

BLUNT ABDOMINAL TRAUMA: CLINICAL ASPECTS AND DIAGNOSTIC-THERAPEUTIC STRATEGIES

GUIDO BASILE, GIUSEPPE EVOLA, MARTINA BRANCIFORTE, NANCY NICOLOSI, ALESSANDRA LEONARDI, ANTONINO BUFFONE
Department of Surgery Emergency and General Surgery Unit, University of Catania

[Traumi addominali chiusi: aspetti clinici e iter diagnostico-terapeutico]

ABSTRACT

Blunt abdominal traumas are caused by road accidents, work accidents, falls, assault and sporting activities. They may involve only the abdominal wall or deep organs (solid organs or hollow viscera, arterial or venous vessels). The most dangerous consequences are hypovolemia and peritonitis.

Diagnostic investigations include laboratory tests, standard radiology, ultrasonography, diagnostic peritoneal lavage, C.T. scan, angio-C.T. and laparoscopy.

Recently, the spread of ultrasound and C.T. in emergency departments has reduced the time to determine the number and the grade of abdominal lesions to only a few minutes, making the decision between an immediate surgical treatment and a conservative approach, with monitoring of clinical, laboratory and radiologic data of the patient, easier and quicker.

With the aim of making the approach of the surgeons working in the same emergency department of making homogeneous and, at the same time, of shortening the diagnostic-therapeutic procedures of the patient with a blunt abdominal trauma, a decisional algorithm, of easy and prompt consultation, is presented.

Finally, techniques of damage control surgery as well as the modalities of surgical repair and resections to treat different lesions of the abdominal organs are described.

Key words: Blunt abdominal trauma, Liver injuries, Splenic injuries, Ultrasonography FAST.

Received February 07, 2013; Accepted February 19, 2013

Introduction

The most frequent cause of blunt abdominal traumas is road accidents (75% of cases), in which the subject can be either the driver or passenger of a vehicle (car, motorcycle, bicycle, heavy goods) or a pedestrian. Other causes are work injuries, falls, being involved in fights and sports activities (boxing, rugby).

Abdominal trauma can be isolated or associated with other lesions, musculoskeletal, cerebral, thoracic or spinal; for this reason the subject must always be examined completely to avoid overlooking lesions, which could be severe, involving other organs. In subjects with multiple traumas the abdomen is involved in about 40% of cases.

Blunt abdominal traumas are divided into superficial and deep. The former only affect the abdominal wall (skin, subcutaneous tissue, fascia and muscles) and rarely pose diagnostic-therapeutic

problems; the latter involve endoperitoneal organs, solid organs or hollow viscera, and/or vascular and peritoneal structures (omentum, mesentery, ligaments). Unlike superficial lesions, deep lesions can sometimes place the patient's life at risk.

As regards solid organ traumas (liver, spleen, kidney, pancreas) there are various types of lesions: subcapsular or intraparenchymal hematomas, lacerations of the capsule or parenchyma, lacerations of the vascular hilum, partial rupture, and multiple-fragmentary rupture. These lesions can also vary according to the extension and the depth, giving rise to clinical pictures of various severity: mild, moderate or severe.

The hollow viscera (stomach, duodenum, small intestine, colon-rectum, bladder) can sustain parietal contusions, partial rupture (when the lesions involve only part of the wall) or total rupture (lesions of the entire wall thickness).

Vascular lesions (aorta, inferior vena cava,

iliac vessels) are often very severe, given that they rapidly lead to hypovolemic shock, but fortunately are rare as these vessels are “protected” by the intestinal mass anteriorly and by the musculoskeletal structure posteriorly.

Finally, there are peritoneal lesions, which generally do not create difficult clinical problems, with the exception of rare persistent bleeding, where surgery is advised with hemostasis and sutures.

Clinical picture

The clinical picture of a patient with a blunt abdominal trauma, other than the presence of injury or skin abrasions, can be characterized by signs of hemorrhage or peritonitis. Hemorrhage is normally secondary to a lesion of a solid organ and shows as, according to intensity, asthenia, pallor, sweating, reduced level of consciousness, tachycardia, and fainting leading to cardio-circulatory collapse. To avoid a fatal hypovolemic shock it is very important in these patients to have a correct approach from the first minutes (golden hour), to determine lesions that could cause irreversible damage. Peritonitis, secondary to laceration of hollow viscera, shows with pain and abdominal tenderness that generally does not allow manual evaluation by the doctor (muscular contracture); there may also be nausea, vomiting, bowels closed to feces and gas. In the cases of parenchymal and hollow viscera lesions, the above mentioned symptoms can be combined, clearly suggesting that diagnostic examinations be carried out and treatment started.

