

INDEX ABDOMINAL TRAUMA

The impact of early diagnostic laparoscopy on the prognosis of patients with suspected acute mesenteric ischemia.	2
Abdominal vascular trauma in 760 severely injured patients.	3
Management of biliary complications following damage control surgery for liver trauma.....	4
Is computed tomography necessary to determine liver injury in pediatric trauma patients with negative ultrasonography?	5
Risk factors and management of anticoagulant-induced intramural hematoma of the gastrointestinal tract.	6
Distinguishing between acute appendicitis and appendiceal mucocele: is this possible preoperatively?	7
Blunt bowel and mesenteric injuries detected on CT scan: who is really eligible for surgery?...	8
Risk factors for liver abscess formation in patients with blunt hepatic injury after non-operative management.	9
Planned re-laparotomy and the need for optimization of physiology and immunology.....	10
The role of surgery in the management of "body packers".....	11
Serum lipase for assessment of pancreatic trauma.	12
Abdominal blast injuries: different patterns, severity, management, and prognosis according to the main mechanism of injury.	13
Temporary vascular shunts.	14

The impact of early diagnostic laparoscopy on the prognosis of patients with suspected acute mesenteric ischemia.

Gonenc M, Dural C A, Kocatas A, Buyukasik S, Karabulut M, Alis H.

Eur J Trauma Emerg S. 2013;39(2):185-189.
10.1007/s00068-013-0253-y

To assess the impact of early diagnostic laparoscopy in patients with suspected acute mesenteric ischemia in whom other diagnostic studies are inconclusive or unavailable.

The medical records of patients who underwent diagnostic laparoscopy with a preoperative diagnosis of acute mesenteric ischemia between January 2008 and January 2012 were reviewed. The patients who had a preoperative diagnosis of acute mesenteric ischemia based on computed tomography or angiography were excluded. Outcome variables were the time between admission and diagnostic laparoscopy, overall revascularization rate, successful revascularization rate, and in-hospital mortality rate.

Fifty-three patients were included in the study. Twelve patients (22.6 %) had negative diagnostic laparoscopy. In 43 patients (77.4 %) who were found to have acute mesenteric ischemia at diagnostic laparoscopy, the mean time between admission and diagnostic laparoscopy, overall revascularization rate, successful revascularization rate, and in-hospital mortality rate were 10.2 h, 32.5 %, 13.9 %, and 74.4 %, respectively. The mean time between admission and diagnostic laparoscopy was significantly shorter in patients who underwent successful revascularization, and in those who survived with or without developing short bowel syndrome.

Diagnostic laparoscopy is a safe and reliable diagnostic tool that can have a positive impact on the prognosis of patients with suspected acute mesenteric ischemia if carried out in a timely manner when radiological diagnostic studies are inconclusive or unavailable.

Keywords

diagnostic laparoscopy - computed tomography - mesenteric ischemia - revascularization - mortality - multidetector ct angiography - intestinal ischemia - management - mortality - accuracy - disease

Abdominal vascular trauma in 760 severely injured patients.

Heuer M, Hussmann B, Kaiser G M, Lefering R, Paul A, Lendemans S, Dgu.

Eur J Trauma Emerg S. 2013;39(1):47-55.

10.1007/s00068-012-0234-6

Purpose

The relevance of abdominal vascular injuries in polytraumatic patients within a large collective has not yet been thoroughly analyzed. This study aimed at assessing the prevalence of traumatic injuries in relation to outcome and currently established treatment options.

Methods

51,425 patients from the Trauma Registry of the German Society of Trauma Surgery (TR DGU) (1993-2009) were analyzed retrospectively. All patients who had an Injury Severity Score (ISS) of ≥ 16 , were directly admitted to a trauma center and subsequently received treatment for at least three days, were ≥ 16 years old, and had an abdominal injury (AIS(abdomen) ≥ 2) were included. Patients with abdominal trauma (AIS(abdomen) ≥ 2) were compared with patients with additional vascular trauma (AIS(vascular) 2-5).

