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Post traumatic gastro thorax as a rare cause of cardiac arrest: a case report and review of the literature.

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Abstract :

Traumatic cardiac arrest has a high mortality. We report the case of a 65 years old women who presented a cardiac arrest following traffic accident. Examinations concluded to a tension gastro thorax with a delayed diagnosis. Naso gastric tube insertion was for many authors a temporary care while waiting for surgery. We report on the diagnostic difficulties found in the literature and a recent review of published cases.

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Introduction

Traumatic cardiac arrest has a high mortality but better neurological outcomes in survivors compared to non-traumatic cardiac arrest (1). We report the rare case of a traffic accident victim, who presented a tension gastro thorax complicated by cardiac arrest secondary to diaphragmatic rupture. The incidence is from 0.8 to 8% in blunt thoraco-abdominal injuries (2). It is a surgical emergency that is not to be missed.

Case

A 65 year old woman with a history of grade 3 obesity (BMI of 53 kg/m^2) was involved in a medium kinetic traffic accident following an initial loss of consciousness without prodrome. The pre-hospital assessment reported haemodynamic stability without tachycardia in a patient with eupnea and Glasgow coma scale 15 without neurological deficit. In the emergency room, the clinical examination revealed some bruising of the lower limbs and lumbar pain with no other abnormalities. The blood test revealed rhabdomyolysis with CPK at 535 IU/L and ASAT at 3 times normal ; initial troponinemia at 7 ng/ml ; negative alcohol level. The electrocardiogram was in regular sinus rhythm with no conduction or repolarisation disorders. The chest X-ray (Figure 1) and the whole-body CT scan were unremarkable, except for a dilated aortic root (Figure 2). Quickly the patient presented a state of shock with arterial hypotension at 70/40 mmHg, sinus tachycardia at 120/min, diffuse marbling, hyperlactatemia at 8 mmol/L without deglobulisation and troponinemia at 2900 ng/L. There was no neurological or respiratory associated failure but the patient presented a first episode of vomiting. The electrocardiogram had changed with an under shift of the antero-septo-apical ST-segment without an associated mirror. Trans thoracic echocardiography (poor echogenicity) showed a preserved LVOT with no right ventricular dysfunction or pericardial effusion but with a collapsible inferior vena cava. The FAST scan was unremarkable. A new CT scan excluded an aortic dissection without any other etiological argument described. The patient was transferred to the intensive care unit after vascular filling with crystalloids (1000ml), allowing a blood pressure correction with a MAP higher than 65mmHg and disappearance of the marbles but persistence of sinus tachycardia at 120/min. The evolution was rapidly unfavourable with a sudden coma Glasgow 3 concomitant with episodes of vomiting and followed by a cardio-circulatory arrest. The echocardioscope showed at the same time an extreme bradycardia followed by asystole. Cardiopulmonary resuscitation was started and the patient was intubated. The return of spontaneous cardiac activity with sinus rhythm was achieved after 10 minutes of external cardiac massage and 3 mg of intravenous adrenaline without shockable rhythm. This was followed by major haemodynamic instability requiring high doses of norepinephrine. Transesophageal echocardiography showed at 30 cm from the dental arches, a large, mobile, heterogeneous, fluid-like additional image in the right paracardial region. It will be a gastric hernia and its contents. The interpretation of qualitative or quantitative echocardiographic images was not feasible due to unusual anatomical landmarks. After hemodynamic stabilization, a new CT scan revealed an intra thoracic gastric hernia secondary in this context to a traumatic rupture of the left hemi diaphragm (Figure 3 and 4) and appearing to compress the right ventricle on the acquired images (Figure 5). The diagnosis of tension gastrothorax was retained and a nasogastric tube was placed to empty the gastric contents and decrease the intra thoracic

pressure and the right ventricular compression in the expectation of emergency surgical management. Unfortunately, the evolution was quickly unfavourable with the emergence of a multi-organ failure secondary to a post-cardiac arrest syndrome and followed by the death of the patient before any surgical management. Other etiologies of cardiac arrest were eliminated. The origin of the patient's initial malaise could not be explored.