Diagnostic investigations

The diagnostic investigations available are blood analyses, traditional radiological examinations, ultrasound, C.T. scan, diagnostic peritoneal lavage and laparoscopy.

Among the laboratory examinations, the most important is without a doubt hemochromocitometry that evaluates the degree of eventual hematic loss; transaminases are increased in hepatic trauma (AST >400, ALT >250)⁽¹⁾; serum amylase and lipase levels are raised in lesions of the pancreas and finally a urine test can show the presence of erythrocytes in almost all cases of kidney or urinary tract trauma.

Traditional radiology can still be useful in the diagnosis of abdominal trauma. Direct abdominal radiography can show the presence of free air

(pneumoperitoneum) in cases of traumatic perforation of the gastro-enteric tract; thoracic radiography can show eventual associated pleuro-pulmonary lesions, as well as fractured ribs, which sometimes accompany hepatic or splenic trauma, or the dislocation in the thoracic cavity of endoperitoneal organs as a consequence of a diaphragmatic rupture. Radiography of the spine and the pelvis is carried out in the patients with multiple traumas to exclude lesions of these important bone structures.

Ultrasound in abdominal trauma has many advantages: rapid execution, not invasive, absence of radiation, possibility of examining both endo- and retro-peritoneal organs, and repeatability of the examination, and it can also be carried out at the patient's bed. It is useful, above all, as an examination for screening to differentiate subjects with internal lesions from those without lesions, and as a rapid diagnostic examination (FAST, as American authors say: Focused Abdominal Sonography for Trauma) in patients with severe hypovolemia. An ultrasound sign that is very important is, in these cases, free endoperitoneal fluid, above all in the most inclined part of the cavity (Morrison's pouch, left upper quadrant, pouch of Douglas), indicating the loss of blood or other organic liquids (gastric juices, bile, feces, urine)^(2,3,4).

Diagnostic peritoneal-lavage should be carried out, in our opinion, in patients with hemodynamic instability, when ultrasound is not possible, due to the lack of the instrument or ultrasound operator. This technique gives indications for surgery when blood, bile, enteric juices or urine is aspirated from the peritoneal cavity. Unfortunately, there still exists a certain level of complications (perforation of vessels or organs) and of false positive or negative results; therefore diagnostic peritoneal-lavage should be reserved only for the aforementioned cases.

Spiral C.T. is indicated when the patient has hemodynamic stability, ab initio or after emergency treatment, or when ultrasound does not provide sufficient information on the type and entity of the organic lesions. C.T., being more accurate than ultrasound, gives a more precise classification of the lesions and thus a better indication for non-surgical or surgical treatment.

The study of the vascular phases with contrast medium (angio-C.T.) allows the identification of the hemorrhage site (contrast blush) and its entity, suggesting, in these cases, the treatment of the lesion, for example hepatic or splenic, by means of arteriography and embolization⁽⁵⁾.

Laparoscopy, among the diagnostic examinations, has, without doubt, the greatest sensitivity and specificity, but remains an invasive examination, to be carried out in anesthesia and not without complications. For this reason, other than the particular organization of some departments, today laparoscopy is indicated when we consider, other than just diagnosis, also therapy (e.g. positioning of hemostatic agents, aspiration and positioning of wound drains, sutures of small perforations of hollow viscera etc.).

Diagnostic-therapeutic approach to blunt abdominal trauma

Over the last few years the diagnostic-therapeutic approach towards patients with blunt abdominal trauma has undergone some changes, above all thanks to the greater use, also in smaller hospitals, of ultrasound and C.T. These examinations, in fact, allow doctors to study better the patients' lesions and decide, based on their severity, the most appropriate treatment, surgical or not.

From these considerations, various diagnostic-therapeutic protocols have been proposed in the literature, starting from the hemodynamic conditions of the patient and bearing in mind the clinical examination, hemato-chemical analyses and ultrasound^(6,7,8), associated or not with C.T.⁽⁹⁾. Following this (Fig. 1) we show the protocol that we believe is currently the most appropriate for blunt abdominal trauma⁽¹⁰⁾.

