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Editorial

Medical Education in COVID-19 Pandemic

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Abstract

Clinical medicine is an essential part of medical education for clerkships, internships, and continuous education for PGY 1 and PGY 2. It is also a foundation for high-quality healthcare services. Across all medical fields, quality training has been shown to be a key element in improving patient outcomes. It is important for medical students to assume roles that allow them to be involved in patient care in a clinical setting. Since the outbreak of the COVID-19 pandemic in 2019, all medical education systems were disrupted globally. Many students and learners worldwide were unable to go to school or receive training in person, due to the restrictions imposed to prevent or slow the spread of the disease. Remote learning has been widely accepted in education systems, including medical education programs. The effectiveness of promoting a medical student's academic success and the well-being of each program depends on the professional capacity and practices of the school personnel. Leaders of hospital education departments need to be aware of the impact of the COVID-19 pandemic on student training and think creatively to support maximum learning outcomes and maintain the quality of patient care.

Key words: COVID-19 pandemic, Medical education, Clinical medicine, Distance learning

Since 2019, a global pandemic due to coronavirus led to millions of deaths worldwide and various challenges to education systems and public health. All levels of education systems and training programs have had to find new ways of continuing to provide quality education during this unprecedented time. New technology has been utilized in remote learning in either synchronous or asynchronous settings. In medical education, integrating basic science, clinical education, and competency-based assessments is necessary.

Unlike the core science courses where students spend most of their time learning in classrooms, clinical medicine training requires students to put their education into practice. However, the policies that have been used to prevent the spread of COVID-19, such as social distancing and quarantines, have affected the traditional clinical learning environment. In order to maintain the quality of patient care, it is crucial to understand the impact of COVID-19 pandemic on medical education and to avoid and reduce the gaps in learning experiences during pandemic and postpandemic times.

Medical schools and hospitals adapted their instruction programs in different ways. The most common change was to have learners meet in virtual platforms. Asynchronous e-learning provided flexible times and pacing as individualized paths for medical students and promotes self-directed learning. Synchronous remote meetings were used to implement small group activities, team-based discussions, and provide immediate feedback from instructors. Theoretically, these types of e-learning models, supported by current technology for basic science courses, may not produce significant changes for fully motivated learners compared with in-person instruction. Chakladar conducted a study on how medical students felt about adapted distance learning during COVID-19 and his research results were published in the journal *BMC Medical Education*. The results indicated that students who participated in the survey were mostly satisfied with the lecture-based online learning and

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77.2% of students agreed that course content was well-delivered virtually [1]. Another related survey conducted by Al-Balas in Jordon also showed a similar result with about 78.3% of the medical students participating in the survey responding that instructors used multimedia to achieve desired course objectives. The survey also showed that about 55.9% of the students acknowledged that the main benefits from online learning were time saving effects and flexibility of class times [2]. However, both surveys showed that the lack of sufficient interaction with instructors and learners is a common drawback of e-learning, and a majority of students reported that challenges they often experienced included poor internet connection and "Zoom" conference call fatigue [1,2]. Weighing the benefits, drawbacks, and challenges of e-learning learned in Al-Balas's study, only 26.77% of students were satisfied with their experience with medical distance learning [2].

Medical clerkship, internship, and postgraduate programs that usually take place in a teaching hospital are important training venues for a number of medical practices. During these training sessions, students can experience all aspects of hospital settings by observing and getting involved in various activities of patient care under the supervision of a senior resident or faculty member. The learning environment of these training sessions during the pandemic were affected by many factors including the maximum number of learners allowed at clinical sites, lack of personal protective equipment, and cancelation of surgical procedures and routine appointments. As a result, many hospitals tailored their programs by creating a hybrid program, prioritizing rotations, or shortening learning times. One example of such adaption is the change in the clerkship program at the University of Washington School of Medicine. This school shortened their program from 52 weeks to 36 weeks and each rotation time was condensed from four weeks to two weeks. They maintained the six week general surgery rotation but adapted it to a hybrid instruction setting with two weeks of virtual learning and four weeks of on-site clerkship [3]. Since many hospitals canceled all elective procedures and adopted telemedicine for clinics, many clerkship programs provided opportunities for medical students to participate in telemedicine in the United States. In addition, another approach for virtual surgical learning was the use of surgical videos as replacements for in-person instruction in the operating room [4,5]. Responses from students about those adaptations in clerkships are varied. In Chakladar's study, 44% of clinical-level students felt that the skills they learned would be sufficient to prepare them for residency, and more than half of the clinical-level students responded that the amount of clinical training that they received during pandemic clerkship was less than what was normally expected. Evaluation of student responses on the University of Washington School of Medicine clerkship program, most types of virtual learning received more positive comments than negative comments. Recorded lectures, Wise MD modules with case-based and skill-based categories, American College of Surgeons and Association for Surgical Education curricula, and live Zoom sessions received positive responses. The only exception was for the virtual skills lab in that less than 20% of students rated it as very helpful or extremely helpful to their understanding of topics learned in clerkship [3]. Despite many concerns raised in the student comments about the virtual learning experience in their clerkship, the report from the University of Washington School of Medicine showed that there was no significant difference in their student National Board of Medical Examiners subject exam results when comparing 2020–2021 results with the three prior years before the pandemic.

The COVID-19 pandemic changed medical education in hospitals worldwide. Even though most learners felt satisfied with lecture-based distance learning formats in the basic science curriculum, many issues with internet use still occurred that disrupted learning globally. A specific challenge in medical education during this period was the limitation of clinical learning experiences for students. Currently, many countries have resumed in-person classes or training since a large portion of the population has been vaccinated. How to reduce the learning loss due to the pandemic and how to train newly graduated medical students to prepare them to provide the best healthcare for their patients will be an essential focus for PGY programs in many hospitals.

