Complications of Abdominal Surgery (Abdominal, Urologic and Gynecologic Emergencies)

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Contents

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Abstract

CT has become the standard reference technique for the diagnosis of most common complications following abdominal, urologic, or gynecologic surgery. An adapted CT technique and knowledge of normal postoperative anatomy are essential for accurate interpretation of CT scans. The main complications following abdominal, urologic, or gynecologic surgery include peritonitis, abscesses, hemorrhage, small-bowel obstruction, abdominal wall wound or hematoma, and anastomotic leaks.

1 Introduction

Despite many improvements in perioperative morbidity related to the development of the laparoscopic approach, complications are still commonly observed after abdominal, gynecologic, or urologic surgery and remain a challenging problem for both the physician and the radiologist. Cross-sectional imaging and particularly CT play a crucial role in the diagnosis and the therapeutic management of most common postoperative complications (Gore et al. 2004). Postoperative imaging of the abdomen in an emergency condition remains difficult and should be integrated in a multidisciplinary approach where physical examination and laboratory tests play a major role (Zins and Ferretti 2009). In this chapter, we will review the CT features of common acute complications following abdominal, gynecologic, or urologic surgery.

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2 CT Technique

CT examination of the postoperative abdomen should start from the level of the dome of the diaphragm and end at the level of the pelvic floor. Associated examination of the thorax may be indicated if pulmonary embolism or pneumonia is suspected. The use of multidetector CT allows such extended study. A first unenhanced scan is recommended (1) to look with a focus on spontaneously increased density consistent with bleeding and (2) to detect a large amount of free intraperitoneal air that could contraindicate rectal contrast medium enema. A second scan is performed after intravenous administration of iodinated contrast medium for exploration of the entire abdominal cavity in the portal phase. The portal phase is perfectly suited for assessment of bowel wall enhancement, as well as for the diagnosis of abdominal collection or abscesses with peripheral enhancement (Zappa et al. 2009). In the case of suspicion of an anastomotic bowel leak, CT should be associated with oral or rectal water-soluble enema, depending on the location of the gastrointestinal anastomosis (Zappa et al. 2009; Power et al. 2007).

3 Normal Postoperative CT Appearance After Abdominal Surgery

3.1 Pneumoperitoneum

Free intraperitoneal air after abdominal surgery is a common finding on CT in the early postoperative period and represents residual postoperative pneumoperitoneum (Gayer et al. 2004). A small amount of free air can be seen during the first week following surgery, but it should not exceed a few milliliters after 3 or 4 days (Fig. 1). Many factors influence the importance of postoperative pneumoperitoneum: a high body weight index is associated with smaller postoperative pneumoperitoneum in obese patients; conversely, in male patients, the presence of postoperative drains and the type of abdominal surgery (colectomy, gastrectomy, and cholecystectomy) seem to be associated with larger postoperative pneumoperitoneum (Gayer et al. 2004).

Fig. 1 Postoperative CT 3 days after left-sided colectomy in a 65-year-old woman. Presence of a small amount of free intraperitoneal air (*arrows*) representing normal residual pneumoperitoneum

3.2 Fluid Collection

The presence of a moderate amount of reactive intraperitoneal fluid is commonly observed during the early postoperative period. It is usually not collected and resolves spontaneously and progressively in less than 2 weeks. Small postoperative fluid collections predominate the surgical bed. Larger volumes of fluid collections can be observed in all peritoneal compartments of the abdominal cavity (Gore et al. 2004; Zappa et al. 2009). Some pitfalls must be known and recognized:

- After Whipple resection, transient fluid collections may be observed in the pancreatic bed or around the three anastomoses, simulating an anastomotic leak (Lepanto et al. 1994). A small amount of gas bubbles can be observed in these collections and should not necessarily indicate infection (Fig. 2) (Lepanto et al. 1994).
- After left-sided hemicolectomy, accumulation of fluid around the pancreatic tail can be observed and is commonly related to the mobilization of the