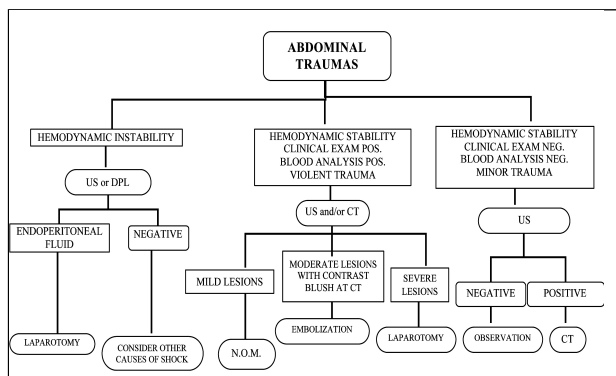


Fig. 1: Diagnostic-therapeutic algorithm for blunt abdominal traumas.

First of all, when the patient is hemodynamically unstable, also after the first emergency treatment (rapid infusion of two liters of Ringer lactate for adults or 20 ml/kg for children), ultrasound is rapidly performed or, if this is not possible, diagnostic peritoneal-lavage. If these examinations

reveal free peritoneal fluid, hematic or other, it is necessary to proceed directly to a laparotomic exploration; otherwise another cause of hypovolemia should be sought (e.g. pelvic fracture).

When the patient is hemodynamically stable, ab initio or after emergency treatment, but the clinical examination of the abdomen shows some anomaly (e.g. injury or hematoma of the superficial tissues, pain or muscular contracture), or when the trauma is particularly violent, or when the results of the laboratory tests are not within normal values (e.g. decrease of hemoglobin, increase of serum amylase or transaminases, presence of erythrocytes in the urine) an ultrasound and/or a C.T. scan of the abdomen should be carried out. If these examinations show lesions of mild or moderate entity, non-operative management can be started (NOM). When the C.T scan in the angiographic phase shows an extravasation of contrast medium (contrast blush) an arteriography with embolization of the blood vessel can be carried out; this should be done especially for solid organ lesions (liver, spleen, kidney) of III or IV degree^(11,12). When the lesions are greater or the patient's condition rapidly worsens it is advisable that the patient undergoes surgery.

Finally, in the cases in which there is a good hemodynamic status, the clinical examination is negative and the hematochemical values are within normal limits, initially ultrasonography can be carried out. This should, however, be required even when clinical and laboratory results are negative, in those patients that present skeletal lesions adjacent to the abdomen (ribs, pelvis), in those with alterations of the senses or in those subjects that have to face prolonged narcosis for other lesions (e.g. cranial or vascular traumas). If ultrasonography is completely negative, the patient should undergo a period of observation (NOM). When ultrasonography shows one or more endoperitoneal lesions, also a C.T. is carried out to better classify the type of lesion.

Non-operative management

As reported in the literature^(13,14,15,16,17,18,19,20), non-operative management is indicated for hemodynamically stable patients, with mild-moderate lesions, while it is not advised in hemodynamically unstable patients, with the presence of abundant intraperitoneal fluid, in cases of multi-visceral lesions⁽²¹⁾, in the patients with pre-existent associated pathologies (e.g.

splenomegaly or hepatomegaly, coagulopathy) and finally when repeated blood transfusions are necessary to maintain sufficient circulatory conditions.

There are numerous advantages of NOM: conservation of the organ function (spleen, liver, kidney, pancreas); elimination of possible post-operative complications (pleuro-pulmonary infection, wound infections, intra-peritoneal abscess, fistulae, hemorrhage, visceral adhesions, thromboembolic diseases); lower costs for the hospital.

NOM is currently applicable in 50-70% of cases.

Once NOM has been decided, the clinical course of the patient must be carefully followed by monitoring arterial pressure, cardiac frequency, electrocardiography and diuresis, and repeating the clinical abdominal examination (every hour), hemochromocytometry (every 2-4 h) and one of the aforementioned instrumental investigations (ultrasonography, peritoneal lavage, C.T.; every 24-48 h). In the meanwhile the patient is not alimented and solutions of crystalloids and/or colloids and antibiotics are administered.