Results

10,530 (20.5 %) of the 51,425 patients had documented abdominal injury. 760 (7.2 %) of the patients with abdominal injury additionally showed abdominal vascular injury (AIS(abdomen) ≥ 2 , AIS(vascular) 2-5) and were analyzed based on the classification of the American Association for the Surgery of Trauma (AAST) organ severity score (AAST vascular injury grade: II, 2.4 %; III, 2.7 %; IV, 1.8 %; V, 0.2 %. Patients with high-grade abdominal vascular injury (grades IV and V) showed a significant increase in mortality (IV, 44.6 %; V, 60 %) and consequently a decrease in the need for surgical intervention (IV, 67.4 %; V, 64 %).

Conclusions

The results presented here show the prevalence and outcome of abdominal vascular injuries in a large collective within the TR DGU for the first time. Based on the current literature and these findings, a treatment algorithm has been developed.

Keywords

trauma - abdomen - vascular injury - mortality - prognosis - multiple organ failure - emergency-room - german-society - management - sepsis - register - surgery - score - time

Management of biliary complications following damage control surgery for liver trauma.

Hommel M, Kazemier G, Schep N W L, Kuipers E J, Schipper I B.

Eur J Trauma Emerg S. 2013;39(5):511-516.
10.1007/s00068-013-0304-4

The liver is the most frequently injured solid intra-abdominal organ. The major cause of early death following severe liver trauma is exsanguination. Although perihepatic packing improves survival in severe liver trauma, this leaves parenchymal damage untreated, often resulting in post-traumatic biliary leakage and a subsequent rise in morbidity. The aim of this study was to analyze the incidence and treatment of biliary leakage following the operative management of liver trauma.

Patients presenting between 2000 and 2009 to Erasmus University Medical Centre with traumatic liver injury were identified. Data from 125 patients were collected and analyzed. Sixty-eight (54 %) patients required operation. All consecutive patients with post-operative biliary complications were analyzed. Post-operative biliary complications were defined as biloma, biliary fistula, and bilhemia.

Ten (15 %) patients were diagnosed with post-operative biliary leakage following liver injury. Three patients with a biloma were treated with percutaneous drainage, without further intervention. Seven patients with significant biliary leakage were managed by endoscopic stenting of the common bile duct to decompress the internal biliary pressure. One patient had a relaparotomy and right hemihepatectomy to control biliary leakage and injury of the right hepatic duct.

Biliary complications continue to occur frequently following damage control surgery for liver trauma. The majority of biliary complications can be managed without an operation. Endoscopic retrograde cholangiopancreatography (ERCP) and internal stenting represent a safe strategy to manage post-operative biliary leakage and bilhemia in patients following liver trauma. Minor biliary leakage should be managed by percutaneous drainage alone.

Keywords

liver trauma - damage control surgery - biliary complications - hepatic hemorrhage - nonoperative management - perihepatic packing - bile leaks - injuries - blunt

Is computed tomography necessary to determine liver injury in pediatric trauma patients with negative ultrasonography?

Kaya U, Cavus U Y, Karakilic M E, Erdem A B, Aydin K, Isik B, Abacioglu S, Buyukcam F.

Eur J Trauma Emerg S. 2013;39(6):641-646.
10.1007/s00068-013-0322-2

Purpose

Abdominal trauma is the third most common cause of all trauma-related deaths in children. Liver injury is the second most common, but the most fatal injury associated with abdomen trauma. Because the liver enzymes have high sensitivity and specificity, the use of tomography has been discussed for accurate diagnosis of liver injury.

Methods

Our study was based on retrospective analyses of hemodynamically stable patients under the age of 18 who were admitted to the emergency department with blunt abdominal trauma.

Results

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels were significantly higher as a result of liver injury. In the patients whose AST and ALT levels were lower than 40 IU/L, no liver injury was observed in the contrast-enhanced computed tomography (CT). No liver injury was detected in the patients with AST levels lower than 100 IU/L. Liver injury was detected with contrast-enhanced CT in only one patient whose ALT level was lower than 100 IU/L, but ultrasonography initially detected liver injury in this patient.

Conclusions

According to our findings, abdominal CT may not be necessary to detect liver injury if the patient has ALT and AST levels below 100 IU/L with a negative abdominal USG at admission and during follow-up.

Keywords

pediatric abdominal trauma - liver enzyme - liver injury - ultrasonography - blunt abdominal-trauma - nonoperative management - emergency-department - transaminase levels - hepatic-injury - united-states - children - diagnosis - risk - ct

Risk factors and management of anticoagulant-induced intramural hematoma of the gastrointestinal tract.