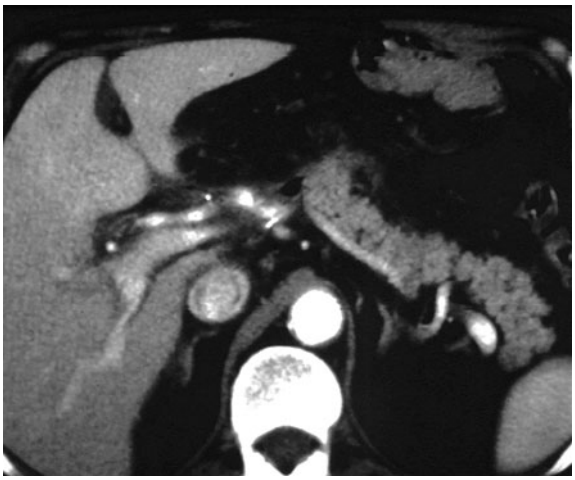

Fig. 2 Postoperative CT 3 days after a Whipple procedure in a 75-year-old man. Presence of a transient fluid collection with a small amount of gas

splenic flexure. This feature should not be mistaken for a posttraumatic pancreatitis (Zappa et al. 2009).

3.3 Postoperative Ileus

Postoperative Ileus is a common finding on CT in the early postoperative period and can develop after all types of surgery, including extraperitoneal surgery. Surgical manipulation of the gut induces an intestinal muscularis inflammatory response resulting in post-surgical ileus. Distended bowel loops with air and fluid may persist for 2–4 days after surgery. If the inhibition of bowel activity lasts more than 3 days, it is referred to as postoperative paralytic ileus and may need specific treatment (Baig and Wexner 2004). The CT appearance includes distended loops of small bowel and/or large bowel without any clear transition zone between dilated and collapsed bowel loops.

4 CT Appearance of Complications After Abdominal Surgery

4.1 Peritonitis

Seventy percent of complications following abdominal surgery are septic complications (Bartels 2009). Post-operative peritonitis usually results from intra-operative or delayed injury to a digestive organ; it is accompanied by a high mortality rate. Prognosis is directly related to early diagnosis and appropriate re-intervention.

The diagnosis of peritonitis is mainly based on clinical and laboratory signs. In case of discrepancy between CT results and clinical and laboratory signs, the latter should be preponderant in therapeutic decision making. In fact, clinical and laboratory signs of gravity impose prompt re-operation. If CT has been performed, CT features suggestive of peritonitis are: (a) persistence or enlargement of a diffuse fluid collection, (b) enhancement of the parietal peritoneum and (c) presence of gas bubbles within a fluid collection (Zappa et al. 2009).

4.2 Abscesses

Postoperative abscesses still remain a difficult diagnostic challenge for the radiologist. The abscesses may develop locally, in the surgical bed, or distantly, related to the spread of septic material along the anatomic pathways between various intraperitoneal compartments (Gore et al. 2004). The subphrenic spaces and the pouch of Douglas are common localizations of post-operative abscesses. CT is considered the standard reference technique, and has an accuracy of over 90% for the diagnosis of postoperative abscesses (Benoist et al. 2002; Harrisinghani et al. 2002; Van Sonnenberg et al. 2001; Fulcher and Turner 1996). Abscesses appear as a well-circumscribed, rounded or ellipsoid fluid collection with an attenuation value around 0–25 Hounsfield units (HU). They show peripheral rim enhancement and may be associated with internal air–fluid levels or gas bubbles (Gore et al. 2004) (Fig. 3). Stranding of the peritoneal fat planes around the abscess is also a common finding. Absence of communication with the gastrointestinal tract is easily demonstrated using multidetector CT with multiplanar reformations. In contrast to the presence of air in the fluid collection, the presence of a peripheral rim enhancement is not a specific sign for the diagnosis of abscess. Differential diagnosis may be difficult and includes loculated sterile hematomas, pseudocyst, and sterile fluid collection. One of the main advantages of CT over ultrasonography (US) or MRI is its very high negative predictive value for the diagnosis of localized postoperative abscess (Negus and Sidhu 2000). In practice, the CT features described above have

Fig. 3 Postoperative CT 8 days after left-sided pancreatectomy in a 64-year-old man. Presence of a fluid collection containing small gas bubbles with peripheral enhancement and representing an abscess