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Review Article

Sternal Fractures Due to Blunt Chest Trauma: A Diagram of Management

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Abstract

Objective: Sternal fractures due to blunt chest trauma become more common with increasing road traffic accidents. The outcomes of patients with isolated sternal fracture are promising. However, complicated sternal fractures are associated with injuries of the thorax and other organs, and the diagnosis and treatment are challenging. This article reviews the clinical features of sternal fractures due to blunt chest trauma and sum up a management diagram.
Methods: Literature was retrieved in the PubMed, Google Scholar and "Baidu" Scholar for English articles published since 2011. The recruited articles were taken as study materials of this review.
Results: The misdiagnosed rate was 5.53% for chest roentgenograph and was 6.25% for sonography in diagnosing sternal fractures. Sternal fractures were a complicated type with associated injuries of other organs in an absolute majority, while they were an isolated type in only 1.17% of patients. Only small portions of patients have an abnormal electrocardiographic finding and (or) an elevated cardiac enzyme level. Surgical treatment was necessary in almost 60% of patients and conservative in about 40%. The outcomes of patients were promising and patients with a poor prognosis were usually not due to the sternal fracture but due to the associated injuries instead.
Conclusions: Isolated sternal fractures do not need routine admission but a pain relief. Patients with an abnormal finding of electrocardiogram and (or) an elevated cardiac enzyme level are recommend admitted for monitoring to exclude heart injury and for necessary conservative treatment. A surgical treatment of sternal fixation of sternal fractures are warranted for majority of patients with complicated/displaced sternal fractures. The outcomes of patients are generally promising.

Key words: Fracture, Sternum, Trauma

Introduction

Sternal fractures are often caused by a direct blunt trauma to the chest, including motor vehicle accident (79%), fall from height (16%) and crush (3%) [1]. The incidence of sternal fracture was as low as 0.33-0.64% among injured patients [2,3]. The fracture site of the sternum can be in the sternal body, xiphoid, manubrium and the manubriosternal joint. The sternal body was reported to be the most frequent fracture site, accounting for 83% of sternal fractures [1]. Sternal fracture can be an isolated condition; however, it is often associated with intrathoracic injuries as well as spinal and rib fractures [4]. The frequent intrathoracic injuries include lung injury, cardiac contusion, and pneumo-, haemo-, or haemopneumothorax, and even cardiac tamponade and flail chest that may require prompt treatments [5]. An epidemiology of sternal fractures disclosed that the associated rib fractures occurred in 49.6%, cardiac contusions in 8.0%, thoracic aortic injuries in 4.0% and heart lacerations in 2.4% of patients [2]. It has been reported that 18-62% of sternal fractures are associated with

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cardiac injury [4]. The resultant cardiac contusion may lead to sudden death early after sternal fracture [3,5]. Thus, electrocardiogram and cardiac enzyme detection are necessary for patients with suspected sternal fractures. However, the challenge for the diagnosis and management of sternal fractures, in particular, the complicated sternal fractures, remains. In this work, the clinical features of sternal fractures due to blunt chest trauma are summarised, and a management diagram is provided.

Methods

Literature retrieval was made in the PubMed, Google Scholar and "Baidu" Scholar for English articles published Since 2011 to present. The search terms and key words were "blunt chest traumas," "sternal fractures", "manubrium", "manubriosternal joint dislocations" and "xiphoid". The inclusion criteria were prospective or retrospective studies, case series and case reports of sternal fractures due to blunt chest trauma. The exclusion criteria were publications: with insufficient patient information of sternal fractures (n=40), blunt chest trauma without a resultant sternal fracture (n=18), stress fracture of the sternum (n=2), rib fractures due to blunt chest trauma (n=2), no direct chest trauma as a cause of sternal fracture (n=1), traumatic coronary artery dissection (n=1) and sternal nonunion (n=1). As a result, 65 articles were excluded and 56 articles with 30,752 patients with sternal fractures were included [6–61] (Figure 1).

IBM SPSS statistics version 22 software was used for the statistical analysis. The measurement data were expressed as mean ± standard deviation and median (range) while categorical data were given as numbers and percentages. The categorical variables were compared by Chi-square or Fisher exact test with continuity correction. $p<0.05$ was considered of a statistical significance.

Results

The included articles were 28 (50%) case reports [7, 8, 14, 18–21, 25–28, 31–34, 40, 41, 43, 44, 52–58, 60], 5 (8.93%) case series [10, 15, 29, 30, 50], 2 (3.57%) prospective studies [23, 59] and 21 (37.5%) retrospective studies [6, 9, 11–13, 16, 17, 22, 24, 35–38, 42, 45–49, 51, 61]. The patients were at the age of 48.8 ± 19.7 (range, 6–92; median, 52) years (n=73). The gender of patients was reported for 4,206 patients with 2,802 (66.6%) male and 1,404 (33.4%) female patients (χ^2=929.3, $p<0.001$) with a male-to-female ratio of 2.0:1.

The mechanisms of blunt chest trauma were described for 26,043 patients. The most common mechanism was road traffic accident, of which motor vehicle accident was the most frequent (Figure 1). Chest pain was the most common symptom among 51 patients whose symptoms were reported (Table 1). Patients' critical conditions and first-aids at the initial presentations were shown in Table 2. In these patients, the intensive care unit stay was 8.46 ± 5.49 (range, 2–14.3; mean 7) days [15, 21, 32, 47, 53], and the intubation time was 10.07 ± 9.53 (range, 1-20; median 9.2) days [14, 33, 47], respectively.