Discussion

The resuscitation of a cardiac arrest involves its etiological management. The etiologies of post-traumatic cardiac arrest are, in order of frequency, hypovolaemia (uncontrolled haemorrhage, 48%), hypoxemia (13%), compressive pneumothorax (13%) and tamponade (10%) (1). Rarer situations may occur and an understanding of the underlying pathophysiological mechanisms may help to guide emergency management. Several observational studies indicate that approximately 2.5% of non-traumatic cardiac arrest occur in the car and are therefore responsible for traffic accidents (1). The etiological investigation must therefore formally eliminate a medical origin for the cardiac arrest. In blunt abdominal trauma, diaphragmatic lesions may occur following a significant increase in intra-abdominal pressure. In more than 90%, these occur in young male victims of traffic accidents (2). Left diaphragmatic rupture occurs in 3/4 of cases (3), because of the liver absorbs a large part of the shock energy and acts as a buffer on the right hemi diaphragm. The abdominal viscera can therefore herniate in the thorax as this patient who presented a gastro thorax. Among the radiographic signs that allow early diagnostic orientation in the emergency room, an intra thoracic water level opposite the cardiac area is one of the most specific signs (2). The gold standard for the assessment of post-traumatic lesions is the injected whole body CT scan (3), with a sensitivity of 71% and a specificity of 76 to 99% for detecting diaphragmatic hernias (3). The radiological semiology includes the intra thoracic herniation of abdominal contents (Se 55%, Sp 100%), the collar sign which is a waist like constriction of the herniating organ at the site of the diaphragmatic tear (Se 67% for left rupture, Sp 100%) and a diaphragmatic defect (Se 73%, Sp 90%) (3). However, the diagnosis of a diaphragmatic rupture remains difficult with frequent diagnostic delays (3). Gastro thorax can cause several complications, including gastric volvulus (4). A decrease in venous return can also occur either by direct compression of the inferior vena cava or by increased intrathoracic pressure, leading to a decrease in right ventricular preload (5). This is a tension gastro thorax. Clinically, the differential diagnosis with a tension pneumothorax is not necessarily easy (6). In this case, the pathophysiological hypothesis would be a direct compression of the right ventricle by the gastric hernia. The pressure of the gastric contents exceeding the right ventricular pressure would have caused a diastolic dysfunction of the right heart associated with a decrease in the right ventricular preload, mimicking tamponade (7). The decrease in right cardiac output leads to a decrease in left cardiac output via the interdependence between the two ventricles, which can progress to cardio circulatory arrest (8). The initial tachycardia, which persisted despite vascular filling, compensated for the decrease in systolic ejection volumes and temporarily ensured satisfactory cardiac output. Compensatory mechanisms also include an increase in afterload via an increase in peripheral vascular resistance, by activation of the sympathetic and neurohumoral systems (9). The increase in right ventricular compression finally exceed the compensatory mechanisms, leading to a decrease in

cardiac output that can progress to cardiac arrest. Two questions remain unanswered. The discomfort with loss of consciousness that caused our patient's accident could not be explored. Assuming a gastric hernia preexisting the trauma, Zwermann et al. (10) reports a case of gastro thorax complicated by syncope by direct compression of the left atrium. However, the patient history did not mention any symptoms related to a congenital or acquired hernia or symptoms of cardiac arrhythmia. An ischemic origin was also not ruled out although the patient did not report chest pain and the ECG was not in favor. In addition, the initial imaging examinations did not find any abnormality. However, for chest X-rays, the false negative rate for diaphragmatic ruptures varies from 12% to 66% (2). The sensitivity of the CT scan is also only 71% with a specificity approaching 100% (2). In addition, the clinical history of our patient reports episodes of vomiting preceding the performance of the first two CT scans and thus reducing the sensitivity of the examination by decreasing gastric volume. Diaphragmatic ruptures therefore remain diagnostic challenges. These are surgical emergencies aimed at reducing the hernia and repairing the diaphragm by laparotomy (11). In the case of tension gastrothorax and awaiting surgery, placement of a nasogastric tube at the same time of cardiopulmonary resuscitation is recommended by several authors (12) (13). However, performing this procedure can be made difficult by anatomical changes such as gastric volvulus or stenosis caused by the opening of the diaphragmatic lesion (13). A recent literature review since 2000 identified 15 cases of post-traumatic gastro-thorax in adult patients (Table 1). The search terms were “traumatic gastro thorax” and “cardiac arrest”. All are secondary to blunt abdominal trauma and in 80% occurring after a traffic accident. The sex ratio M / F is 0.6 with an average age of 46 years. The initial clinical presentation is mixed with 7 (46%) cases of isolated acute respiratory distress, 1 (6%) case of isolated hemodynamic failure, 5 (33%) cases of respiratory and associated hemodynamic failure, 1 (6%) case of associated neurological and hemodynamic failure, 1 (6%) case of isolated chest pain. All patients received surgical management, 2 (13%) died. A nasogastric tube was inserted in 60% of cases while awaiting surgery.

