Portal venous blood flow ↓
Portocollateral flow ↑
Lactate clearance ↓
Glucose metabolism ↓
Mitochondrial function ↓
Cytochrome p450 function ↓
Plasma disappearance rate
Indocyanine green ↓

**GASTRO-INTESTINAL SYSTEM**
Abdominal perfusion pressure ↓
Celiac blood flow ↓
Superior mesenteric artery blood flow ↓
Blood flow to intra-abdominal organs ↓
Mucosal blood flow ↓
Mesenteric vein compression ↑
Intramucosal pH ↓
Regional $CO_2$ ↑
$CO_2$-gap ↑
Success enteral feeding ↓
Intestinal permeability ↑
Bacterial translocation ↑
Multiple organ failure ↑
Gastro-intestinal ulcer (re)bleeding ↑
Variceal wall stress ↑
Variceal (re)bleeding ↑
Peritoneal adhesions ↑

**RESPIRATORY SYSTEM**
Intrathoracic pressure ↑
Pleural pressure ↑
Functional residual capacity ↓
All lung volumes ↓
(~restrictive disease)
Auto-PEEP ↑
Peak airway pressure ↑
Plateau airway pressure ↑
Dynamic compliance ↓
Static respiratory system compliance ↓
Static chest wall compliance ↓
Static lung compliance =
Hypercarbia ↑
$PaO_2$ ↓ and $PaO_2/FiO_2$ ↓
Dead-space ventilation ↑
Intrapulmonary shunt ↑
Lower inflection point ↓
Upper inflection point ↑
Extra vascular lung water =↗
Prolonged ventilation
Difficult weaning
Activated lung neutrophils ↑
Pulmonary inflammatory infiltration ↑
Alveolar edema ↑
Compression atelectasis ↑

**RENAL SYSTEM**
Renal perfusion pressure ↓
Filtration gradient ↓
Renal blood flow ↓
Diuresis ↓
Tubular dysfunction ↑
Glomerular filtration rate ↓
Renal vascular resistance ↑
Renal vein compression ↑
Compression ureters ↑
Anti-diuretic hormone ↑
Adrenal blood flow =
Abdominal wall complications in CAPD↑

**ABDOMINAL WALL**
Abdominal wall compliance ↓
Rectus sheath blood flow ↓
Wound complications ↑
Incisional hernia ↑

**ENDOCRINE SYSTEM**
Release pro-inflammatory cytokines ↑
(IL-1b, TNF-a, IL-6)


# Onderzoek

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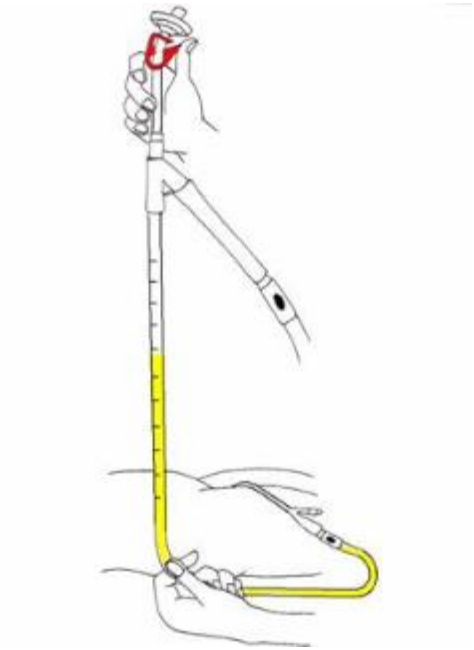
- Klinische beoordeling niet betrouwbaar[2,9]
- CT scan niet specifiek.
- Meest betrouwbaar maar invasief:
  directe drukmeting in buik
- Gouden standaard: blaasdrukmeting dmv een foleymanometer of een ander meetsysteem

- Risico: interindividuele en interinstitutionele variatie

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- Bij risico factoren: blaasdrukmeting (nulmeting)
- 2 metingen IAP ≥ 12 mmHg: vermijd te grote hoeveelheden vochttoediening en start algoritme WSACS (bijlage 1)
- Meet de druk bij risico patiënten elke 4 uur
- Onstabiele patiënten elk uur druk meten


# Behandeling

IAH >12 mmHg

- Decompressie van de darm/ maag
- Reductie intra abdominaal vocht en oedeem
- Buikwand compliantie
- Vochtregulatie
- Systemische perfusie optimaliseren