The diagnostic techniques for sternal fractures were reported for 1,134 patients. A computed tomography (CT) and (or) a three-dimensional CT were taken in 1,102 (97.17%), a chest X-ray in 198 (17.46%) (twice X-ray films were taken for diagnosis of sternal fracture in one of the patients [43]), sonography in 32 (2.82%), magnetic resonance imaging in 2 (0.18%)

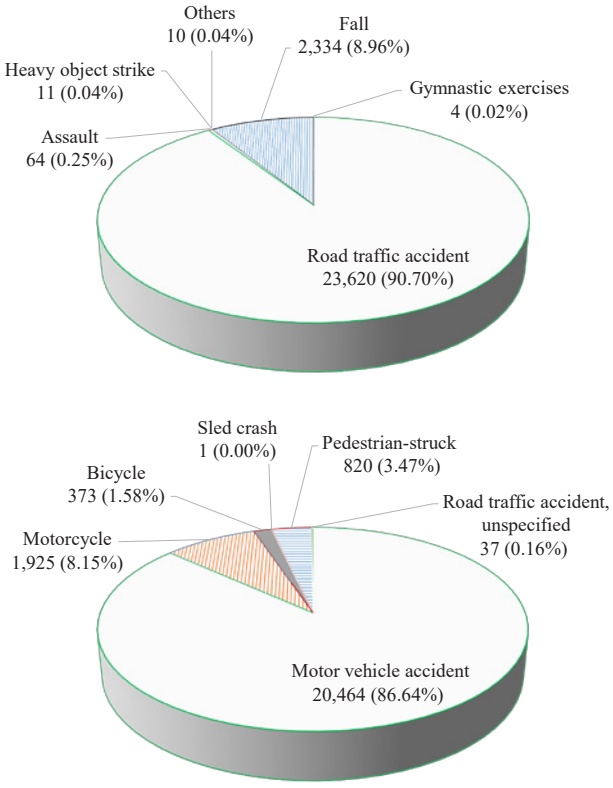

Figure 1. The mechanisms of blunt chest trauma: (A) A distribution of the mechanisms of blunt chest trauma of 26,043 patients; and (B) A distribution of road traffic accidents as a mechanism of blunt chest trauma.

and by autopsy in 2 (0.18%) patients. Sternal fracture was misdiagnosed in 12 patients by 13 diagnostic techniques, including by X-ray films in 11 (11/199, 5.53%) patients [20, 34, 43, 59, 60], and by sonography in 2 (2/32, 6.25%) patients [8, 34]. In fact, the diagnosis was missed by both X-ray film and sonography in one patient [34]. There was no missed diagnosis by CT.

Electrocardiogram was normal in 70 (90.91%) patients [8, 16, 20, 23, 28, 37, 44, 50, 52] and abnormal (arrhythmia, acute myocardial infarction, or unspecified abnormal findings) in 7 (9.09%) patients [12, 15, 21, 34, 54] (χ^2=103.1, p<0.001). Cardiac enzyme (troponin I, troponin T, creatine phosphokinase, or creatine phosphokinase isosome MB) levels at presentation were reported for 104 patients: it was normal in 57 (54.81%) patients [12, 20, 28, 44, 52] and elevated in 47 (45.19%) patients [8, 12, 23, 34, 54] (χ^2=1.9, p=0.212). The elevated cardiac enzyme levels returned normal the next day in 42 (89.36%) patient [23].

A sternal fracture-related complication occurred in 7 patients. The time of occurrence was in the 14.08 ± 18.77 months (range, 5 days–4 years) after sternal fracture. After proper treatment of the complications, 5 patients recovered, 1 patient improved and went to a rehabilitation center, and one patient's prognosis was not reported (Table 3).

Of the deceased patients, one died in accident. The death causes of other patients were also unrelated to sternal fractures but to the associated injuries.

The sternal fracture was isolated in 360 (360/30,752, 1.17%) patients [6, 9, 11–13, 16, 18, 20, 23–26, 28, 30, 31, 34, 38–41, 43, 45, 50, 56, 58, 60, 61]. Whether the sternal fracture was a displaced or a nondisplaced one was stated for 350 patients: 196 (56%) were displaced [7, 10–12, 15–17, 21, 26–28, 30, 31, 33, 34, 43, 44, 50, 53, 55, 56], and 154 (44%) were nondisplaced [10, 13, 16–18, 20, 29, 39, 41, 50, 52, 57, 60] (χ^2=0, p=0.833). The locations of the sternal fractures were reported for 499 patients: it was in the sternal body in 408 (81.76%) [7, 10, 11, 13, 14, 16, 18–22, 26–31, 34, 37, 39, 41, 43, 46, 48–50, 54–57, 59, 60], in the manubrium in 60 (12.02%) [22, 33, 46, 49], in a fashion of manubriosternal joint dislocation in 23 (4.61%) [11, 15, 30, 44, 50, 52], in the manubrium and in the sternal body

Table 1. 74 symptoms of 51 patients

Symptom	n (%)
Pain chest [10, 14, 15, 21, 26–31, 34, 37, 39–41, 43, 44, 50, 51, 55–57, 60]	44 (59.46)
Pain & swelling of the chest wall [51, 52]	11 (14.86)
Palpable deformity & motion of the fracture [44, 51]	11 (14.86)
Agitated [15]	1 (1.35)
Bruise to sternum [25]	1 (1.35)
Chest wall swelling [18]	1 (1.35)
Dyspnoea [14, 28–30, 39]	1 (1.35)
Respiratory distress [8]	1 (1.35)
Fever at day 10 [18]	1 (1.35)
Pain, chest & back [15]	1 (1.35)
Pain-free [15]	1 (1.35)

