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The Abdominal Compartment Society

The World Society of the Abdominal Compartment Syndrome (www.wsacs.org) presents

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Intra-abdominal Hypertension and the Abdominal Compartment Syndrome: Updated Consensus Definitions and Clinical Practice Guidelines from the World Society of the Abdominal Compartment Syndrome

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Consensus Definitions

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Table 1. Final 2012 Consensus Definitions of the World Society of the Abdominal Compartment Syndrome

No.	Definition
Retained Definitions from the Original 2006 Consensus Statements [13]	
1.	IAP is the steady-state pressure concealed within the abdominal cavity.
2.	The reference standard for intermittent IAP measurements is via the bladder with a maximal instillation volume of 25 mL of sterile saline.
3.	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.
4.	IAP is approximately 5-7 mmHg in critically ill adults
5.	IAH is defined by a sustained or repeated pathological elevation in IAP $\geq$ 12 mmHg
6.	ACS is defined as a sustained IAP>20mmHg (with or without an APP < 60mmHg) that is associated with new organ dysfunction/failure
7.	IAH is graded as follows: Grade I, IAP 12-15 mmHg Grade II, IAP 16-20 mmHg Grade III, IAP 21-25 mmHg Grade IV, IAP > 25 mmHg
8.	Primary IAH or ACS is a condition associated with injury or disease in the abdominopelvic region that frequently requires early surgical or interventional radiological intervention
9.	Secondary IAH or ACS refers to conditions that do not originate from the abdominopelvic region.
10.	Recurrent IAH or ACS refers to the condition in which ACS redevelops following previous surgical or medical treatment of primary or secondary ACS
11.	APP=MAP – IAP
New Definitions Accepted by the 2012 Consensus Panel	
12.	A poly-compartment syndrome is a condition where two or more anatomical compartments have elevated compartmental pressures.
13.	Abdominal compliance quantifies the ease of abdominal expansion, is determined by the elasticity of the abdominal wall and diaphragm, and is expressed as the change in intra-abdominal volume per change in intra-abdominal pressure.
14.	An open abdomen is any abdomen requiring a temporary abdominal closure due to the skin and fascia not being closed after laparotomy. The technique of temporary abdominal closure should be explicitly described.
15.	Lateralization of the abdominal wall refers to the phenomenon whereby the musculature and fascia of the abdominal wall, most well seen by the rectus abdominus muscles and their enveloping fascia, move lateraly away from the midine with time.

Retained Definitions from the Original 2006 Consensus Statements[1]

- 1) Intra-abdominal pressure (IAP) is the steady-state pressure concealed within the abdominal cavity.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 2) The reference standard for intermittent IAP measurements is via the bladder with a maximal instillation volume of 25 mL of sterile saline.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 3) 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.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 4) The IAP is approximately 5-7 mmHg in critically ill adults

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 5) IAH is defined by a sustained or repeated pathological elevation in IAP $\geq$ 12 mmHg

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 6) ACS is defined as a sustained IAP>20mmHg (with or without an APP < 60mmHg) that is associated with new organ dysfunction/failure

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 7) IAH is graded as follows:

  Grade I, IAP 12-15 mmHg
  Grade II, IAP 16-20 mmHg
  Grade III, IAP 21-25 mmHg
  Grade IV, IAP > 25 mmHg

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 8) Primary IAH or ACS is a condition associated with injury or disease in the abdominopelvic region that frequently requires early surgical or interventional radiological intervention

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 9) Secondary IAH or ACS refers to conditions that do not originate from the abdominopelvic region.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 10) Recurrent IAH or ACS refers to the condition in which ACS redevelops following previous surgical or medical treatment of primary or secondary ACS

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 11) Abdominal perfusion pressure (APP) =Mean arterial pressure (MAP) – IAP

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 2) The reference standard for intermittent IAP measurements is via the bladder with a maximal instillation volume of 25 mL of sterile saline.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

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New Definitions Accepted by the 2012 Consensus Panel

Retained Definitions from the Original 2006 Consensus Statements[1]