To undertake NOM it is necessary, other than patient monitoring, to have an operating room and surgical team always available.

The percentage of cases that initially undergo NOM and then require surgery due to a worsening of local conditions (hemorrhage) and general conditions (cardio-circulatory failure) vary, according to different authors, from 2 to 15%.

After discharge from hospital, the patients that underwent NOM must have a period of rest of at least one month, avoid physical effort or sports for at least three months and undergo ultrasonography or C.T. after one-two months.

Also NOM is not completely without complications; among these are the return of hemorrhage, including the so-called "two-stage rupture" both at the parenchymal and the vascular level (pseudoaneurysm), hemorrhagic pseudocyst, abscesses and the post-transfusional infections (hepatitis, AIDS etc.).

Surgical treatment

Damage Control Surgery (D.C.S.)

This terminology defines a series of surgical interventions that are primarily aimed at saving the life of the patient by arresting hemorrhage, the consequent lethal triade (hypothermia, coagulopathy, and acidosis) and peritoneal contamination by feces or other organic fluids. To stop bleeding, other than

ligature or clamping of major vessels (celiac trunk, portal vein, inferior vena cava, mesenteric vein, hepatic artery), it is necessary to proceed to the so-called "packing" or compression of solid organs (i.e. liver, spleen) or peritoneal spaces (i.e. pelvis) using gauzes. To avoid contamination it is advisable to use a manual or mechanical suturing of the perforations found in the hollow viscera (stomach, intestine, bladder, biliary tracts), without lengthening surgery time with reconstructions or cutaneous stoma. All this allows anesthetists to face the emergency phase with better results, characterized, in particular, by warming the patient, correction of coagulopathies and acidosis, respiratory and hemodynamic support; this last one enhanced by eventual embolization of bleeding vessels. It is advisable to end surgery closing the abdominal wall rapidly and sometimes partially (i.e. only dermis, application of a bogota-bag) to avoid the possible onset of a post-operative abdominal compartmental syndrome.

Here follow the interventions most commonly carried out for the lesions of the various abdominal organs.

Stomach

The contusion and the incomplete rupture (affecting one or more layers of the wall) are treated conservatively, that is without surgery, with the patient fasting and with nasal-gastric probe for some days. The complete rupture, which is the laceration of all the thickness of the anterior or posterior wall of the stomach, requires sutures, with the positioning of part of the greater omentum for further protection⁽²²⁾. The transection of the stomach, which generally happens near the pylorus, necessitates the reconstruction of the gastro-intestinal continuity by means of end-to-end anastomosis.

Duodenum

The types of lesions (contusion, hematoma, incomplete rupture, complete rupture, transection) and the relative treatments are similar to those of gastric lesions. Only in more severe lesions does the surgical approach changes: in cases of complete rupture involving more than 75% of the parietal diameter it is advised to carry out a duodenojejunostomy to close the breach; if the lesion, other than being extensive, involves the second portion of the duodenum and the pancreas a pancreaticoduodenectomy should be carried out; the duodeno-jejunal section can, instead, be resolved by an end-to-end anastomosis.

Small intestine

Also in this intestinal tract there can be contusions, hematomas, incomplete rupture, complete rupture and transection⁽²³⁾. Conservative therapy is indicated for minor lesions, and surgery for major ones (sutures for small lacerations, resection with end-to-end or side-to-side anastomosis in the transections and intestinal necrosis from lacerations of the mesenteric vascular peduncle).

Colon

Contusions, hematomas and incomplete ruptures are treated conservatively; complete ruptures need, according to severity of the lesions, one of the following surgical interventions: suture, resection and anastomosis, suture and exteriorization of the tract of the colon affected, Hartmann's operation.

Gallbladder and biliary tracts

In cases of lesions of the gallbladder a cholecystectomy is carried out; in cases of laceration of the bile duct sutures are used with the positioning of Kehr's tube, while in the transection of the bile duct it is better to opt for a choledocho-jejunal anastomosis.

Bladder

For small lesions and when in correspondence to the extraperitoneal portion of the bladder it is sufficient to position a catheter for about 15 days to allow the organ to heal. In other cases surgery is advised with suturing of the breach in two layers.