Table 2. Patient status and first-aid at initial presentation

Patient status and first-aid	n (%)
Shock [8, 47]	54 (0.18)
Intubation-dependent [7, 8, 14, 35, 42, 47]	951 (3.09)
Organ failure [47]	134 (0.44)
Thoracotomy [29, 35, 42, 47]	69 (0.22)
Chest tube [7, 8, 16, 33, 35, 37, 47, 52, 53]	168 (0.55)

Table 3. Sternal fracture-related complications

Complication	Time of occurrence after sternal fracture	Treatment	Prognosis
Delayed haemothorax [55]	5 days	Tube drainage & anti-shock	Recovered
Nonunion [31]	6 months	Teriparatide for 24 months	Recovered
Hypertrophic pseudarthrosis [15]	6 months	Pseudarthrosis resected, fixed with an angle plate	Recovered
Infective endocarditis with chronic sternal osteomyelitis [25]	2 years	Abscess subcutaneous drainage and extensive sequestrectomy of the sternum	Transfer to a rehabilitation hospital
Sternal osteomyelitis [18]	10 days	Antibiotics	Recovered
Traumatic right coronary artery pseudoaneurysm [58]	4 years	Coronary artery bypass grafting	Not given
Delayed cardiac tamponade [28]	Not given	Removal of pericardial effusions and thrombus via pericardiotomy	Recovered

in 7 (1.40%) [15, 16, 37, 53] and in the xiphoid process in 1 (0.20%) patient [22], respectively.

Extremity fractures, brain injury, lung contusion and intraabdominal or intraperitoneal injuries were the most common associated injuries among the 3,790 patients in whom the associated injuries were described (Table 4).

Four patients were reported to be with no treatment: 2 did not consult a doctor after trauma, thus no treatment was given [18, 25], 1 died in the accident [19] and 1 died of cardiac arrest but resuscitation was not successful [54]. Treatments of choice were known for 484 patients: 288 (59.50%) were treated surgically, 192 (39.67%) were managed conservatively and 4 (0.83%) patients were treated conservatively and surgically (Table 5). In the surgically treated patients, a plate with or without a screw was used in 93 (46.5%) patients with an isolated sternal fracture and 107 (53.5%) patients with complicated sternal fractures (χ^2=2.0, p=0.194). Wiring was applied in 13 (54.17%) patients with an isolated and 11 (45.83%) patients with complicated sternal fractures (χ^2=0.3, p=0.773).

In patients with a nondisplaced sternal fracture, 3 (33.33%) patients were surgically and 6 (66.67%) were conservatively treated. In patients with a displaced sternal fracture, 26 (29.89%) were surgically and 61 (68.54%) were conservatively treated (χ^2=0, p=0.833). The surgical requirement did not show any prevalence in any of the two groups.

In addition to sternal fracture fixations, a total of 64 concurrent surgical operations or interventions, such as fixation of other fractures and surgical management of other associated injuries, were performed in 53 patients (Table 6).

A sternal fracture fixation was performed on

Table 4. Associated injuries of 3,790 patients

Associated injury	n (%)
Extremity fractures [16, 42, 45–47]	2,626 (69.29)
Brain injury [16, 29, 42, 46, 47, 49]	2,325 (61.35)
Lung contusion [8, 13–16, 21, 28, 32, 33, 38, 42, 45–47, 49]	1,742 (45.95)
Intraabdominal organ/intraperitoneal/abdominal injury [16, 27, 42, 46, 47]	1,693 (44.67)
Clavicle fracture [9, 42, 45–47, 49, 52, 57]	616 (16.25)
Scapular fracture [8, 9, 32, 33, 38, 42, 45–47]	331 (8.73)
Rib fracture [6, 8–10, 13–16, 19, 32, 33, 38, 45, 46, 52–57, 61]	250 (6.60)
Pneumothorax [9, 13, 14, 16, 27, 33, 38, 45–47, 49]	242 (6.39)
Spinal cord injury [42]	201 (5.30)
Blunt cardiac injury [17, 42]	195 (5.15)
Haemothoraces [9, 13, 16, 21, 32, 38, 47, 49, 52]	144 (3.80)
Spine fracture [9, 14, 15, 24, 32, 38, 44–47, 49, 52]	185 (4.88)
Mediastinal haematoma [38, 44, 54]	101 (2.66)

Table 5. Treatment of choice for 484 patients with sternal fractures

Treatment	n (%)
Surgical	288 (59.50)
Plate with/without screws [6–11, 13–15, 29, 30, 44–46, 48, 49, 55, 61]	200 (69.44)
Wire [6, 11, 51, 52]	24 (8.33)
Unspecified [8, 16, 24, 53, 57]	64 (22.22)
Conservative	192 (39.67)
Pain relief [23, 37, 41, 50]	55 (28.65)
Observation [12, 16, 20, 21, 60]	10 (5.21)
Magnetotherapy & physical therapy [31]	1 (0.52)
Unspecified [13, 14, 24, 29, 39, 40, 46, 48, 56, 58]	126 (65.63)
Conservative & surgical	4 (0.83)
Narcotics & plate [30, 33]	2 (50)
Analgesic & wiring & Ni-Ti shape memory alloy embracing fixator [28]	1 (25)
Nonsteroidal anti-inflammatory & plate & screw & teriparatide [43]	1 (25)

Table 6. 64 concurrent surgical operations or interventions in 53 patients.