- 12) A poly-compartment syndrome is a condition where two or more anatomical compartments have elevated compartmental pressures.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 13) Abdominal compliance quantifies the ease of abdominal expansion, is determined by the elasticity of the abdominal wall and diaphragm, and is expressed as the change in intra-abdominal volume per change in intra-abdominal pressure.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 14) An open abdomen is any abdomen requiring a temporary abdominal closure due to the skin and fascia not being closed after laparotomy. The technique of temporary abdominal closure should be explicitly described.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Retained Definitions from the Original 2006 Consensus Statements[1]

- 15) Lateralization of the abdominal wall refers to the phenomenon whereby the musculature and fascia of the abdominal wall, most well seen by the rectus abdominus muscles and their enveloping fascia, move lateraly away from the midine with time.

[1]Malbrain ML et al., Results from the International Conference of Experts on Intra-Abdominal hypertension and Abdominal Compartment Syndrome. I. Definitions , Intensive Care Medicine 2006;32:1722 -1732

Classification System for the Complexity of an Open abdomen

1 – No Fixation	
1A:	Clean, no fixation
1B:	Contaminated, no fixation
1C:	Enteric leak, no fixation
2 – Developing Fixation	
2A:	Clean, developing fixation
2B:	Contaminated, developing fixation
2C:	Enteric leak, developing fixation
3– Frozen Abdomen	
3A:	Clean, frozen abdomen
3B	Contaminated, frozen abdomen
4:	**Established enteroatmospheric fistula**

This is an update of the original Bjorck[1] classification regarding the importance of an enteroatmospheric or enterocutaneous fistula in the open abdomen.

[1]Bjorck M, Bruhin A, Cheatham M, et al. Classification--important step to improve management of patients with an open abdomen. *World J Surg* 2009; 33(6):1154-7.

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Consensus Management Statements

Final 2012 WSACS Consensus Management Statements

Recommendations	
1.	Measure LAP when any known risk factor for IAH/ACS is present in a critically ill or injured patient
2.	Studies should adopt current and accepted standard trans-bladder IAP measurement technique
3.	Protocolized monitoring and management of IAP should be utilized when caring for the critically ill or injured
4.	Efforts and/or protocols should be utilized to avoid sustained IAH in critically ill patients
5.	Efforts and/or protocols should be utilized to obtain early or at least same-hospital-stay abdominal fascial closure
6.	Use decompressive laparotomy to reduce IAP in cases of overt ACS
7.	Negative pressure wound therapy should be utilized to facilitate earlier abdominal fascial closure among those with open abdominal wounds
Suggestions	
1.	Critically ill or injured patients should receive optimal pain and anxiety relief
2.	Brief trials of neuromuscular blockade may be used to temporize the treatment of IAH
3.	The potential contribution of body position in elevating IAP should be considered in patients with IAH or ACS
4.	Use a protocol to try and avoid a positive cumulative fluid balance in the critically ill patient with, or at risk of, IAH
5.	Use an enhanced ratio of plasma to packed red blood cells during resuscitation from massive hemorrhage
6.	Use percutaneous catheter drainge to remove fluid in those with IAH/ACS when this is technically possible and the alternative is doing nothing or a decompressive laparotomy
7.	Physiologically-exhausted post-trauma laparotomy patients should utilize a prophylactic open abdomen strategy
8.	Intraperitoneal contamination (even if severe) is not a sole indication for the routine or prophylactic use of an open abdomen technique
9.	Biologic meshes should not be routinely utilized to facilitate early acute fascial closure
No Recommendations	
1.	No recommendation can be made regarding use of abdominal perfusion pressure as a resuscitation endpoint
2.	No recommendation can be made regarding use of diuretics for patients with IAH
3.	No recommendaiton can be made regarding use of renal replacement therapies for patients with IAH
4.	No recommendation can be made regarding administration of albumin to patients with IAH
5.	No recommendation can be mde regarding use of the components separation technique for earlier abdominal fascia closure among patients with open abdominal wounds
6.	No recommendation can be made regarding use of the open abdomen in non-trauma acute care surgery patients with physiologic exhaustion

ACS, abdominal compartment syndrome; IAP, intra-abdominal pressure; IAH, intra-abdominal hypertension.