Samie A A, Theilmann L.

Eur J Trauma Emerg S. 2013;39(2):191-194.
10.1007/s00068-013-0250-1

Intramural intestinal hematoma is considered a rare complication of overanticoagulation in elderly patients. Nevertheless, this clinical entity is increasingly being reported in the literature, and its incidence is predicted to increase further as a result of the wide use of long-term anticoagulation in an aging population. However, data regarding the risk factors and optimal management of this unusual complication in patients on phenprocoumon/warfarin are scarce. We retrospectively analyzed the medical reports of patients with intramural gastrointestinal hematoma on anticoagulant therapy who were treated in our unit between January 2008 and July 2011.

Four consecutive patients were identified during the study period. The mean age of the patients was 80 years. All patients were on uninterrupted anticoagulation with phenprocoumon due to chronic atrial fibrillation. Hematoma was localized in the duodenum in one patient, in the jejunum in two patients, and in the rectum in one patient. Hematoma occurred spontaneously in three patients and following a trauma in one patient. Excessive anticoagulation with an INR of > 6 was associated with the development of this complication in all spontaneous cases. A combination of computed tomography and sonography established the diagnosis in all four. Conservative therapy proved successful in two patients, and surgery was necessary in two cases. Intramural hematoma of the gastrointestinal tract should be suspected in any patient with abdominal pain or intestinal obstruction under anticoagulant therapy. Emergency physicians and surgeons should be aware of this rare complication, as most such cases will resolve spontaneously under conservative measures without the need for surgery.

Keywords

intestinal hematoma - phenprocoumon - anticoagulant therapy - small-bowel hematoma - obstruction - therapy - secondary - warfarin

Distinguishing between acute appendicitis and appendiceal mucocele: is this possible preoperatively?

Saylam B, Guldogan C E, Coskun F, Vural V, Comcali B, Tez M.

Eur J Trauma Emerg S. 2013;39(5):523-529.
10.1007/s00068-013-0321-3

Mucocele of the appendix is an infrequent event, characterized by a cystic dilatation of the lumen. It is often diagnosed clinically from signs and symptoms of acute appendicitis or, if it is asymptomatic, as an incidental finding during ultrasonography, computed tomography, or laparotomy.

We evaluated the histological data of patients who were believed to have mucocele of the appendix. These patients (n = 23) were compared with sex- and age-matched control subjects (n = 79) with appendicitis.

The main reason for emergency surgery was lower right abdominal pain in 15 patients, and intestinal obstruction in three. Univariate analysis using sonography demonstrated that the larger appendiceal outer diameter was positively correlated with the diagnosis of appendiceal mucocele (p = 0.001) and the mean white blood cell count was negatively correlated (p = 0.023). In urine analysis, 41.7 % of the mucocele patients and 10 % of the appendicitis patients had microscopic hematuria, respectively (p = 0.019). An outer diameter of 10 mm or more was predictive of appendiceal mucocele diagnosis, with a sensitivity of 76.5 %, specificity of 81 %, positive predictive value of 76.5 %, and negative predictive value of 94.12 %. The overall diagnostic accuracy was 80.2 %. One point was given for the presence of each of these factors to develop a new score. The resulting area under the receiver operator characteristic curve was 0.855 (95 % CI 0.741-0.969) for the score. The histological examination of the specimens revealed mucocele in 15 cases, mucinous cystadenoma in seven cases and mucinous cystadenocarcinoma in one case. Twenty patients underwent appendectomy, and three patients were treated with right colectomy.

A threshold 10-mm diameter of the appendix under compression is a useful preoperative measurement for differentiating between appendiceal mucocele and acute appendicitis. Microhematuria is simple test that can provide a significant role in supporting the clinical diagnosis of appendiceal mucocele in the emergency department.

Keywords

mucocele of the appendix - appendicitis - score - microhematuria - urologic disease - ct findings - appendectomy - hematuria

Blunt bowel and mesenteric injuries detected on CT scan: who is really eligible for surgery?

Bege T, Chaumoitre K, Leone M, Mancini J, Berdah S V, Brunet C.

Eur J Trauma Emerg S. 2014;40(1):75-81.
10.1007/s00068-013-0318-y

There is no consensually accepted approach to the management of blunt bowel and mesenteric injuries. Surgery is required urgently in the case of bowel perforation or haemodynamic instability, but several patients can be treated non-operatively. This study aimed to identify the risk factors for surgery in an initial assessment.