# Wat als dit niet helpt???

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# Behandeling

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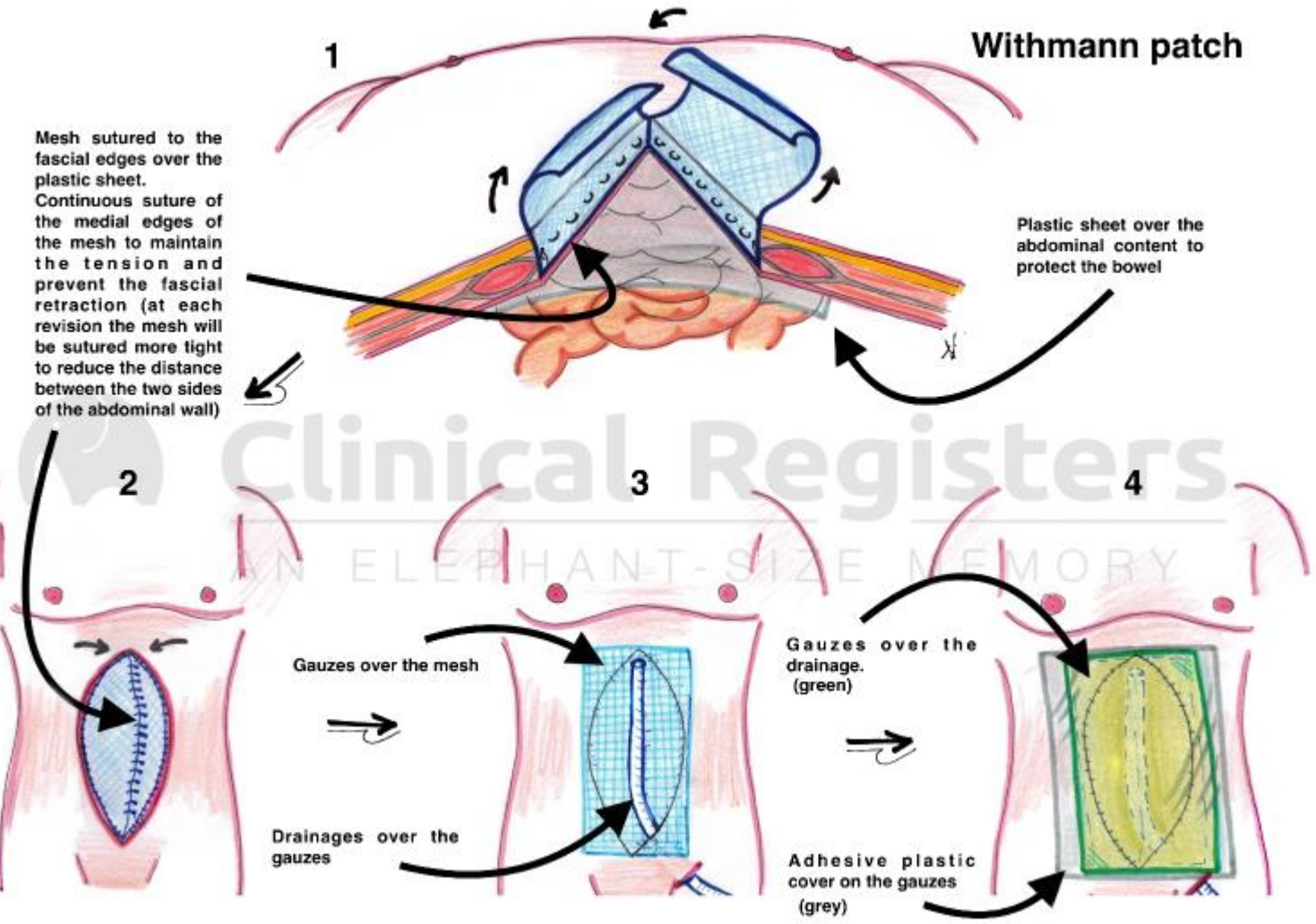
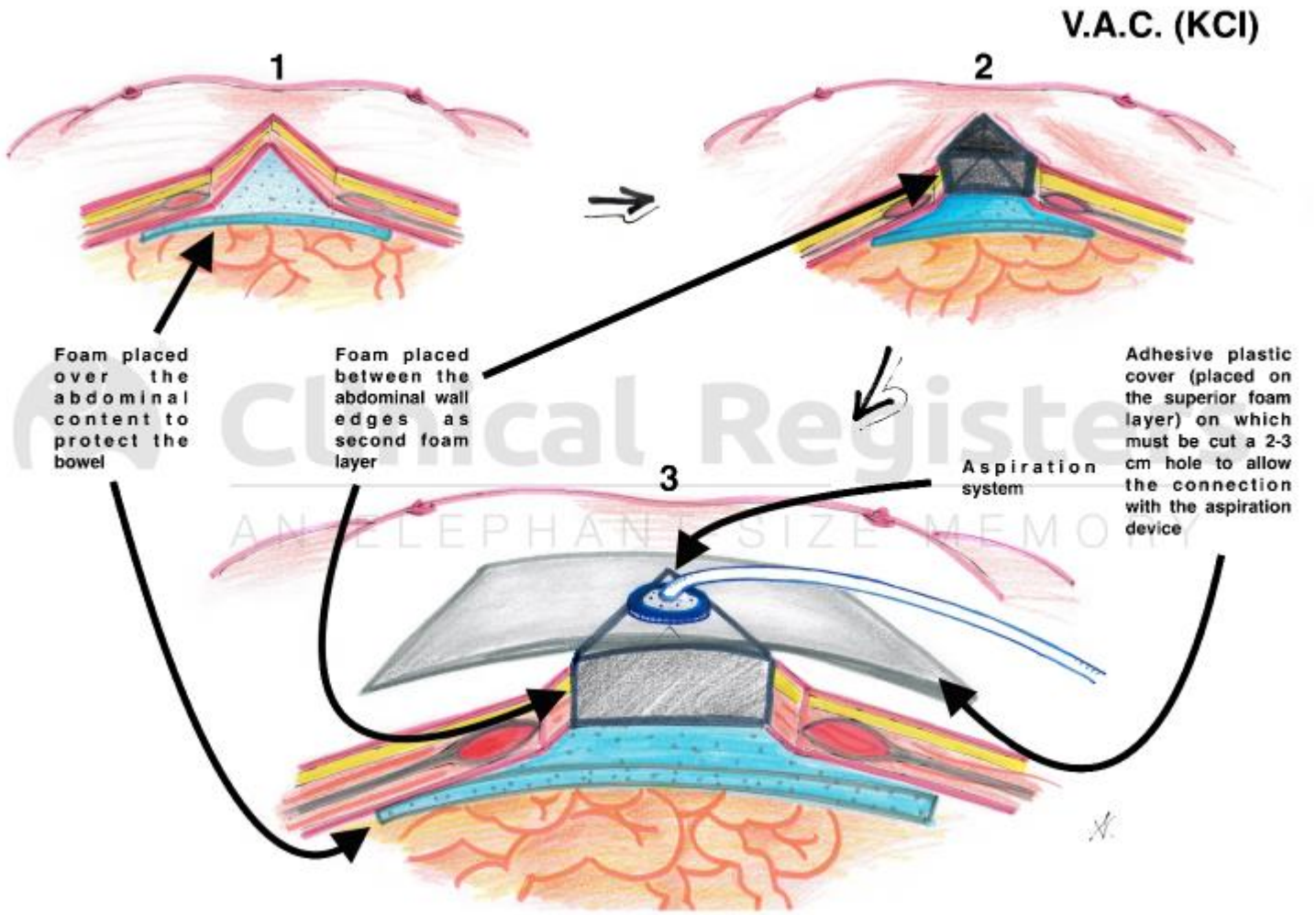
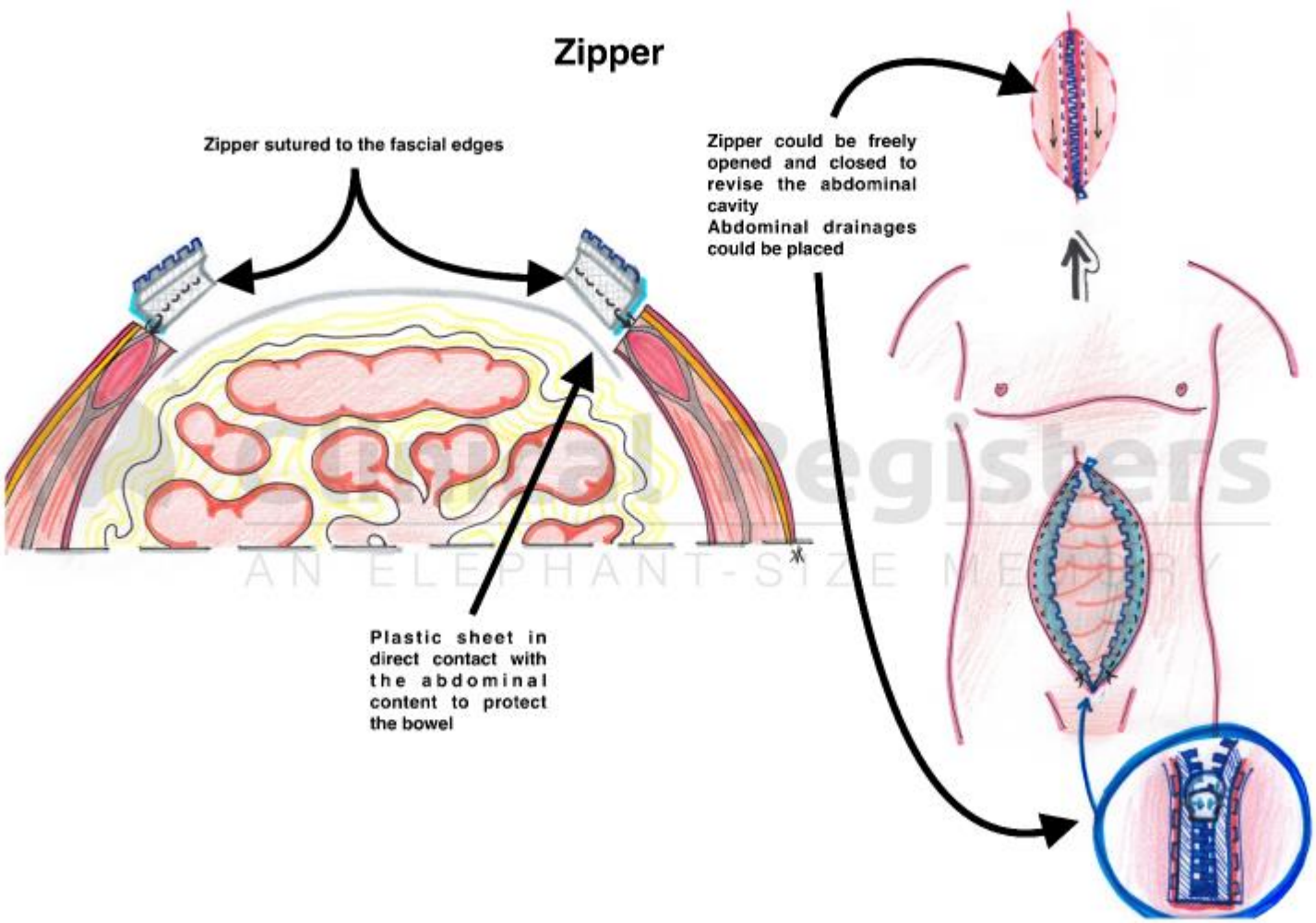
**Bij ACS (=ICH> 20 mm Hg met orgaanfalen)**