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Recommendations

- Updated consensus definitions and management statements were then derived using a modified Delphi method and the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) methodology. Quality of evidence was graded from high (A) to very low (D) and management statements from strong RECOMMENDATIONS (desirable effects clearly outweigh potential undesirable ones) to weaker SUGGESTIONS (potential risks and benefits of the intervention are less clear).

Consensus Management Statements - Recommendation

- 1) **We RECOMMEND measuring intra-abdominal pressure versus not when any known risk factor for IAH/ACS is present in critically ill or injured patients [1] (Unchanged Management Recommendation 1 [GRADE 1C]).**

[1]Risk Factors are presented in the next slide

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Risk Factors Continued

Evidence-based Risk Factors:

Abdominal surgery [1-3]
Acidemia [4,19,47]
Acute pancreatitis [1]
Age [2]
Gastroparesis/gastric distention/ileus [4]
Hemoperitoneum/pneumoperitoneum or intra-peritoneal fluid collections [5]
Hypothermia [6]
Increased APACHE-II or SOFA score [5, 7]
Increased head of bed angle [8-10]
Intra-abdominal infection/abscess [11]
Liver dysfunction/cirrhosis with ascites [1]
Major trauma [3, 6, 12]
Massive fluid resuscitation or positive fluid balance [2, 2, 3, 5, 6, 12, 13]
Mechanical ventilation [4]
Obesity or increased body mass index [2,48, 1, 13]
PEEP >10 [1]
Polytransfusion [6]
Prone positioning [14-16]
Sepsis [2, 11]
Shock or hypotension [4,45, 1, 6]

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Risk Factors

Opinion- or Pathophysiology-based Risk Factors:
Bacteremia
Coagulopathy
Damage control laparotomy
Distended abdomen
Intra-abdominal or retropertoneal tumors
Laparoscopy with excessive inflation pressures
Major burns
Massive incisional hernia repair
Peritoneal dialysis
Peritonitis
Pneumonia
Volvulus

Where APACHE-II indicates Acute Physiology and Chronic Health Evaluation-II; PEEP, positive end expiratory pressure; and SOFA, Sequential Organ Failure Assessment.

*References are presented if the presented risk factor is supported at least to some degree by primary literature. Those unsupported by primary literature are based on clinical judgment and/or pathophysiological rationale.

†The patient populations included in these studies included major trauma patients, general intensive care unit patients, severe acute pancreatitis patients, severe extremity injury patients, and surgical intensive care unit patients. Moreover, some of these studies addressed only patients that were mechanically ventilated, whereas others included mixed cohorts of patients with different ventilation statuses.

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References for Risk Factors

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Consensus Management Statements - Recommendation

- 2) **We also RECOMMEND that studies of IAH or ACS adopt the trans-bladder technique as a standard IAP measurement technique[1] (Unchanged Management Recommendation 2; [not GRADED]).**

[1]Risk 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.

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Consensus Management Statements - Recommendation

- 3) **we RECOMMEND use of protocolized monitoring and management of IAP versus not (New Management Recommendation 3 [GRADE 1C]).**

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Consensus Management Statements - Recommendation

- 4) Efforts and/or protocols should be utilized to avoid sustained IAH in critically ill patients

GRADE 1C

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Consensus Management Statements - Recommendation

- 5) We recommend decompressive laparotomy to decrease IAP in cases of overt ACS compared to strategies that do not use decompressive laparotomy in critically ill adults with ACS [GRADE 1D]

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Consensus Management Statements - Recommendation

- 6) We recommend that among ICU patients with open abdominal wounds, conscious and/or protocolized efforts be made to obtain an early or at least same hospital stay closure [GRADE 1D]

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Consensus Management Statements - Recommendation

- 7) We recommend that among critically ill/injured patients with open abdominal wounds, strategies utilizing negative pressure wound therapy should be used versus not [GRADE 1C]

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Suggestions

- Updated consensus definitions and management statements were then derived using a modified Delphi method and the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) methodology. Quality of evidence was graded from high (A) to very low (D) and management statements from strong RECOMMENDATIONS (desirable effects clearly outweigh potential undesirable ones) to weaker SUGGESTIONS (potential risks and benefits of the intervention are less clear).