Concurrent procedure	n (%)
Fixation of other fractures	57 (89.06)
Rib [6, 8, 9]	33 (57.89)
Spine [15, 24]	19 (33.33)
Scapula [9]	2 (3.51)
Clavicle [9]	1 (1.75)
Costal cartilage [14]	1 (1.75)
Humerus & left radial head fracture [15]	1 (1.75)
Costochondral joints stabilisation [7]	1 (1.56)
Surgical repair of the tracheal laceration [53]	1 (1.56)
Drainage of extensive fluid collection [18]	1 (1.56)
Heart injury repair [29]	1 (1.56)
Heart repair & ligations of bilateral mammary arteries & left mammary vein [29]	1 (1.56)
Intervention on left anterior descending artery & on right coronary artery the next day [34]	1 (1.56)
Balloon & stenting of right coronary artery [21]	1 (1.56)

day 20.79 ± 56.91 after blunt chest trauma (n=13) [7, 8, 10, 13, 15, 30, 33, 43, 52, 53, 61]. Patients were hospitalised for 10.45 ± 10.02 (range, 1–41; median, 7) days after sternal fracture fixation [6, 7, 10, 12, 13, 15–17, 21, 23, 24, 28, 29, 33, 37, 38, 44, 53]. Patients were on a follow-up of 10.96 ± 12.01 (range, 2–54; median, 6) months (n=23) [7, 8, 10, 11, 15, 18, 23, 30, 31, 43–45, 50, 51, 55, 57, 60, 61]. The outcomes were known for 30,341 patients: 26,914 (88.71%) patients recovered, 1 (0.00%) patient improved, 1,126 (3.71%) patients were complicated and 2,300 (7.58%) patients died. Patients' outcomes of the three treatment groups demonstrated an overall intergroup difference (χ^2=22.0, p<0.001). Pairwise comparisons between groups revealed that the surgical group patients had a high recovery rate, and the conservative group patients had a high comorbidity and a high mortality rates (Table 7).

Discussion

The diagnosis of sternal fractures is not difficult. The diagnosis can be made based on a history of chest trauma and pertinent clinical presentations including chest pain and swelling, sternal tenderness, bone rubbing sensation and palpable sternal deformity. The pain is often exacerbated while coughing and breathing deeply. However, in sternal fracture patients with associated injuries and in those with atypical sternal fractures, the diagnosis can be sometimes difficult. Nevertheless, medical imaging techniques are helpful in leading to a definite diagnosis. Chest roentgenograph and sonography are noninvasive diagnostic means, but sometimes false negatives occur. In the present study, the false negative rates of these two imaging techniques were 5.53% and 6.25%, respectively. CT provides ideal and reliable diagnostic results for sternal fractures unless the fracture line is not a horizontal one. Three dimensional reconstructive CT has been praised as the most sensitive diagnostic way for diagnosing sternal fractures. As sternal fractures are associated with blunt cardiac injury, electrocardiogram and cardiac monitoring as well as cardiac enzyme detection are necessary for patients with sternal fractures [4]. Güler et al. [16] followed all their patients with sternal fractures at the 12 and 24 hours with the cardiac enzyme, electrocardiogram, and echocardiogram, and determined that patients with nondisplaced, isolated sternal fractures with no pathological findings in electrocardiogram, echocardiography and cardiac enzymes were not admitted into the hospital.

Isolated sternal fractures are benign in the absence of concomitant cardiorespiratory conditions, and do not need routine admission [62]. An adequate analgesia is a treatment of choice for patients with isolated sternal fractures [4]. Isolated sternal fractures heals spontaneously in a mean of 10 weeks in majority of patients [63]. Sadaba et al. [64] summarised the information of 649 cases of sternal fractures, 423 of which were isolated sternal fractures. None of them with abnormal electrocardiogram or small pericardial effusion developed life-threatening complications. Isolated sternal fractures have an excellent prognosis, with a documented overall mortality rate of 0.7%. Two-thirds of sternal fractures have associated injuries, with a mortality of 25–45% [63].

Sternal fractures can be classified as nondisplaced or displaced. The type of the displaced fractures can be fragmented or overriding [65]. For unstable or significantly displaced sternal fractures, especially for those with severe associated injuries, patients should be hospitalised and operative fixation is necessary. Most displaced fractures have been treated with open reduction and internal fixation with titanium plate and screws. The surgical indications for sternal fractures were unstable or flailed chest, fracture displacement, sternal nonunion, a sustained chest pain unresponsive to analgesia management, decreased pulmonary function and limited upper extremity motion [13, 45, 61, 66]. Al-Qudah [67] reported

Table 7. Patients' outcomes of 484 patients of the three treatment groups

Treatment	Recovered	Complicated	Died
Surgical	285 (98.96)	3 (1.04)	0 (0)
Conservative	183 (95.31)	4 (2.08)	5 (2.60)
Conservative & surgical	3 (75)	1 (25)	0 (0)
χ^2	13.5	14.2	7.7
p value	<0.001	<0.001	0.021

that four patients with displaced sternal fractures with intractable pain and bone deformities underwent operative reduction and fractured sternum fixation with stainless steel plate and screws. The surgical outcomes were satisfactory with significant pain relief.

In elderly patients, especially in those with osteoporosis, traumatic sternal fractures are prone to developing sternal nonunions. The use of teriparatide in addition to surgical fixation in such patients could accelerate fracture healing and the healing of a sternal nonunion fracture [68]. In the present study, surgical fixation was necessarily performed in about 70% of patients and the outcomes were promising. Most of the deceased patients were due to complicated injuries rather than sternal fracture per se. A diagram of management of sternal fracture due to blunt chest trauma is shown in Figure 2.

Limitations

The major drawbacks of the present study were a wide range of patient age and incomplete patient information. More conclusive results are anticipated base on more concise patient information in the future.