Conclusion

Post-traumatic gastro-thorax, if it is under tension or complicated by localized tamponade, is a rare cause of cardio circulatory arrest that should not be ignored. Placing a nasogastric tube while waiting for surgery may correct hemodynamic and respiratory failures. However, clinical and radiological diagnosis remains difficult.

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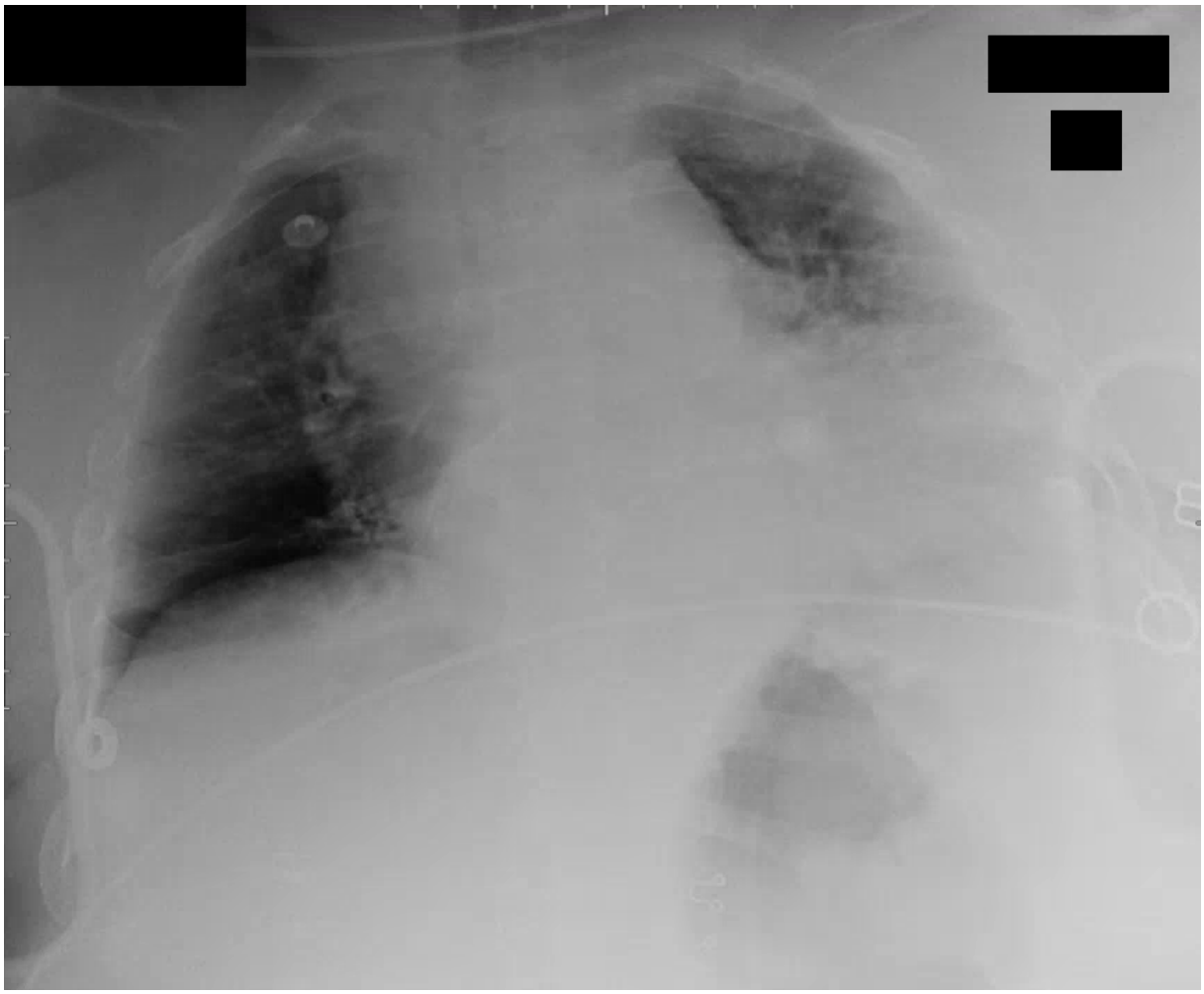