We retrospectively reviewed the medical charts and computed tomography (CT) scans of adult patients presenting with a blunt abdominal trauma to our centre between the years 2004 and 2011. We included only patients with a CT scan showing suspected injury to the mesentery or bowel.

There were 43 patients (33 males and 10 females), with a mean Injury Severity Score (ISS) of 22. The most frequently suspected injuries based on a CT scan were mesenteric infiltrations in 40 (93 %) patients and bowel wall thickening in 22 (51 %) patients. Surgical therapy was required for 23 (54 %) patients. Four factors were independently associated with surgical treatment: a free-fluid peritoneal effusion without solid organ injury [adjusted odds ratio (OR) = 14.4, 95 % confidence interval (CI) [1.9-111]; $p = 0.015$], a beaded appearance of the mesenteric vessels (OR = 9 [1.3-63]; $p = 0.027$), female gender (OR = 14.2 [1.3-159]; $p = 0.031$) and ISS > 15 (OR = 6.9 [1.1-44]; $p = 0.041$). Surgery was prescribed immediately for 11 (26 %) patients and with delay, after the failure of initially conservative treatment, for 12 (28 %) patients. The presence of a free-fluid peritoneal effusion without solid organ injury was also an independent risk factor for delayed surgery (OR = 9.8 [1-95]; $p = 0.048$).

In blunt abdominal trauma, the association of a bowel and/or mesenteric injury with a peritoneal effusion without solid organ injury on an initial CT scan should raise the suspicion of an injury requiring surgical treatment. Additionally, this finding should lead to a clinical discussion of the benefit of explorative laparotomy to prevent delayed surgery. However, these findings need validation by larger studies.

Keywords

blunt trauma - bowel and mesenteric injury - surgery - ct scan - screening computed-tomography - 275,557 trauma admissions - hours produce morbidity - gender-related outcomes - abdominal-trauma - multidetector ct - multicenter experience - operative intervention - hollow viscus - free fluid

Risk factors for liver abscess formation in patients with blunt hepatic injury after non-operative management.

Hsu C P, Wang S Y, Hsu Y P, Chen H W, Lin B C, Kang S C, Yuan K C, Liu E H, Kuo I M, Liao C H, Ouyang C H, Yang S J.

Eur J Trauma Emerg S. 2014;40(5):547-552.
10.1007/s00068-013-0346-7

Purpose

To identify risk factors for liver abscess formation in patients with blunt hepatic injury who underwent non-operative management (NOM).

Methods

From January 2004 to October 2008, retrospective data were collected from a single level I trauma center. Clinical data, hospital course, and outcome were all extracted from patient medical records for further analysis.

Results

A total of 358 patients were enrolled for analysis. There were 13 patients with liver abscess after blunt hepatic injury. Patients with abscess had a significant increase in glutamic oxaloacetic transaminase (GOT, $p = 0.006$) and glutamic pyruvic transaminase (GPT, $p < 0.0001$), and a decrease in arterial blood pH ($p = 0.023$) compared to patients without abscess in the univariate analyses. In addition, high-grade hepatic injury and transarterial embolization (TAE, $p < 0.001$) were also risk factors for liver abscess formation. Five factors (GOT, GPT, pH level in the arterial blood sample, TAE, and high-grade hepatic injury) were included in the multivariate analysis. TAE, high-grade hepatic injury, and GPT level were statistically significant. The odds ratios of TAE and high-grade hepatic injury were 15.41 and 16.08, respectively. A receiver operating characteristic (ROC) analysis was used for GPT, and it suggested cutoff values of 372.5 U/L. A prediction model based on the ROC analysis had 100 % sensitivity and 86.7 % specificity to predict liver abscess formation in patients with two of the three independent risk factors.

Conclusions

TAE, high-grade hepatic injury, and a high GPT level are independent risk factors for liver abscess formation.

Keywords

hepatic injury - liver injury - liver laceration - non-operative management - liver abscess - transarterial embolization - increased aspartate-aminotransferase - abdominal computed-tomography - trauma - complications - sonography - experience - diagnosis - children - victims - enzymes

Planned re-laparotomy and the need for optimization of physiology and immunology.