- Decompressielaparotomie waarbij de buik na OK “open” blijft.
- Uitzondering; brandwonden
- Elke 2-3 dagen opnieuw laparotomie

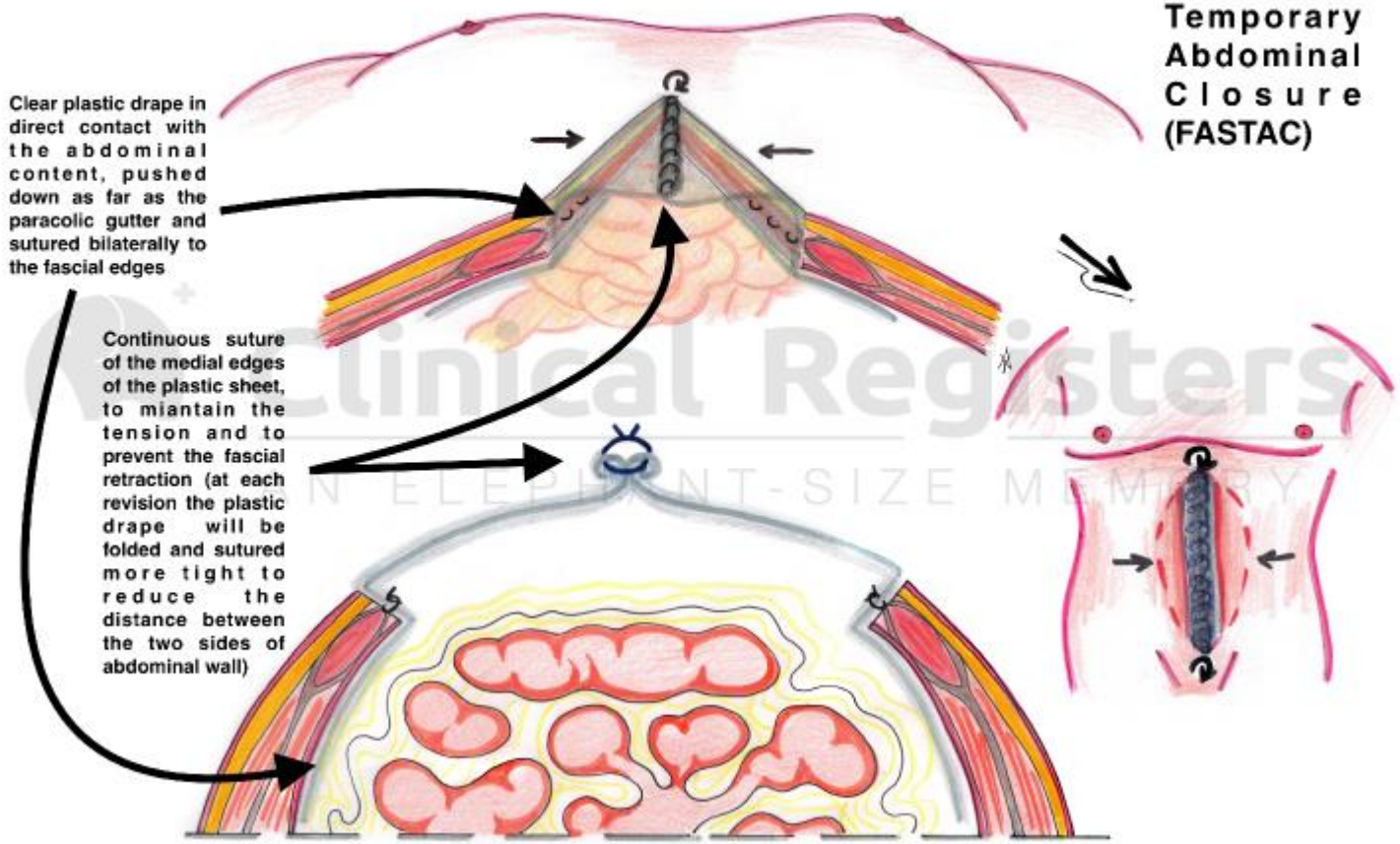
- Uitstel decompressie laparotomie verhoogd de mortaliteit