Figure 1. Chest radiography at the emergency department.

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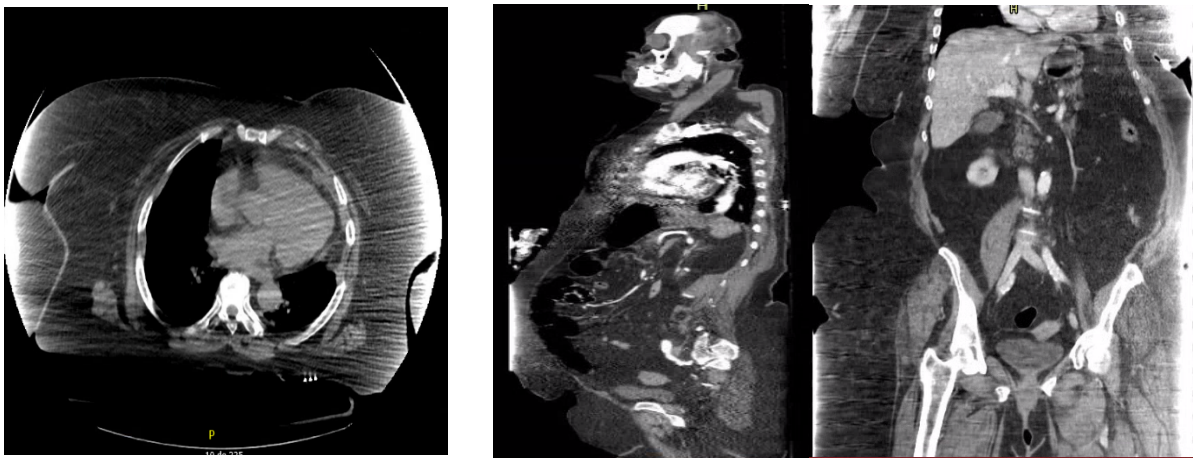

Figure 2. Whole-body CT scan at the entrance of the emergency department. The diaphragm is intact and there is no intra thoracic additional image.

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Figure 3. Scoot of the second CT scan. Several radiological signs are identifiable: 1) intrathoracic herniation of the stomach with 2) the collar sign (a focal constriction of the viscus at the site of the tear).