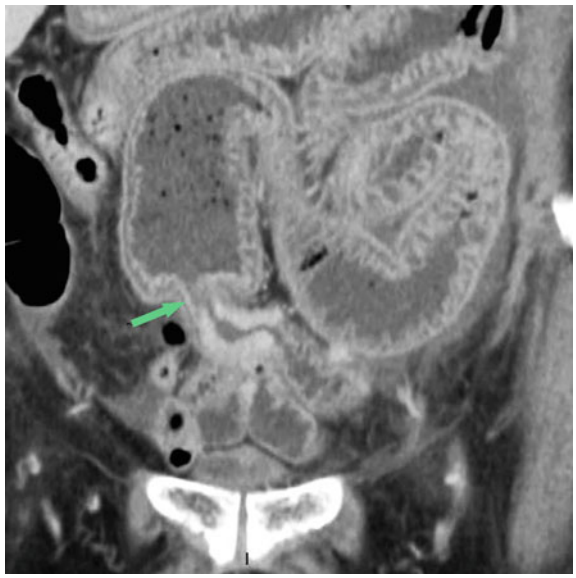

Fig. 4 Mechanical small-bowel obstruction on CT performed 14 days after appendicectomy associated with peritonitis in a 34-year-old man

moderate specificity, and in the case of clinical suspicion of sepsis, any significant intraabdominal collection will be managed with a CT-guided puncture with associated drainage if necessary (Akinci et al. 2005).

4.3 Postoperative Bowel Obstruction

Adhesions are the most common cause of small-bowel obstruction after abdominal or gynecologic surgery and more than 90% of patients who have undergone abdominal surgery will have enteric adhesions (Sandrasegaran et al. 2005). Adhesion-related small-bowel obstruction is presumed to exist on CT when there is a narrow zone of transition without an identifiable obstructive lesion. However, adhesion-related small-bowel obstruction is a rare condition in the immediate postoperative period. Early postoperative small-bowel obstruction is mainly related to an inflammatory process (hematoma, abscess, anastomotic leak) (Zappa et al. 2009). In the immediate postoperative period, CT is the method of choice for diagnosing mechanical small-bowel obstruction and distinguishing it from paralytic ileus (Taourel et al. 1995). In the case of mechanical small-bowel obstruction, the CT diagnosis is based on the presence of dilated small-bowel loops proximal to the suspected site of obstruction and collapsed or normal-appearing loops of small bowel distal to the obstruction (Fig. 4). Multiplanar reformations increase accuracy and confidence in the identification of the transition zone (Hodel et al. 2009). Although these patients rarely require surgery, those with complete, closed-loop, or strangulating obstruction with CT signs of ischemia (decreased bowel wall enhancement, thickening of the bowel wall) require emergent surgery (Sandrasegaran et al. 2005; Zalcman et al. 2000).

4.3.1 Transmesenteric Hernias

Internal hernia is a very uncommon cause of small-bowel obstruction but that may be increasing in frequency owing to the development of gastric bariatric surgery (Blachar et al. 2001) Transmesenteric hernia is the most common type of acquired internal hernia and is usually related to prior abdominal surgery, especially with the creation of a Roux-en-Y anastomosis (e.g., liver transplantation, gastric bypass). Transmesenteric hernias occur through the tear in the mesocolon through which the Roux loop is brought during a retrocolic anastomosis (Sandrasegaran et al. 2005). CT may allow confident diagnosis in most cases in showing a cluster of dilated bowel loops anterior to the transverse mesocolon associated with a deviation and an engorgement of the mesenteric vessels as they pass through the transverse mesocolon (Sandrasegaran et al. 2005; Blachar et al. 2001) (Fig. 5).

Fig. 5 Transmesenteric hernia in a 64-year-old man with history of total gastrectomy for cancer. Presence of a cluster of dilated bowel loops anterior to the transverse mesocolon (*arrowheads*) associated with an engorgement of the mesenteric vessels (*arrows*)