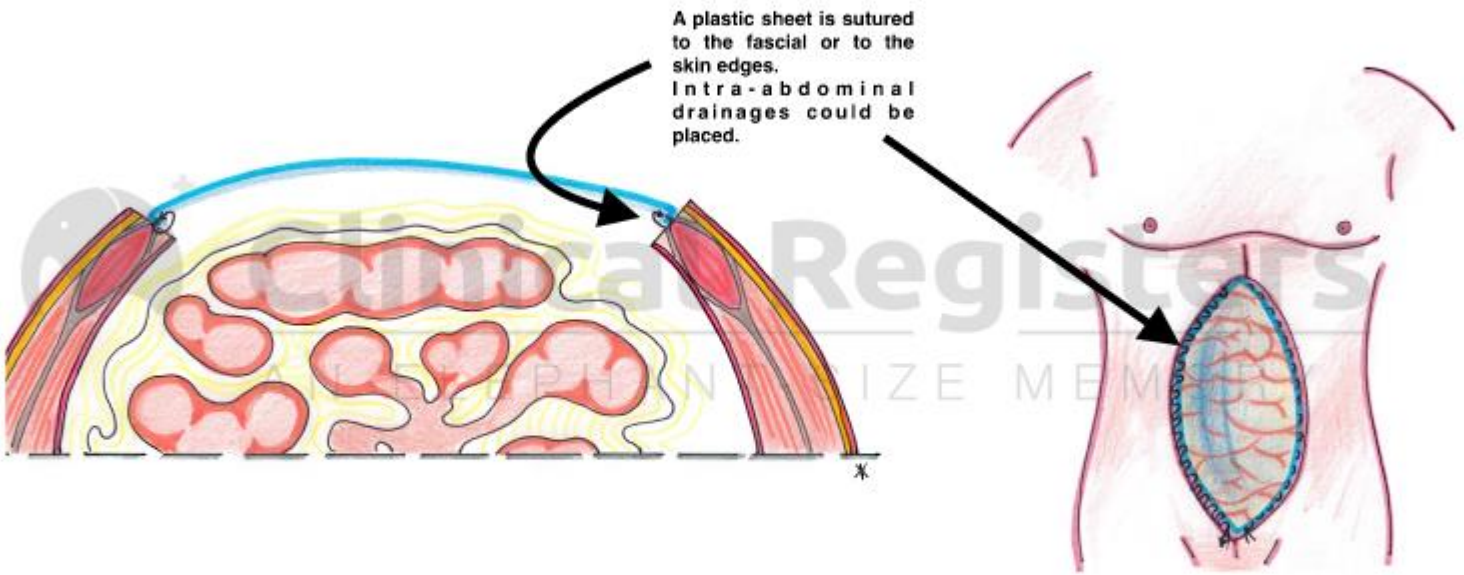




# Frequent Assessment Temporary Abdominal Closure (FASTAC)



## Bogotà bag




# Abra systeem

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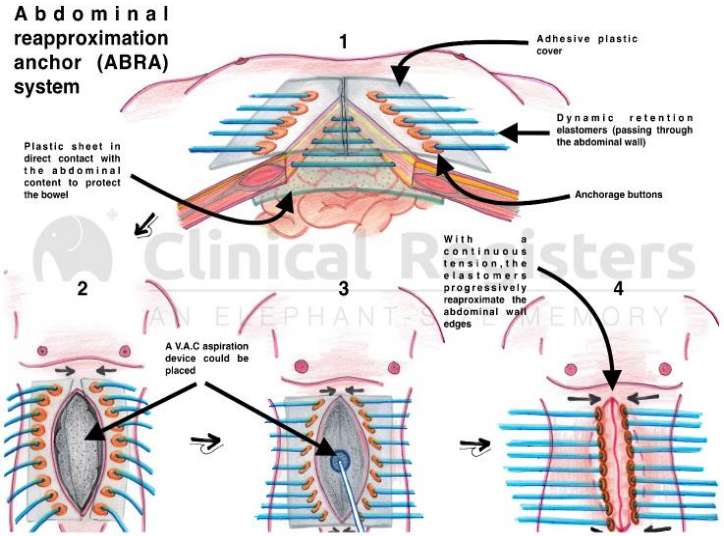