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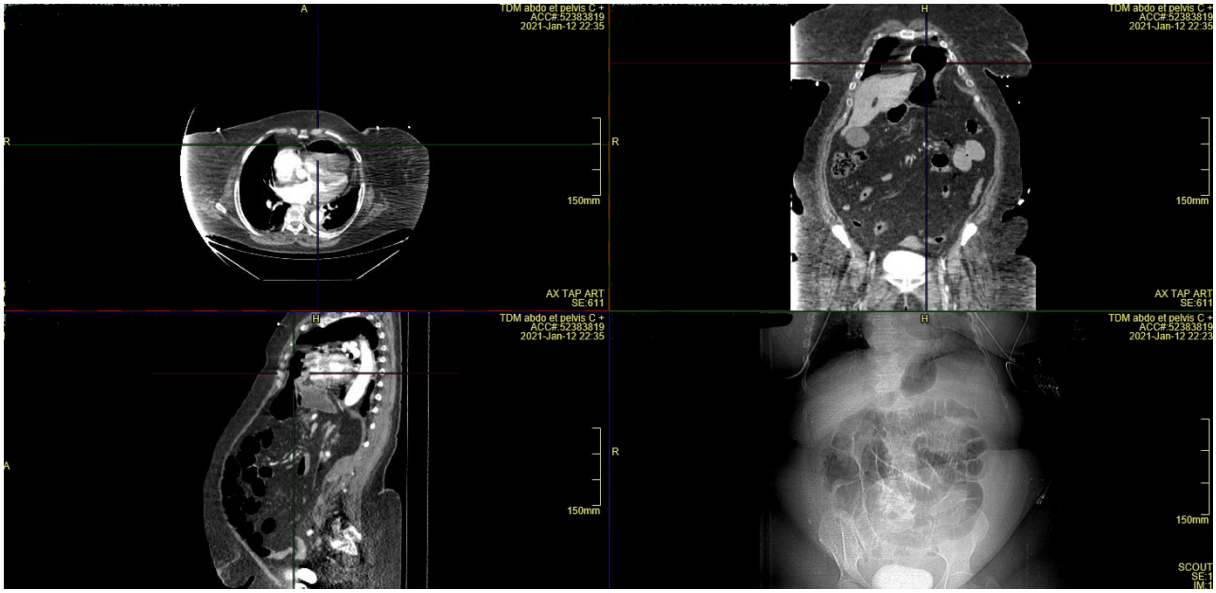

Figure 4. Second CT scan: 1) A diaphragmatic defect on the left hemidiaphragm 2) Intrathoracic herniation of abdominal contents (stomach) 3) The collar sign.

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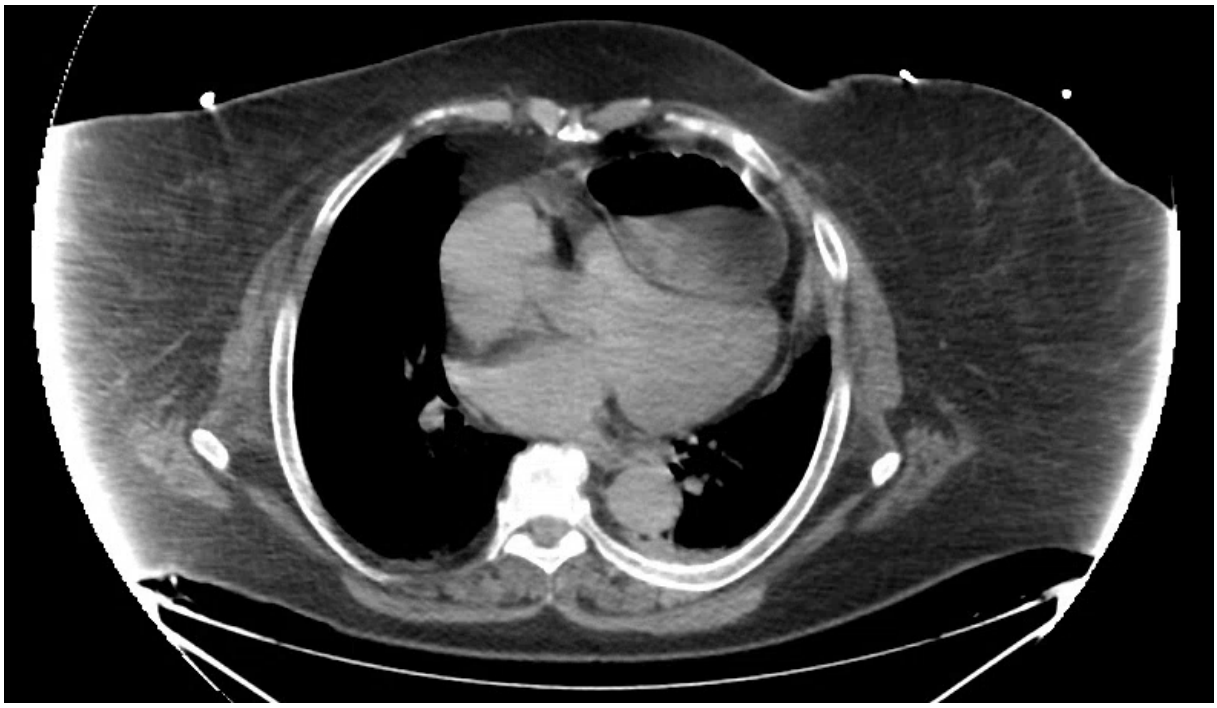