Liver

In cases of small or moderate lesions (subcapsular hematoma involving less than 50% of the hepatic surface, intraparenchymal hematoma less than 10 cm., laceration involving less than 25% of a lobe) NOM is advised. In the hemodynamically stable patients, who at C.T. show active bleeding (contrast blush) angiographic embolization is indicated. In lesions of greater dimensions surgery is advised suturing the parenchyma (hepatorrhaphy), positioning of prosthetic mesh wrapped around the liver or hepatic resection⁽²⁴⁾.

Spleen

In cases of small lesions (subcapsular hematoma involving less than 50% of the splenic surface, intraparenchymal hematoma less than 3 cm., laceration less than 3 cm.) NOM is advised. As for the liver, in moderate lesions with active hemorrhage

embolization is used, while for greater lesions surgery is advised with suturing of the parenchyma (splenorrhaphy), partial resection (superior or inferior pole), wrapping of the spleen with a re-absorbable mesh, or, in the more severe cases, total splenectomy.

Pancreas

In case of slight contusion or superficial laceration NOM is advised; if the contusion and/or the laceration is greater, in absence of lesions of the duct, laparotomy is carried out for hemostasis and positioning of a drain; in distal transections or in parenchymal and ductal lesions of the tail of the pancreas a distal pancreatectomy is carried out; in lacerations of the head of the pancreas involving the duct, anastomosis is performed out on a jejunal loop (Roux-en-Y drainage); finally, in cases of massive disruption of the head a pancreatico-duodenectomy is necessary.

Kidney

In contusions, subcapsular hematomas and single lacerations not involving the collecting system, NOM is advised; in parenchymal lacerations involving the collecting system with urine leak, suturing of the urinary tract and of the renal parenchyma should be carried out; in multiple fractures or renal hilum avulsion a total nephrectomy is necessary.

Diaphragm

The diaphragmatic tears, generally following thoraco-abdominal compressions, are always repaired with interrupted sutures or with the placement of prostheses abdominally (lesions of the left diaphragm) or thoracically (lesions of the right diaphragm).

Conclusions

In patients with blunt abdominal trauma it is necessary to recognize eventual severe lesions within the first hour (golden hour) to avoid possible death from hypovolemic shock. The use of ultrasonography over the last few years together with FAST, and spiral C.T. has allowed, in only a few minutes, to determine signs of direct or indirect severe lesions of solid organs or hollow viscera or of the vascular structures of the abdomen. In these cases the patient should be taken directly to the operating room to carry out minimal surgery

(damage control surgery) that aims at stabilizing the patient, or for definitive procedures of removal or repair of the damaged organ (e.g.. splenectomy, nephrectomy, hemostatic suture). If, however, the diagnostic investigations, including blood tests, suggest mild or moderate lesions, today NOM is indicated, with careful observation of the patient in the emergency department; surgery must be available should there be a sudden worsening of the patient's conditions.

The algorithm that we propose aims to help and, above all, optimize the time of decision making, both diagnostic and therapeutic, of the surgeon responsible for the patient.