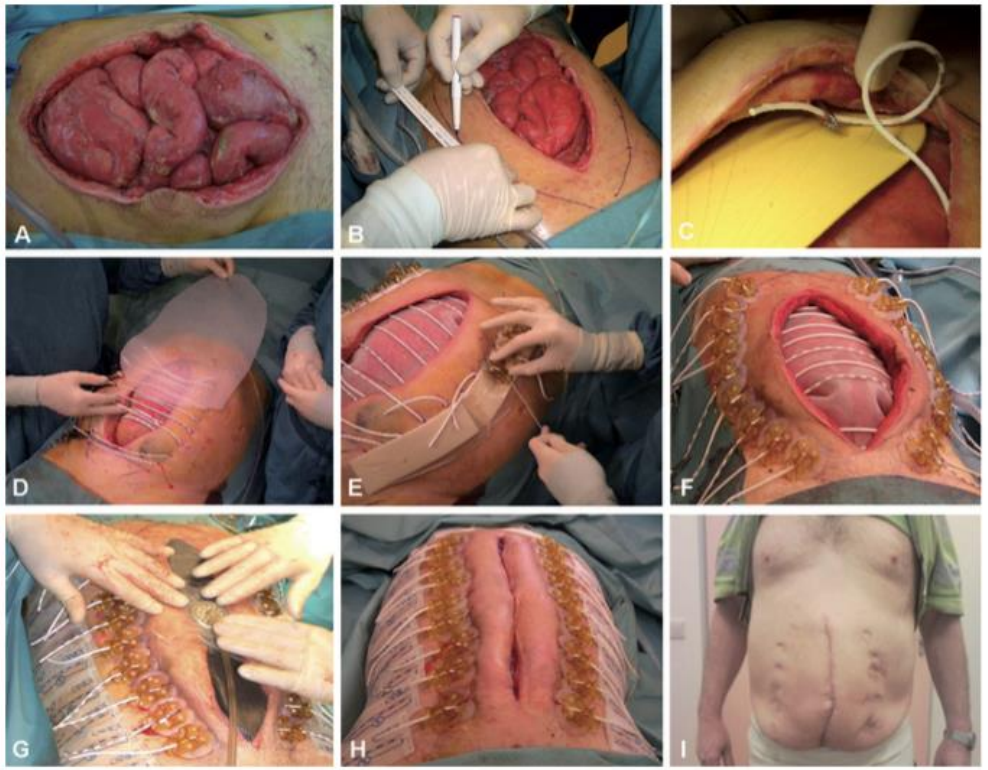


# Systemen bij open buik behandeling

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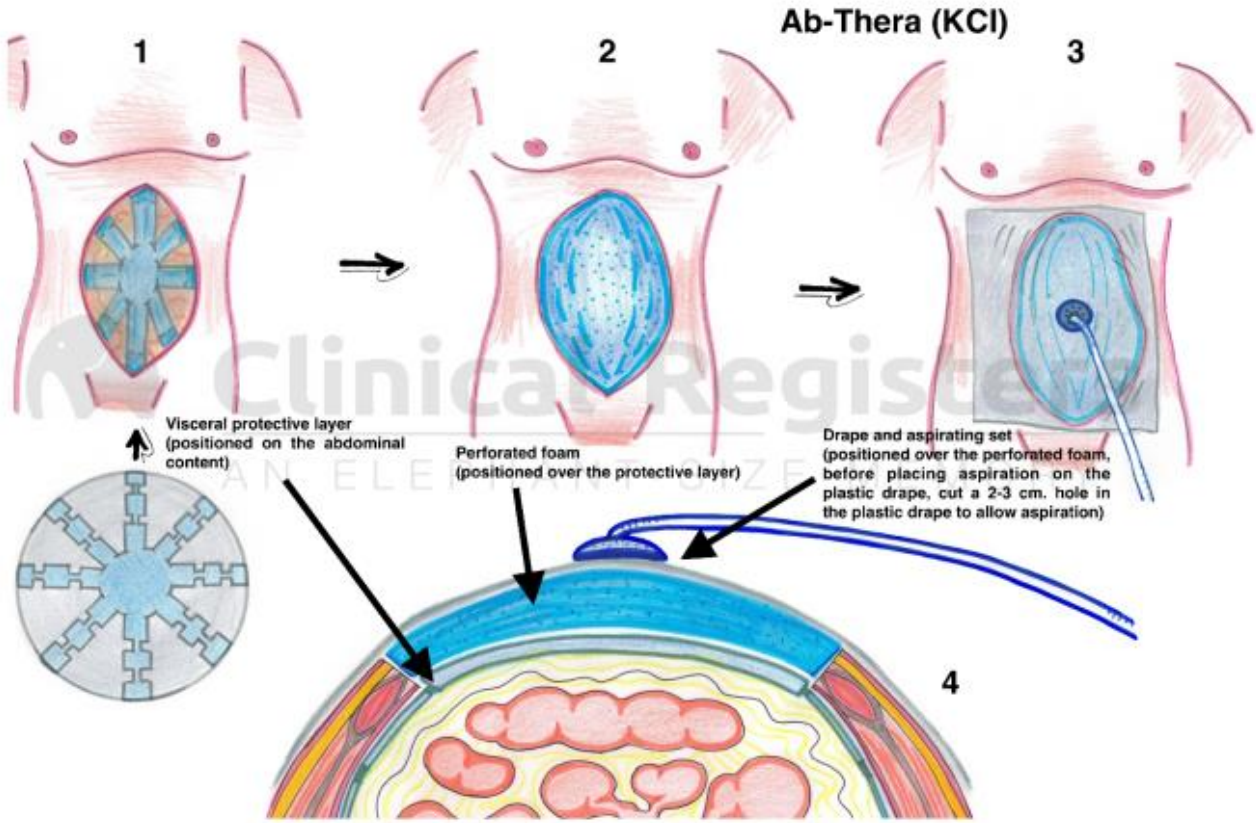


https://www.clinicalregisters.org

http://www.dailymotion.com/video/xjcb5t_open-abdomen-management-abthera-kci_tech


# Sluiten buikwand

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- Zodra de spanning van de buik er af is en klinische toestand het toelaat
- Evt met biologische mat
- Evt met huidlap