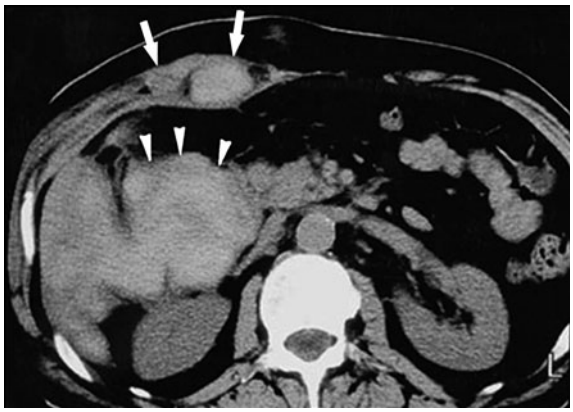

Fig. 6 Rectus sheath hematoma above the arcuate line in a 65-year-old man with abdominal pain and a drop in hematocrit after cholecystectomy: CT demonstration. The unenhanced CT scan shows spindle-shaped, hyperattenuating rectus sheath hematoma (*arrows*) and associated hematoma in the gallbladder fossa (*arrowheads*)

4.4 Postoperative Abdominal Wall Complications

Postoperative complications involving the abdominal wall and presenting as acute abdomen include wound infection, abdominal wall hematoma, and complicated incisional hernias (Gore et al. 2004).

4.4.1 Wound Infection

Wound infections following abdominal, gynecologic, or urologic surgery remain a major source of postoperative morbidity, accounting for about a quarter of the total number of nosocomial infections (Nichols 1991). Today, many of these infections are first recognized in the patient's home because of the large number of operations done in the outpatient setting. As the presence of wound infection is most often clinically apparent, CT plays a minor role in establishing the diagnosis. In some cases, CT performed for another indication will demonstrate a fluid collection containing gas bubbles or an air–fluid level, deep within the incision area, and allows earlier diagnosis and management. US is also an excellent alternative imaging technique for diagnosing such occult abdominal wall abscess.

4.4.2 Abdominal Wall Hematoma

Clinical diagnosis of abdominal wall hematoma is often easy when a patient presents with abdominal pain, swelling, a palpable mass, and a drop in hemoglobin level and hematocrit. Rectus sheath hematomas result from intraoperative injury of the epigastric vessels and are associated with paramedian incision or cesarean section (Gore et al. 2004). Rectus sheath hematomas above the level of the arcuate line are easy to diagnose with CT or US and are treated conservatively. On unenhanced CT, they appear as a spindle-shaped, hyperattenuating formation developed in the rectus sheath (Fig. 6). Below the arcuate line, these hematomas extend posteriorly through the thin fascia transversalis into the prevesical space and large hyperattenuating collections, displacing the peritoneal contents, as often seen (Blum et al. 1995); therefore, precise diagnosis with CT is mandatory.

4.4.3 Complicated Incisional Hernias

Incisional hernias develop in approximately 5% of patients after abdominal surgery and represent a significant iatrogenic problem. Most incisional hernias are recognized by careful inspection and palpation and can be easily confirmed by US examination when the findings of clinical examination are equivocal. However, 10% of incisional hernias cannot be detected on physical examination (obese patients, interparietal hernias) and remain clinically silent for several years. Therefore, CT evaluation of the postsurgical abdomen often shows unsuspected incisional hernias. The main complication occurring with incisional hernias is incarceration and strangulation of

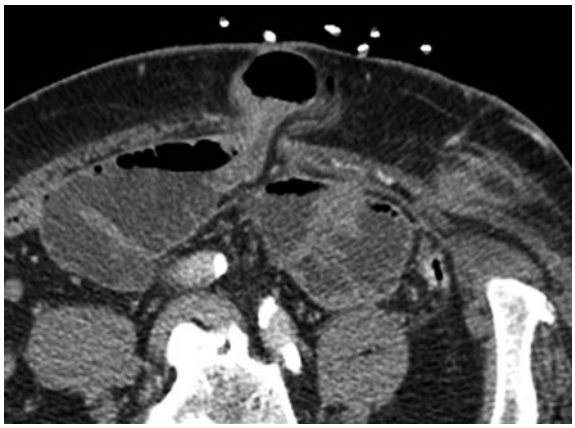

Fig. 7 Incarcerated incisional hernia in a 76-year-old man following jejunostomy

bowel loops. This situation is uncommon in the early postoperative period. CT is accurate in establishing a precise diagnosis of incarceration and strangulation, and helps in therapeutic management, in indicating the need for prompt surgical intervention (Fig. 7).