Figure 5. Focus on the stomach herniation on the non-injected CT scan. The right ventricular compression by the hernia is viewable.

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	Age / Sexe	Circumstance	Type of trauma	Presentation	Cardiac arrest	NGT placement	Outcome
Algin et al., 2020 (14)	40 / M	TA	BAT	RF	None	Yes	Alive after surgery
Ghandour et al., 2020 (15)	59 / F	TA	BAT	RF	None	Yes	Alive after surgery
Vempalli et al., 2020 (16)	45 / M	TA	BAT	RF	None	Yes	Alive after surgery
Royalty et al., 2019 (8)	64 / F	TA	BAT	HF	None	Yes	Alive after surgery
Bunya et al., 2017 (12)	75 / F	TA	BAT	HF / RF	Yes	Yes	Died after surgery
Elangovan et al., 2013 (17)	30 /M	TA	BAT	RF	None	Yes	Alive after surgery
Safdar et al., 2013 (11)	60 / M	Fall down the stairs	BAT	RF	None	No	Alive after surgery
Kao et al., 2009 (18)	52 / M	TA	BAT	Thoracic pain	None	Unable	Died after surgery
Ekim et al., 2008 (19)	31 / M	TA	BAT	HF / RF	None	Unable*	Alive after surgery
How et al., 2007 (20)	35 / F	Fall on a chair	BAT	RF	None	Yes	Alive after surgery
Nishijima et al., 2007 (21)	25 / M	TA	BAT	HF / RF	None	No	Alive after surgery
Bamgbade et al., 2006 (22)	30 / F	TA	BAT	HF / RF No radiologic sign initially	None	Yes**	Alive after surgery
McCann et al., 2005 (23)	70 / M	Struck by a car	BAT	HF / RF	None	Yes	Alive after surgery
Mortelmans et al., 2003 (24)	32 / M	TA	BAT	RF	None	No	Alive after surgery
	41 / F	TA	BAT	NF / RF	None	No	Alive after surgery

Table 1. Case reports since 2000 of gastro thorax complicating a traumatic injury. F = female, M = male, TA = traffic accident, BAT = Blunt Abdominal Trauma, RF = respiratory failure, HF = hemodynamic failure, NGT = naso gastric tube. * NGT was positioning during surgery. ** NGT placement under gastroscopy.

Références

1. Truhlář A, Deakin CD, Soar J, Khalifa GEA, Alfonzo A, Bierens JJLM, et al. European Resuscitation Council Guidelines for Resuscitation 2015. Resuscitation. oct 2015;95:148-201.

2. Iochum S, Ludig T, Walter F, Sebbag H, Grosdidier G, Blum AG. Imaging of Diaphragmatic Injury: A Diagnostic Challenge? RadioGraphics. oct 2002;22:103-116.

3. Sangster G, Ventura VP, Carbo A, Gates T, Garayburu J, D'Agostino H. Diaphragmatic rupture: a frequently missed injury in blunt thoracoabdominal trauma patients. Emerg Radiol. févr 2007;13(5):225-230.

4. Ter Avest E, Kamphuis DD, Sprakel J, Witteveen H, Hannivoort LN. Cardiac Arrest Caused by an Acute Intrathoracic Gastric Volvulus Treated With Percutaneous Gastrostomy. Ann Emerg Med. févr 2021;77(2):249-252.