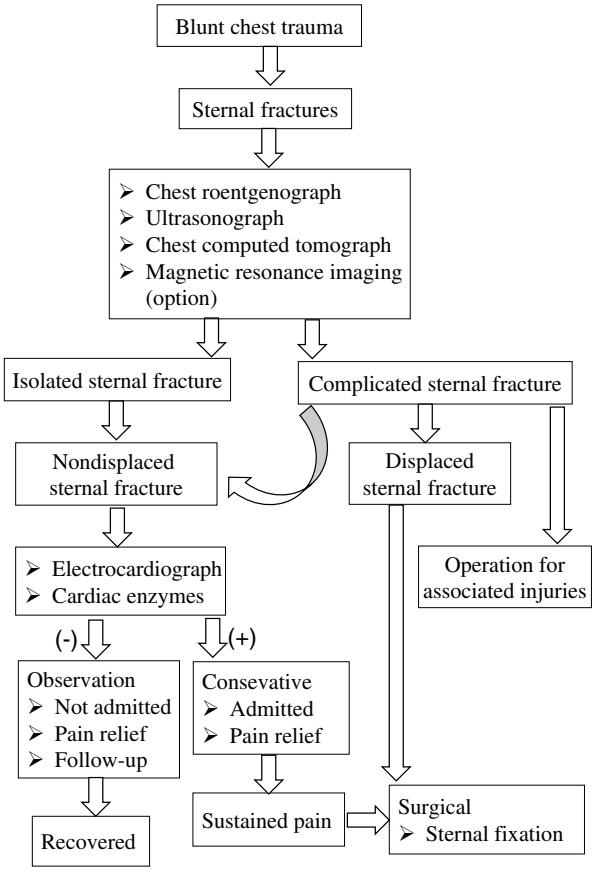

Figure 2. A diagram of management of sternal fractures due to blunt chest trauma.

Conclusion

Isolated nondisplaced sternal fractures have a benign course, whereas complicated and displaced sternal fractures often warrant a surgical treatment with plate with or without screws or wires for sternal fixation. Electrocardiogram and cardiac enzyme examinations are necessary for patients with sternal fractures to exclude concurrent heart injury. An early diagnosis and a prompt treatment are crucial for rescuing the critical patients with associated intrathoracic injuries. The overall outcomes of the patients are promising.

Declarations:

Ethics approval and consent to participate: Not applicable.

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Original Article

Uric Acid is Independently Associated with Atherosclerosis among Healthy Chinese in Taiwan

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Abstract

Objective: This study investigated the association between uric acid and atherosclerosis in a community population.
Methods: We enrolled 2,790 subjects aged ≥ 30 years from the CardioVascular Disease FACTor Two-Township Study. The common carotid artery intima-media thickness (IMT) and atherosclerotic plaque were used as indices of atherosclerosis. Pearson's correlation coefficient, the general linear model, and a logistic model were used to assess the association between uric acid and atherosclerosis.
Results: Elevated uric acid was moderately associated with obesity, dyslipidemia, elevated blood pressure, impaired glucose, insulin resistance (all correlation coefficients < 0.05) and IMT (r: 0.12, $p < 0.05$). Subjects were classified into four groups according to uric acid levels: group 1 (<5.0 mg/dl), group 2 (5.0–6.9 mg/dl), group 3 (7.0–8.9 mg/dl) and group 4 (≥9.0 mg/dl). The age and sex-adjusted mean of IMT was 0.54 in group 1, was 0.55 in both groups 2 and 3, and the mean of IMT (0.59 mm) in group 4 (≥9.0 mg/dl) was significantly higher. Uric acid (≥9.0 mg/dl) was significantly and positively associated with higher IMT (multivariate adjusted mean: 0.58 mm), independent of other risk factors, and atherosclerosis (≥75th IMT value in the population) with an odds ratio of 2.67 (95% confidence intervals = 1.55–4.59). This association remained significant in a healthy subgroup (without metabolic syndrome, hypertension, or diabetes; OR = 2.91; CI = 1.16–7.25).
Conclusion: Uric acid of 9 mg/dL and/or above was independently associated with atherosclerosis in terms of IMT measures in the general population and those without metabolic syndrome. Further study is warranted.

Key words: Uric acid, Intima-media thickness, Atherosclerosis, Cross-sectional study, Chinese

Introduction

A high serum uric acid (SUA) level is a risk factor for the development of cardiovascular disease (CVD) and mortality, independent of other CVD risk factors [1-8]. It remains uncertain whether several frequently mentioned mechanisms actually underpin the association between uric acid and CVD.

SUA is associated with metabolic syndrome [9] or insulin disorders. Therefore, elevated SUA levels may also be considered as an early-stage indicator of insulin resistance, which may contribute to atherosclerosis and thrombosis through multiple mechanisms. Moreover, elevated SUA has been associated with high levels of C-reactive protein, interleukin-6, interleukin-18, and tumor necrosis factor-alpha [9]. Elevated SUA may also be considered as an inflammatory marker [9]. Inflammation is as a key factor involved in the development of coronary artery disease via its contribution to atherogenesis and thrombogenesis [10]. Therefore, elevated SUA may contribute to the development of CVD through atherosclerosis.

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The association between uric acid and atherosclerosis is still not fully understood [11-13]. Most studies have been cross-sectional and were carried out in high risk populations, such as patients with arthritis [14], diabetes [15], and hypertension [16]. There are relatively few studies that included participants from the general population [11,17]. This study investigated the relationship between uric acid and atherosclerosis in a community population, particularly those without metabolic syndrome.