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# literatuurlijst

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14 www.WSACS.org


# Pathofysiologie

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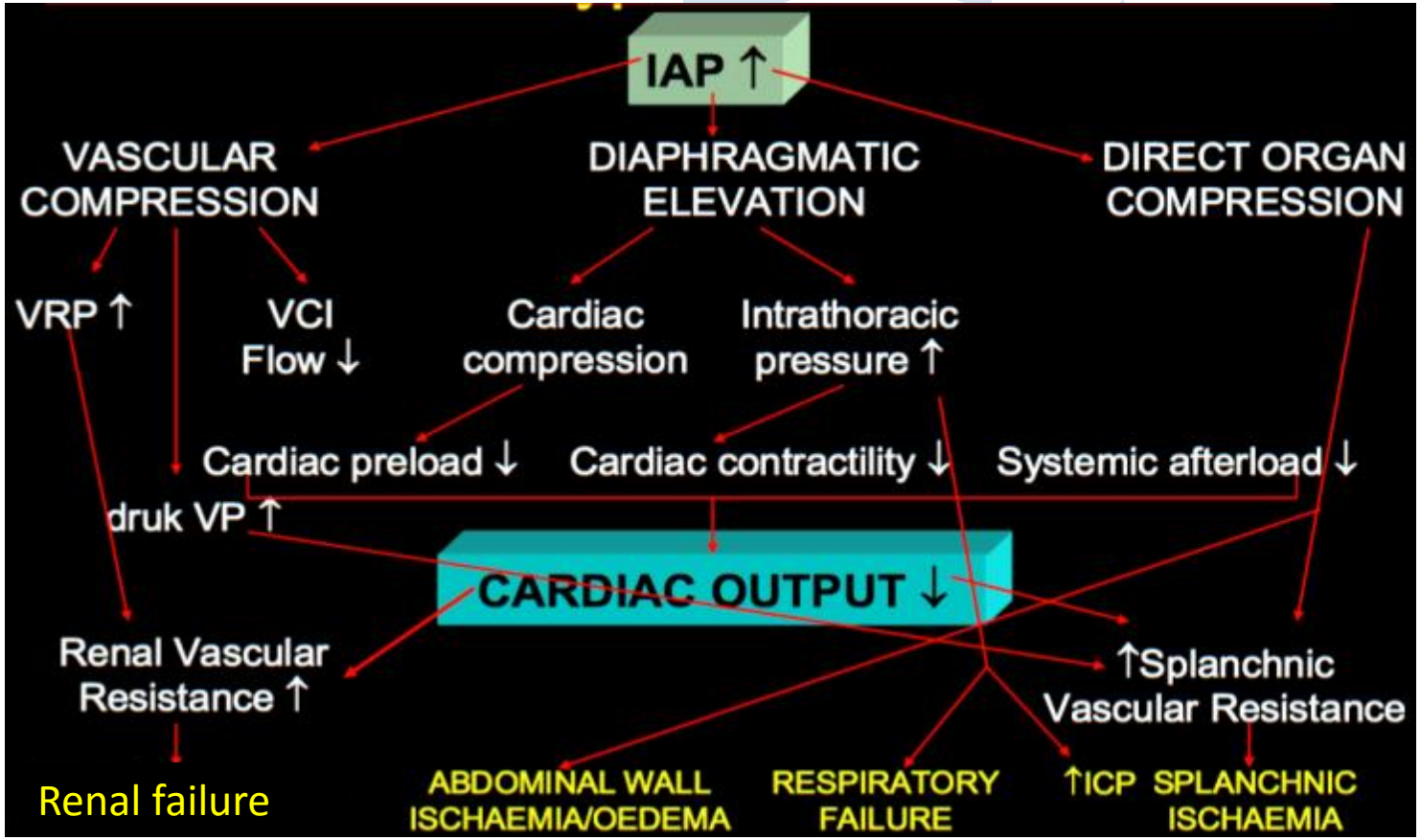


- *The choice (and success) of the medical management strategies listed below is strongly related to both the etiology of the patient's IAH / ACS and the patient's clinical situation. The appropriateness of each intervention should always be considered prior to implementing these interventions in any individual patient.*
- *The interventions should be applied in a stepwise fashion until the patient's intra-abdominal pressure (IAP) decreases.*
- *If there is no response to a particular intervention, therapy should be escalated to the next step in the algorithm.*

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**Patient has IAP ≥ 12 mmHg**
**Begin medical management to reduce IAP (GRADE 1C)**