5. Van Der Linde RA, Lases SS, Buist TJ, van Westreenen HL, Nieuwenhuijs VB. A Decreased Preload Due to a Loaded Stomach: A Rare Presentation of a Paraesophageal Hernia. Ann Thorac Surg. déc 2017;104(6):e451-453.

6. Singh S, Sukesan S, Kiran U, Makhija N. Gastrothorax or tension pneumothorax: A diagnostic dilemma. J Emerg Trauma Shock. 2011;4(1):128.

7. Bellier M, Schenck M, Guillot M, Riehm S, Schneider F. Tamponnade localisée : une cause rare d'arrêt cardiaque inopiné. Presse Médicale. mars 2014;43(3):323-325.

8. Royalty AK, Nash NA, Motameni AT, Arnold LF. Tension Gastrothorax Causing Hemodynamic Instability in a Traumatic Diaphragm Rupture. Am Surg. mai 2019;85(5):e260-261.

9. Spodick DH. Acute Cardiac Tamponade. N Engl J Med. août 2003;349(7):684-690.

10. Zwermann L, Ritter P, Spelberg F, Helck A, Pratschke S, Methe H. Syncope Due to a Massive Upside-Down Stomach. J Am Coll Cardiol. mai 2013;61(18):1925.

11. Safdar G, Slater R, Garner JP. Laparoscopically assisted repair of an acute traumatic diaphragmatic hernia. Case Rep. juin 2013;2013(jun24 1):bcr2013009415-bcr2013009415.

12. Bunya N, Sawamoto K, Uemura S, Toyohara T, Mori Y, Kyan R, et al. How to manage tension gastrothorax: a case report of tension gastrothorax with multiple trauma due to traumatic diaphragmatic rupture. Int J Emerg Med. déc 2017;10(1):4.

13. Ahn S, Kim W, Sohn CH, Seo DW. Tension Viscerothorax after Blunt Abdominal Trauma: A Case Report and Review of the Literature. J Emerg Med. déc 2012;43(6):e451-453.

14. Algın A. Tension gastrothorax secondary to trauma in the emergency room: A case report. Turk J Trauma Emerg Surg [Internet]. 2019; Disponible sur: http://www.tjtes.org/eng/jvi.aspx?pdir=travma&plng=eng&un=UTD-94694

15. Ghandour R, Ejbeh S, Maalouf P, Sayegh F, El Masri S, El Assaad H, et al. Never seen right gastrothorax: A case report. Trauma Case Rep. août 2020;28:100316.

16. Vempalli N, Konda S, Kaeley N, Bhardwaj B, Kumar S. Post-traumatic diaphragmatic hernia: Diagnostic dilemma in primary care. J Fam Med Prim Care. 2020;9(5):2555.

17. Elangovan A, Chacko J, Gadiyaram S, Moorthy R, Ranjan P. Traumatic Tension Gastrothorax and Pneumothorax. J Emerg Med. févr 2013;44(2):e279-280.

18. Kao Y, Lee W-J, Lin H-J. Tension gastrothorax: a life-threatening cause of acute abdominal

pain. Can Med Assoc J. avr 2009;180(9):983-983.

19. Ekim H, Tuncer M, Özbay B. Tension viscerothorax due to traumatic diaphragmatic rupture. Ann Saudi Med. mai 2008;28(3):207-208.

20. How C, Tee A, Quah J. Delayed presentation of gastrothorax masquerading as pneumothorax. Prim Care Respir J. nov 2006;S1471441806003367.

21. Nishijima D, Zehbtachi S, Austin RB. Acute posttraumatic tension gastrothorax mimicking acute tension pneumothorax. Am J Emerg Med. juill 2007;25(6):734.e5-734.e6.

22. Bamgbade OA. Management of tension gastrothorax. Resuscitation. août 2006;70(2):293-294.

23. McCann B. Tension viscerothorax: an important differential for tension pneumothorax. Emerg Med J. mars 2005;22(3):220-221.

24. Mortelmans LJM, Jutten GCY, Coene L. Acute post-traumatic tension gastrothorax, a tension pneumothorax-like injury: Eur J Emerg Med. déc 2003;10(4):344-346.