Materials and methods

Subjects

The CardioVascular Disease risk FACtors Two-township Study (CVDFACTS) is a community-based follow-up study that focused on risk factors for CVD in Taiwan. From 1991 to 1993, all residents aged ≥3 years in five villages in Chu-Dung and another five villages in Pu-Tzu participated in the baseline examination. The cycle 4 follow-up examination was conducted from 1997 to 1999, and 3,440 residents aged ≥30 years participated in the cycle 3 examination. Carotid artery ultrasound imaging was included as one of the main subclinical endpoints in cycle 4 in which no biochemistry data were collected (Figure 1).

The anthropometric, blood pressure, and biochemical data of cycle 3 (1994–1997) was merged and analyzed in relation to the intima-media thickness (IMT) derived from quantitative ultrasound imaging. A total of 2,790 subjects completed carotid artery ultrasound measurements and information on all components of metabolic syndrome was obtained. Further details on the study design and data collection have been described elsewhere [18]. All participants provided written informed consent.

Quantitative ultrasound imaging

A color-coded and duplex Doppler ultrasound system (SONOs 1000, Hewlett-Packard, Palo Alto, USA) was used to obtain images. It had a transducer frequency of 7.5 Hz and color Doppler frequency of 5.4 Hz. A standardized protocol modified from Howard et al. [19] was established for B-mode image analysis and Doppler spectral analysis.

IMT was measured at the far wall of the CCA at least 1 cm proximal to its bifurcation into the internal and external carotid arteries. Plaque was defined as localized wall thickening at least twice the thickness of the adjacent IMT. It was considered present if the plaque was ≥30% of the vessel diameter [20] because plaque was relatively less frequent in this study population. The presence of atherosclerosis was defined as IMT more than 1 mm [20].

Study protocol

Examinations were performed in the study clinics established in the two townships. Weight, height, and waist circumference were measured in participants wearing light clothes [21]. Blood pressure was measured three times after the subject was seated for >5 minutes, and the mean of the lowest two readings was used for analysis. All subjects fasted overnight for ≥8 hours before blood specimen collection and the samples were stored at −70°C. Fasting glucose and triglycerides were measured within one month. The homogeneous method [22] was used to measure high-density lipoprotein-cholesterol. Individuals attending the baseline and follow-up examinations also completed a questionnaire-based interview, which contained items on demography, lifestyle, self-reported health conditions, and family history of disease. All subjects signed informed consent forms and the study was approved by the Institute Review Board.

Hypertension [23] was defined as systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg, or the use of antihypertension medication. Diabetes mellitus [24] was defined as fasting glucose ≥126 mg/dl or reported use of antidiabetic medication. The metabolic syndrome score was the sum of the abnormal components of metabolic syndrome, according to the ATP III-NCEP-definition [25]. Central obesity was defined as waist circumference ≥90 cm in males and ≥80 cm in females. An elevated triglyceride level was defined as fasting triglycerides ≥150

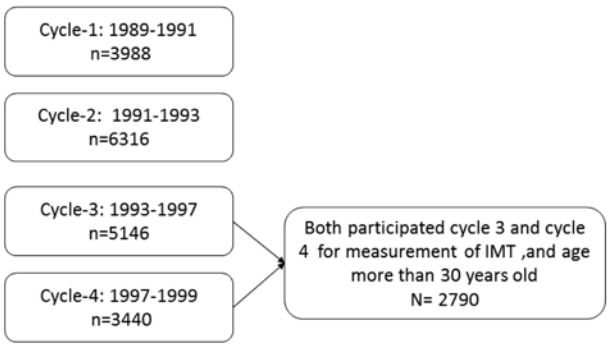

Fig. 1 Flow Chart of study.

mg/dl, while reduced HDL-cholesterol was defined as <40 mg/dl in males and <50 mg/dl in females. Elevated blood pressure was defined as systolic blood pressure ≥130 mmHg, diastolic blood pressure ≥85 mmHg, or receiving treatment for hypertension. Elevated fasting plasma glucose[26] was defined as fasting plasma glucose ≥100 mg/dl or receiving treatment for type 2 diabetes. The healthy population was defined as without metabolic syndrome, hypertension, or diabetes.

Statistical methods

The mean and standard deviation of various characteristic variables were presented for each of the four uric acid groups (uric acid levels <5.0, 5.0–6.9, 7.0–8.9, and ≥9.0 mg/dL). Correlation coefficients estimated the degree of association between uric acid and other cardiovascular risk factors. The general linear regression model was used to obtain the covariate-adjusted mean IMT for each of the four groups. Covariates include age, sex, waist circumference, systolic blood pressure, total cholesterol, HDL-cholesterol, LDL-cholesterol, glucose, and creatinine. Higher adjusted-IMT levels indicated worse atherosclerosis. The SAS proc GLM method was used with LSMEANS and AT MEANS options for all covariate effects set equal to their mean values for computation of standard LS-means.

Logistic regression was used to evaluate the association between hyperuricemia (≥9.0 mg/dL) levels and atherosclerosis (IMT ≥ the 75th percentile value of the population, referent group: IMT < 75th percentage value of the population). Multivariate odds ratios and 95% confidence intervals were presented to show the degree of independent association between hyperuricemia (≥9.0 mg/dL) and atherosclerosis.

We further conducted a sensitivity analysis among the healthy population with metabolic syndrome, diabetes, and hypertension, and a gender-stratified analysis.

Results

The prevalence of metabolic syndrome was 31.54% and no gender difference was found (31.6% for men vs. 31.5% for women; p = 0.9822). The total number of subjects without diabetes, hypertension, or metabolic syndrome (healthy group) was 1,629 (58.39%; 56.17% for men and 60.26% for women; p-value = 0.0288).