5 Specific Complications

5.1 Biliary Surgery

Specific complications following hepatobiliary surgery include bile leakage, bile duct injury, and dropped gallstones. US and MRI with magnetic resonance cholangiopancreatography (MRCP) sequences are the preferred modalities for assessment of the postoperative biliary tract (Hoeffel et al. 2006). MRI is particularly well suited in patients with jaundice or biliary tract stenosis. In patients with a nondistended biliary tract and suspected bile leak, MRCP should be completed by the injection of a liver-specific contrast medium with biliary excretion to achieve noninvasive biliary tract opacification. CT is mainly performed in patients with bile peritonitis or biloma, with suspected hepatic artery or portal vein injury in addition to biliary tract injury, and in patients with suspicion of dropped gallstones. On CT, bilomas appear as well-defined fluid collections in the perihepatic spaces, with low attenuation value (Gore et al. 2004) (Fig. 8). Percutaneous aspiration associated with drainage under CT or sonographic guidance will confirm the

Fig. 8 Large biloma on CT following cholecystectomy in a 63-year-old man

diagnosis of bile leakage. Abscesses related to dropped gallstones result from gallbladder perforation during laparoscopic cholecystectomy. This condition is rare in the early postoperative period, with a mean duration of 2 years from the time of surgery to the development of clinical symptoms (Morrin et al. 2000). But in some cases, the dropped gallstones will result in early abscess formation or inflammatory reaction and indicate a requirement for prompt reintervention because simple drainage without removal of the calculi by surgery will be inadequate (Morrin et al. 2000; Bennett et al. 2000).

5.2 Anastomotic Leaks After Gastrointestinal Tract Surgery

CT is the preferred technique for diagnosis of a postoperative lower gastrointestinal tract leak (Khoury et al. 2009). However, the accuracy and sensitivity of CT for diagnosing anastomotic bowel leakage are moderate (Khoury et al. 2009; Power et al. 2007). In fact, the presence of fluid collection and/or free gas around the anastomosis is a common finding after gastrointestinal tract surgery and does not represent a specific sign of anastomotic leak (Power et al. 2007).

Fig. 9 Postoperative CT 6 days after left-sided hemicolectomy showing a large anastomotic leakage with extraluminal accumulation of rectally administered contrast medium anterior to the sacrum

The most specific sign of anastomotic leakage is extraluminal accumulation of the orally or rectally administered contrast medium (Fig. 9) but this sign seems to have a low sensitivity (Power et al. 2007). Thus, CT findings should be carefully interpreted in combination with clinical symptoms.

5.3 Gynecologic Surgery

Surgery remains the main treatment option for most gynecologic diseases. Total hysterectomy, myomectomy, and cesarean section represent the most frequent interventions. In the early postoperative period, specific risks and complications related to those interventions include bladder injury, ureteral injury, bowel injury, vesicovaginal or rectovaginal fistulas, hemorrhage, and abscesses (Paspulati and Dalal 2010). CT is ideally suited for diagnosis of visceral injuries, hemorrhage, and sepsis, whereas MRI is the preferred technique for assessment of postoperative fistulas.

Hemorrhage is the most common complication following gynecologic surgery and the diagnosis is based on physical signs and laboratory tests. When CT is performed, a high attenuation (60–90 HU) is demonstrated within the surgical bed (Fig. 10). Extravasation of contrast medium is diagnostic for active bleeding, which may necessitate transcatheter arterial embolization.

Bowel perforation occurs mainly in the small bowel or the rectosigmoid colon. The presence of an important pneumoperitoneum after the first postoperative week is an indicator of bowel perforation.

Bladder and ureteral injuries may be revealed by urinoma, ureteral obstruction and ureterovaginal or vesicovaginal fistulas (Paspulati and Dalal 2010). CT urography is now the preferred imaging technique for assessment of urinary tract injuries.

5.4 Urologic Surgery

Surgery remains the major treatment option in patients with malignant renal or bladder tumors, and radical prostatectomy with a retropubic, perineal, or laparoscopic approach is the most frequently used treatment for prostate cancer confined to the prostate (Catalá et al. 2009; Israel et al. 2006; Yablon et al. 2004). In the early postoperative period, CT plays a major role in the diagnosis and management of postoperative complications. Multidetector CT with the use of the CT urography technique is now the preferred modality for postoperative assessment in patients who have had urinary tract surgery (Catalá et al. 2009; Israel et al. 2006). Moreover, the excretory phase images are well suited for diagnosis of urinary leaks and should be part of the CT protocol for assessment of any fluid collection following urinary tract surgery.