Kobayashi L, Coimbra R.

Eur J Trauma Emerg S. 2014;40(2):135-142.
10.1007/s00068-014-0396-5

Planned re-laparotomy or damage control laparotomy (DCL), first described by Dr. Harlan Stone in 1983, has become a widely utilized technique in a broad range of patients and operative situations. Studies have validated the use of DCL by demonstrating decreased mortality and morbidity in trauma, general surgery and abdominal vascular catastrophes. Indications for planned re-laparotomy include severe physiologic derangements, coagulopathy, concern for bowel ischemia, and abdominal compartment syndrome. The immunology of DCL patients is not well described in humans, but promising animal studies suggest a benefit from the open abdomen (OA) and several human trials on this subject are currently underway. Optimal critical care of patients with OA's, including sedation, paralysis, nutrition, antimicrobial and fluid management strategies have been associated with improved closure rates and recovery.

Keywords

re-laparotomy - damage control laparotomy - open abdomen - abdominal compartment syndrome - damage-control laparotomy - hypertonic saline resuscitation - primary fascial closure - multiple organ failure - severe intraabdominal hemorrhage - trauma exsanguination protocol - massive transfusion protocols - elusive early complication - vascular surgical-patients

The role of surgery in the management of "body packers".

Llano L A, Valcalcel C R, Al-lal Y M, Diaz M D P, Stafford A, Fuentes F T.

Eur J Trauma Emerg S. 2014;40(3):351-355.

10.1007/s00068-014-0388-5

The concealment of packets of illegal substances within body cavities is a common technique for drug smuggling worldwide. The goal of our study was to analyze the results of conservative treatment of "body packers", indications for surgical intervention, and postoperative morbidity. This is a retrospective study of patients admitted to our hospital and diagnosed as body packers. The diagnostic protocol included an abdominal X-ray and urinalysis for toxic substances. Only patients with gastrointestinal symptoms, signs of intoxication, or a positive urinalysis were admitted for observation. Conservative management included bowel rest and serial abdominal radiographs to confirm the passage per rectum of all foreign bodies. Asymptomatic patients were given laxatives in the emergency department (ED) to promote bowel movements and were not admitted to the hospital.

A total of 763 body packers were admitted to the hospital, all of whom were initially treated conservatively. Of these patients, 47 (6 %) developed complications: 28 with bowel obstruction, three with bowel perforation, and 16 with substance intoxication. In patients developing complications, urinalysis for toxic substances was negative in 19 (40 %). Sixteen (34 %) patients who developed complications were successfully managed nonoperatively. Three (6 %) other patients died before surgery: two deaths resulted from acute toxicity (one of them with an acute onset and a negative urinalysis) and the third patient died of bowel perforation. Laparotomy was required in 28 (3.5 %) body packers admitted for observation. Enterotomy and/or gastrotomy to remove the packets were the most frequently performed procedures. Postoperative morbidity occurred in 57 % of patients, with wound infection being the most frequent complication.

Conservative management was effective in 94 % of symptomatic patients. A laparotomy was required in only 3.5 % of cases. The mortality rate in this series was low, resulting from either severe cocaine poisoning from ruptured packets or bowel perforation.

Keywords

body packers - swallowers - drug smuggling - surgical-treatment - experience - packing - pushers - drugs

Serum lipase for assessment of pancreatic trauma.

Mitra B, Fitzgerald M, Raoofi M, Tan G A, Spencer J C, Atkin C.

Eur J Trauma Emerg S. 2014;40(3):309-313.

10.1007/s00068-013-0341-z

Pancreatic enzymes are routinely measured during reception of trauma patients to assess for pancreatic injury despite conflicting evidence on their utility. The aim of this study was to investigate the utility of routine initial serum lipase measurement for the diagnosis of acute pancreatic trauma.

Lipase measurements were introduced as part of the trauma pathology panel and requested on all patients who presented to an adult major trauma service and met trauma call-out criteria. Clinical records of these patients were extracted from the trauma registry and retrospectively reviewed. The performance of an initial serum lipase level measured on presentation to detect pancreatic trauma was determined.