**Measure IAP at least every 4-6 hours or continuously. Titrate therapy to maintain IAP ≤ 15 mmHg (GRADE 1C)**

| | Evacuate intraluminal contents | Evacuate intra-abdominal space occupying lesions | Improve abdominal wall compliance | Optimize fluid adminstration | Optimize systemic / regional perfusion |
|---|---|---|---|---|---|
| Step 1 | Insert nasogastric and/or rectal tube | Abdominal ultrasound to identify lesions | Ensure adequate sedation & analgesia (GRADE 1D) | Avoid excessive fluid resuscitation (GRADE 2C) | Goal-directed fluid resuscitation |
| | Initiate gastro-/colo-prokinetic agents (GRADE 2D) | | Remove constrictive dressings, abdominal eschars | Aim for zero to negative fluid balance by day 3 (GRADE 2C) | |
| Step 2 | Minimize enteral nutrition | Abdominal computed tomography to identify lesions | Consider reverse Trendelenberg position | Resuscitate using hypertonic fluids, colloids | Hemodynamic monitoring to guide resuscitation |
| | Administer enemas (GRADE 1D) | Percutaneous catheter drainage (GRADE 2C) | | Fluid removal through judicious diuresis once stable | |
| Step 3 | Consider colonoscopic decompression (GRADE 1D) | Consider surgical evacuation of lesions (GRADE 1D) | Consider neuromuscular blockade (GRADE 1D) | Consider hemodialysis / ultrafiltration | |
| | Discontinue enteral nutrition | | | | |

**Step 4**

If IAP > 20 mmHg and new organ dysfunction / failure is present, patient's IAH / ACS is refractory to medical management. Strongly consider surgical abdominal decompression (GRADE 1D).


# INTRA-ABDOMINAL HYPERTENSION (IAH) / ABDOMINAL COMPARTMENT SYNDROME (ACS) MANAGEMENT ALGORITHM

## Intra-Abdominal Hypertension (IAH)

**Patient has IAH (IAP ≥ 12 mmHg)**

Initiate treatment to reduce IAP
Avoid excessive fluid resuscitation
Optimize organ perfusion
(GRADE 1C)

IAP > 20 mmHg with new organ failure?

NO → Monitor IAP with serial measurements at least every 4 hours while patient is critically ill (GRADE 1C)

IAP < 12 mmHg consistently?

NO → Patient has IAH (IAP ≥ 12 mmHg)

YES → **IAH has resolved**
Discontinue IAP measurements and monitor patient for clinical deterioration

YES → **Patient has ACS**

**Medical treatment options to reduce IAP**

1. Improve abdominal wall compliance
   - Sedation & analgesia
   - Neuromuscular blockade
   - Avoid head of bed > 30 degrees
2. Evacuate intra-luminal contents
   - Nasogastric decompression
   - Rectal decompression
   - Gastro-/colo-prokinetic agents
3. Evacuate abdominal fluid collections
   - Paracentesis
   - Percutaneous drainage
4. Correct positive fluid balance
   - Avoid excessive fluid resuscitation
   - Diuretics
   - Colloids / hypertonic fluids
   - Hemodialysis / ultrafiltration
5. Organ Support
   - Optimize ventilation, alveolar recruitment
   - Use transmural (tm) airway pressures
     - $Pplat_{tm}$ = Plat - 0.5 * IAP
   - Consider using volumetric preload indices
   - If using PAOP/CVP, use transmural pressures
     - $PAOP_{tm}$ = PAOP - 0.5 * IAP
     - $CVP_{tm}$ = CVP - 0.5 * IAP

## Abdominal Compartment Syndrome (ACS)

**IDENTIFY AND TREAT UNDERLYING ETIOLOGY FOR PATIENT'S ACS**

Does patient have Primary ACS?

NO → Patient has Secondary or Recurrent ACS

YES

Is IAP > 20 mmHg with progressive organ failure?

YES → Perform / revise abdominal decompression with temporary abdominal closure as needed to reduce IAP (GRADE 2D)

NO → Continue medical treatment options to reduce IAP (GRADE 1C)

Measure IAP at least every 4 hours while patient is critically ill (GRADE 1C)

Perform balanced resuscitation of patient preload, contractility, and afterload using crystalloid / colloid / vasoactive medications
AVOID EXCESSIVE FLUID RESUSCITATION (GRADE 2D)

Is IAP < 12 mmHg consistently?

YES → **IAH has resolved**
Decrease frequency of IAP measurements and observe patient for deterioration

NO → Is IAP > 20 mmHg with organ failure?

**Definitions**

**IAH** - intra-abdominal hypertension

**ACS** - abdominal compartment syndrome

**IAP** - intra-abdominal pressure

**APP** - abdominal perfusion pressure (MAP-IAP)

**Primary ACS** - A condition associated with injury or disease in the abdomino-pelvic region that frequently requires early surgical or interventional radiological intervention

**Secondary ACS** - ACS due to conditions that do not originate from the abdomino-pelvic region

**Recurrent ACS** - The condition in which ACS redevelops following previous surgical or medical treatment of primary or secondary ACS