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Consensus Management Statements - Suggestions

- 1) We suggest that critically ill or injured patients receive optimal pain and anxiety relief [GRADE 2D]

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Consensus Management Statements - Suggestions

- 2) We suggest brief trials of neuromuscular blockade as temporizing measure in the treatment of IAH [GRADE 2D]

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Consensus Management Statements - Suggestions

- 3) We suggest that the potential contribution of body position to elevated IAP be considered among patients with, or at risk of, IAH or ACS [GRADE 2D]

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Consensus Management Statements - Suggestions

- 4) We suggest using a protocol to try and avoid a positive cumulative fluid balance in the critically ill or injured patient with, or at risk of, IAH, after the acute resuscitation has been completed and the inciting issues/source control have been addressed [GRADE 2C]

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Consensus Management Statements - Suggestions

- 5) We suggest use of an enhanced ratio of plasma/packed red blood cells for resuscitation of massive hemorrhage versus low or no attention to plasma/packed red blood cell ratios [GRADE 2D]

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Consensus Management Statements - Suggestions

- We suggest use of PCD to remove fluid (in the setting of obvious intraperitoneal fluid) in those with IAH/ACS when this is technically possible compared to doing nothing [GRADE 2C].
- We also suggest using PCD to remove fluid (in the setting of obvious intraperitoneal fluid) in those with IAH/ACS when this is technically possible compared to immediate decompressive laparotomy as this may alleviate the need for decompressive laparotomy [GRADE 2D]

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Consensus Management Statements - Suggestions

- 7) We suggest that patients undergoing laparotomy for trauma suffering from physiologic exhaustion be treated with the prophylactic use of the open abdomen versus closure and expectant IAP management [GRADE 2D]

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Consensus Management Statements - Suggestions

- 8) We suggest not to routinely utilize the open abdomen for patients with severe intraperitoneal contamination undergoing emergency laparotomy for intra-abdominal sepsis unless IAH is a specific concern [GRADE 2B]

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Consensus Management Statements - Suggestions

- 9) We suggest that bioprosthetic meshes should not be routinely used in the early closure of the open abdomen compared to alternative strategies [GRADE 2D]

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No Recommendations

- Updated consensus definitions and management statements were then derived using a modified Delphi method and the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) methodology. Quality of evidence was graded from high (A) to very low (D) and management statements from strong RECOMMENDATIONS (desirable effects clearly outweigh potential undesirable ones) to weaker SUGGESTIONS (potential risks and benefits of the intervention are less clear).

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Consensus Management Statements

- 1) We could make no recommendation regarding use of abdominal perfusion pressure in the resuscitation/management of the critically ill/injured

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Consensus Management Statements

- 2) We could make no recommendation regarding use of diuretics to mobilize fluids in hemodynamically stable patients with IAH after the acute resuscitation has been completed and the inciting issues/source control have been addressed

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Consensus Management Statements

- 3) We could make no recommendation regarding the use of renal replacement therapies to mobilize fluid in hemodynamically stable patients with IAH after the acute resuscitation has been completed and the inciting issues/source control have been addressed

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- 4) We could make n o recommendation regarding the administration of albumin versus not, to mobilize fluid in hemodynamically stable patients with IAH after the acute resuscitation has been completed and the inciting issues/source control have been addressed

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- 5) We could make no recommendation regarding the prophylactic use of the open abdomen in non-trauma acute care surgery patients with physiologic exhaustion versus closing and expectant IAP management