There were 2,580 patients included in the study, with 17 patients diagnosed with pancreatic trauma. An elevated lipase was recorded in 390 patients. Statistically significant associations were observed for elevated lipase in patients with pancreatic trauma, head injury, acute alcohol ingestion and massive blood transfusion. As a test for pancreatic trauma, an abnormal serum lipase result had a specificity of 85.3 % (95 % CI 83.8-86.6), sensitivity of 76.5 % (95 % CI 49.8-92.2), positive predictive value of 3.3 % (95 % CI 1.8-5.8) and negative predictive value of 99.8 % (95 % CI 99.4-99.9). Higher cut-offs of serum lipase did not result in better performance.

A normal serum lipase result can be a useful adjunct to exclude pancreatic injury. A positive lipase result, regardless of the cut-off used, was not reliably associated with pancreatic trauma, and should not be used to guide further assessment.

Keywords

wounds and injuries - pancreas - abdomen - resuscitation - hematologic tests - tomography - x-ray computed - blunt abdominal-trauma - head-injury - amylase - utility - hyperamylasemia - management - chemistry - enzymes - panels - level

Abdominal blast injuries: different patterns, severity, management, and prognosis according to the main mechanism of injury.

Turegano-Fuentes F, Perez-Diaz D, Sanz-Sanchez M, Alfici R, Ashkenazi I.

Eur J Trauma Emerg S. 2014;40(4):451-460.
10.1007/s00068-014-0397-4

To review the frequency, different patterns, anatomic severity, management, and prognosis of abdominal injuries in survivors of explosions, according to the main mechanism of injury.

A MEDLINE search was conducted from January 1982 to August 2013, including the following MeSH terms: blast injuries, abdominal injuries. EMBASE was also searched, with the same entries. Abdominal blast injuries (ABIs) have been defined as injuries resulting not only from the effects of the overpressure on abdominal organs, but also from the multimechanistic effects and projectile fragments resulting from the blast. Special emphasis was placed on the detailed assessment of ABIs in patients admitted to GMUGH (Gregorio Maran University General Hospital) after the Madrid 2004 terrorist bombings, and in patients admitted to HYMC (Hillel Yaffe Medical Centre) in Hadera (Israel) following several bombing episodes. The anatomic severity of injuries was assessed by the abdominal component of the AIS, and the overall anatomic severity of casualties was assessed by means of the NISS.

Abdominal injuries are not common in survivors of terrorist explosions, although they are a frequent finding in those immediately killed. Primary and tertiary blast injuries have predominated in survivors from explosions in enclosed spaces reported outside of Israel. In contrast, secondary blast injuries causing fragmentation wounds were predominant in suicide bombings in open and/or semi-confined spaces, mainly in Israel, and also in military conflicts. Multiple perforations of the ileum seem to be the most common primary blast injury to the bowel, but delayed bowel perforations are rare. Secondary blast injuries carry the highest anatomic severity and mortality rate. Most of the deaths assessed occurred early, with hemorrhagic shock from penetrating fragments as the main contributing factor. The negative laparotomy rate has been very variable, with higher rates reported, in general, from civilian hospitals attending a large number of casualties.

The pattern, severity, management, and prognosis of ABI vary considerably, in accordance with the main mechanism of injury.

Keywords

blast injuries - abdominal injuries - fragment wounds - explosions - suicide bombing attacks - operation-iraqi-freedom - terrorist bombings - casualty incidents - external signs - combat wounds - global war - trauma - experience - explosion

Temporary vascular shunts.

Feliciano D V, Subramanian A.

Eur J Trauma Emerg S. 2013;39(6):553-560.
10.1007/s00068-011-0171-9

Temporary vascular shunts have been used for nearly 100 years in patients. Originally, they were used as vascular grafts that were likely to thrombose as collaterals would hopefully develop. More recently, they have been used as a device to be replaced by a permanent vascular graft during the same operation or at a reoperation. Indications for the use of shunts are a "damage control" procedure for a peripheral or truncal vascular injury, Gustilo III C fracture of an extremity, need for perfusion as a complex revascularization is performed, and planned replantation of a hand, forearm, or arm. They are used in approximately 8% of vascular injuries treated in urban trauma centers in the United States and have an excellent patency rate without heparinization.

Keywords

vascular shunt - intravascular shunt - intraluminal shunt - temporary shunt - "damage control" - vascular shunt - peripheral arterial injuries - lower-limb trauma - intravascular shunts - damage control - intraluminal shunts - lower-extremity - management - experience