5.4.1 Cystectomy and Prostatectomy

In the early postoperative period, specific risks and complications related to cystectomy or prostatectomy include urinomas related to anastomotic leaks (vesicourethral, ureteroileal, or ileourethral), fistulas, and rectum injury (Fig. 11) (Catalá et al. 2009; Yablon et al. 2004).

Urinary leakage occurs in nearly 4% of patients after urinary diversion; it is more frequent at the site of the ureteroileal anastomosis and is well demonstrated with excretory phase images (Catalá et al. 2009). Leaks at the site of the intestinal anastomotis are currently

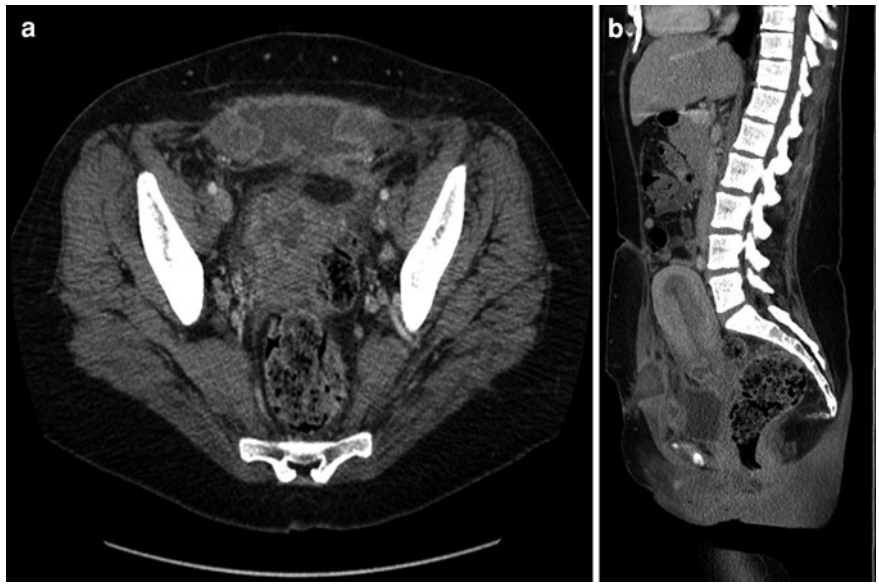

Fig. 10 Hematoma following caesaran section. CT appearance with **a** the axial view and **b** the sagittal view

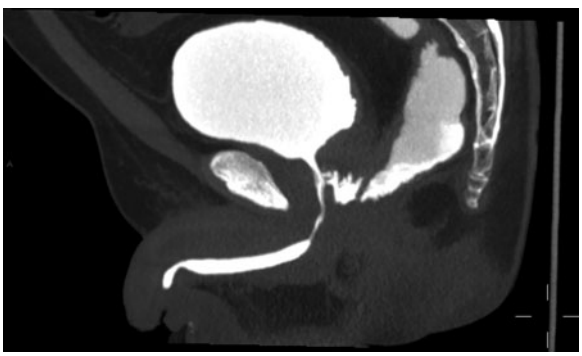

Fig. 11 CT urography following prostatectomy showing a vesicourethral leak

Fig. 12 Postoperative CT in the excretory phase, 8 days after left-sided partial nephrectomy in a 54-year-old man showing urinary leakage

associated with urinary-enteric, enterocutaneous, or enterogenital fistulas (Catalá et al. 2009).

5.4.2 Nephrectomy and Partial Nephrectomy

Partial nephrectomy using a laparoscopic approach is being performed with increased frequency for the treatment of renal cell carcinoma. This is a complex procedure compared with radical nephrectomy, with a major complication rate of about 10% (Israel et al. 2006).

In the early postoperative period, specific risks and complications related to partial nephrectomy include vascular complications (hematoma, renal infarction, pseudoaneurysm) and urinary leakage related to failure of calyceal repair. Multidetector CT with use of the arterial phase is perfectly suited for assessment of a pseudoaneurysm, whereas the use of an excretory phase is mandatory for positive diagnosis of urinary leakage as well as precise location of the leak (Fig. 12) (Israel et al. 2006).

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