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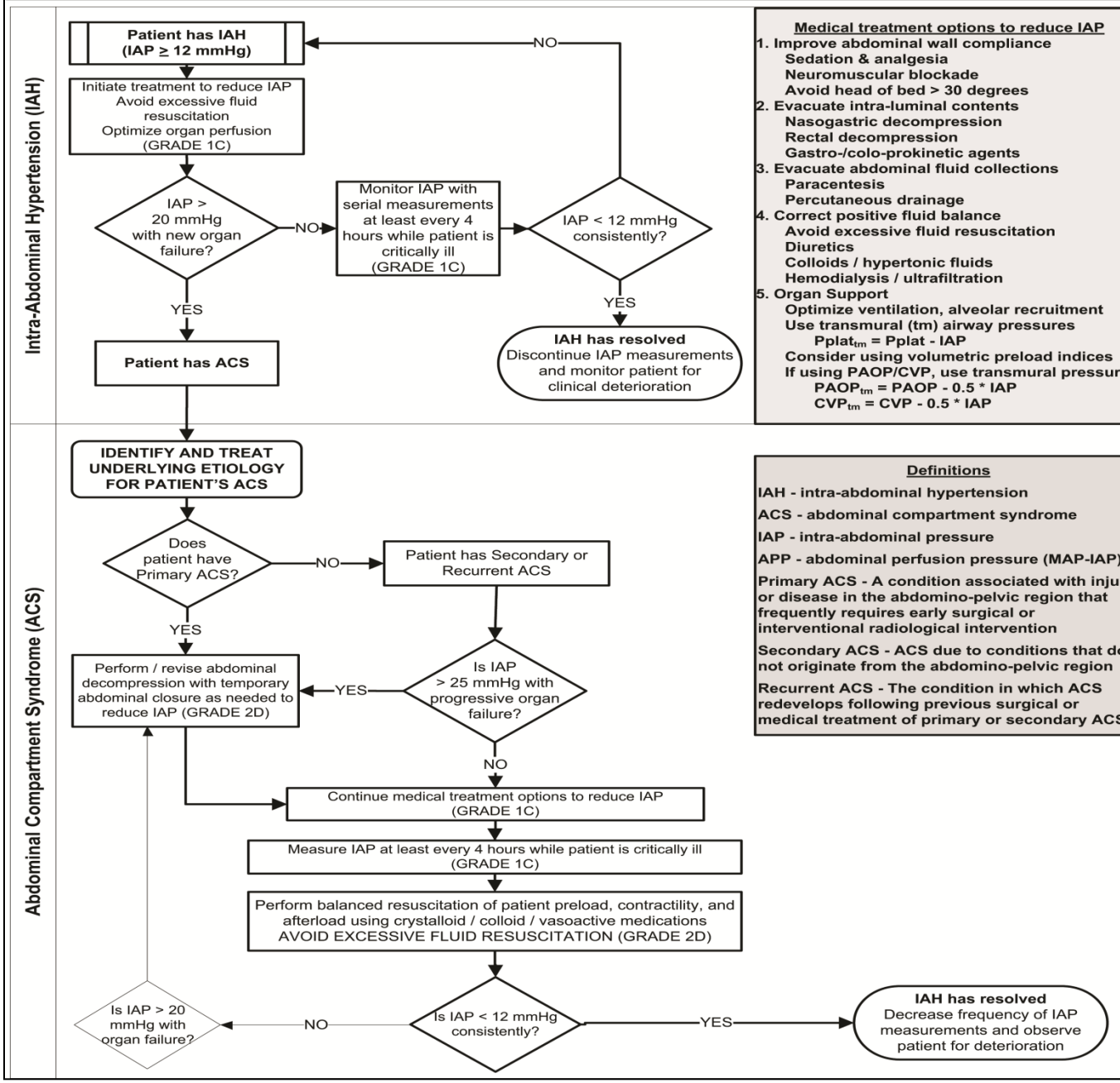
Consensus Management Statements

- 6) We could make no recommendation regarding use of the component separation technique to facilitate early fascial closure versus not

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



IAH / ACS MEDICAL MANAGEMENT ALGORITHM

- *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.*

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 > 25 mmHg and new organ dysfunction / failure is present, patient's IAH / ACS is refractory to medical management. Strongly consider surgical abdominal decompression (GRADE 1D).