References

- 1) Puranik SR, Hayes JS, Long J, Mata M. *Liver enzymes as predictors of liver damage due to blunt abdominal trauma in children*. South Med J 2002; 95: 203-6.
- 2) Coley BD, Mutabagani KH, Martin LC, Zumberge N, Cooney DR, Caniano DA, Besner GE, Groner JJ, Shiels WE. *Focused abdominal sonography for trauma (FAST) in children with blunt abdominal trauma*. J Trauma 2000; 48: 902-6.
- 3) Helling TS, Wilson J, Augustosky K. *The utility of focused abdominal ultrasound in blunt abdominal trauma: a reappraisal*. Am J Surg 2007; 194: 728-32.
- 4) Lee BC, Ormsby EL, McGahan JP, Melendres GM, Richards JR. *The utility of sonography for the triage of blunt abdominal trauma patients to exploratory laparotomy*. Am J Roentgenol 2007; 188: 415-21.
- 5) Hamilton JD, Kumaravel M, Censullo ML, Cohen AM, Kievlan DS, West OC. *Multidetector CT evaluation of active extravasation in blunt abdominal and pelvic trauma patients*. Radiographics 2008; 28: 1603-16.
- 6) Brown MA, Sirlin CB, Hoyt DB, Casola G. *Screening ultrasound in blunt abdominal trauma*. J Intensive Care Med 2003; 18: 253-60.
- 7) Dolich MO, Mckenney MG, Varela JE, Compton RP, Mckenney KL, Cohn SM. *2,576 ultrasounds for blunt abdominal trauma*. J Trauma 2001; 50: 108-12.
- 8) Richards JR, Schleper NH, Woo BD, Bohnen PA, McGahan JP. *Sonographic assessment of blunt abdominal trauma: a 4-year prospective study*. J Clin Ultrasound 2002; 30: 59-67.
- 9) Becker CD, Menta G, Terrier F. *Blunt abdominal trauma in adults: role of CT in the diagnosis and management of visceral injuries*. Eur Radiol 1998; 8: 553-62.
- 10) Basile G, Chiarenza S, Di Mari P, Primus A, Boscarelli G, Buffone A, Cirino E. *Il trattamento dei traumi addominali chiusi. Nostra esperienza*. Ann Ital Chir, 2006; 77: 149-54.
- 11) Gaarder C, Naess PA, Eken T, Skaga NO, Pillgram-Larsen J, Klow NE, Buanes T. *Liver injuries: improved results with a formal protocol including angiography*. Injury 2007; 38: 1075-83.
- 12) Hagiwara A, Murata A, Matsuda T, Shimazaki S. *The usefulness of transcatheter arterial embolization for patients with blunt polytrauma showing transient response to fluid resuscitation*. J Trauma 2004; 57: 271-7.
- 13) Bonariol L, Massani M, Caratozzolo E, Ricordare A, Callegari P, Antoniutti M, Calia di Pinto F, Callegari F, Jelmoni A, Bassi N. *Selection criteria for non-surgical treatment of liver injury in adult polytraumatized patients*. Chir Ital 2002; 54: 621-8.
- 14) Matthews LA, Smith EM, Spirnak JP. *Nonoperative treatment of major blunt renal lacerations with urinary extravasation*. J Urol 1997; 157: 2056-8.
- 15) Maull KI. *Current status of nonoperative management of liver injuries*. World J Surg 2001; 25: 1403-4.
- 16) Chiara O, Cimbanassi S, Bini R, Pavesi L, Rampoldi A, Colombo F, Sansonna F, Pugliese R. *Il trattamento non operatorio delle lesioni traumatiche del fegato*. Ann Ital Chir 2005; 76: 161-5.
- 17) Christmas AB, Wilson AK, Manning B, Franklin GA, Miller FB, Richardson JD, Rodriguez JL. *Selective management of blunt hepatic injuries including nonoperative management is a safe and effective strategy*. Surgery 2005; 138: 606-11.
- 18) Marmorale C., Guercioni G., Siquini W, Asselhab S, Stortoni P, Fianchini M, Fianchini A, Landi E. *Il trattamento non operativo dei traumi addominali chiusi*. 2007; 59: 1-15.
- 19) Schwab CW. *Selection of nonoperative management candidates*. World J Surg 2001; 25: 1389-92.
- 20) Sartorelli KH, Frukientti C, Rogers FB, Osler TM. *Nonoperative management of hepatic, splenic and renal injuries in adults with multiple injuries*. J Trauma 2000; 49: 56-62.
- 21) Miller PR, Croce MA, Bee TK, Malhotra AK, Fabian TC. *Associated injuries in blunt solid organ trauma. Implications for missed injury in nonoperative management*. J Trauma 2003; 53: 238-44.
- 22) Tejerina Alvarez EE, Holanda MS, Lopez-Espadas F, Dominguez MJ, Ots E, Diaz-Reganon J. *Gastric rupture from blunt abdominal trauma*. Injury 2004; 35: 228-31.
- 23) Menegaux F, Tresallet C, Gosgnach M, Nguyen-Thanh Q, Langeron O, Riou B. *Diagnosis of bowel and mesenteric injuries in blunt abdominal trauma: a prospective study*. Am J Emerg Med 2006; 24: 19-24.
- 24) Asensio JA, Roldan G, Petrone P, Rojo E, Tillou A, Kuncir E et al. *Operative management and outcomes in 103 AAST-OIS grades IV and V complex hepatic injuries: trauma surgeons still need to operate, but angioembolization helps*. J Trauma 2003; 54: 653-4.

Request reprints from:

Prof. GUIDO BASILE

Viale Odorico da Pordenone 5

95128 CATANIA

(Italy)