The subjects were classified into four groups by uric acid levels (<5.0, 5.0–6.9, 7.0–8.9, and ≥ 9.0 mg/dL). Waist circumference (WC), body mass index (BMI), triglycerides, low-density lipoprotein (LDL) cholesterol, total cholesterol, systolic blood pressure (SBP), diastolic blood pressure, fasting insulin, HOMA-IR, and CCA-IMT were increased with increasing uric acid and high-density lipoprotein (HDL) cholesterol. Moreover, prevalence rates of metabolic syndrome and hypertension were decreased with less uric acid (Table 1). Similar results were observed in the healthy subpopulation who did not have metabolic syndrome, hypertension, and hypertension (data not shown).

The correlation coefficients between uric acid and cardiovascular risk factors are shown in Table 2. WC and creatinine were positively associated with uric acid levels in the entire population and within the healthy group. The correlation coefficient for uric acid and IMT was weakened from 0.12 for all samples to 0.09, but remained significant in the healthy subgroup.

The prevalence of atherosclerotic plaque was 1.61% (n = 45). The prevalence rates of atherosclerotic plaque in groups 1–4 were 1.8%, 2.1%, 1.6%, and 1.1%, respectively (Chisq X^2 = 2.138; p = 0.5542).

Table 3 shows the CVD risk factor adjusted-IMT mean for the four groups. Subjects with uric acid ≥9.0 mg/dl had significantly higher IMT than those with uric acid < 5.0 mg/dl. This indicates those with uric acid ≥9.0 mg/dl had significantly worse atherosclerosis than those with uric acid less than 5 mg/dl, and this association was independent of other confounding factors. The association remained significant after adjusting for other confounders in the overall sample and in the healthy subgroup.

The logistic regression model revealed that SUA level ≥9.0 mg/dl was positively associated with atherosclerosis, defined by IMT ≥ the 75th value, independent of age, sex, WC, SBP, cholesterol, glucose, creatinine, HDL-cholesterol, and LDL-cholesterol in overall samples (OR = 2.67; 95%CI = 1.55–4.59) and in the healthy subgroup (OR = 2.91; 95%CI = 1.16–7.25; Table 4.)

In gender-stratified analysis, the association between higher uric acid (≥9.0 mg/dl) and atherosclerosis was significant in men (odds ratio = 2.32; 1.26–1.26; p = 0.0066), but not in women (OR = 3.19;

Table 1. Demographic profiles of cardio-vascular risk factors stratified by varied uric acid levels

Variables	Uric acid (mg/dl)				*p* value† for trend
	< 5 (n=627)	5.0~6.9 (n=1229)	7.0~8.9 (n=714)	≥ 9.0 (n=220)	
Age, yrs	50.9 ± 12.5	53.0 ± 11.9	55.0 ± 12.4	54.6 ± 12.3	
Male sex, %	17%	43%	67%	77%	
Waist circumference, cm	76.0 ± 8.3	80.8 ± 9.0	84.9 ± 8.6	87.7 ± 9.1	<.0001
Body mass index, kg/m^2	23.1 ± 2.8	24.2 ± 3.2	24.9 ± 3.2	25.6 ± 3.1	<.0001
Triglycerides, mg/dL	93.3 ± 58.7	118.5 ± 69.3	148.3 ± 98.4	187.7 ± 130.8	<.0001
HDL-cholesterol, mg/dL	51.8 ± 18.2	46.7 ± 15.3	43.5 ± 16.1	43.0 ± 19.7	<.0001
LDL-cholesterol, mg/dL	113.6 ±34.0	125.1 ± 38.5	129.2 ± 35.5	131.3 ± 38.8	<.0001
Total cholesterol, mg/dL	183.2 ± 36.9	195.2 ± 40.7	201.7 ± 37.1	209.3 ± 38.8	<.0001
Systolic blood pressure, mmHg	113.4 ± 19.3	117.0 ± 18.6	120.1 ± 18.4	124.8 ± 18.9	<.0001
Diastolic blood pressure, mmHg	70.8 ± 10.1	74.0 ± 10.5	76.4 ±10.7	78.9 ± 11.1	<.0001
Fasting insulin	11.2 ± 6.2	12.7 ± 7.4	13.9 ± 8.6	15.9 ± 10.4	<.0001
Fasting glucose, mg/dL	100.6 ± 25.9	103.0 ± 29.4	103.1 ± 22.5	103.0 ± 18.2	0.8967
HOMA-IR	2.8 ± 2.2	3.3 ± 2.6	3.8 ± 4.1	4.1 ± 2.9	<.0001
Creatinine, mg/dL	0.84 ± 0.19	0.98 ± 0.27	1.09 ± 0.24	1.20 ± 0.32	<.0001
uric acid, mg/dL	4.2 ± 0.7	5.9 ± 0.6	7.8 ± 0.5	10.2 ± 1.3	<.0001
CCA-IMT, mm	0.52 ± 0.15	0.55 ± 0.15	0.56 ± 0.14	0.60 ± 0.14	0.0005
Metabolic syndrome	17%	30%	40%	55%	<.0001
Hypertension, %	15%	21%	28%	41%	<.0001
Diabetes, %	7.2%	8.5%	7.6%	6.4%	0.3071
Alcohol drinker	1.8%	5.6%	10.4%	15.0%	<.0001
Smoker	9.7%	19.9%	32.1%	36.8%	<.0001

†Adjusted for age and sex

Table 2. Correlation coefficients among uric acid, CVD risk factors and IMT in the healthy and whole populations

	Whole	(n = 2790)	Healthy group	(n = 1629)
	Uric acid, mg/dL	IMT, mm	Uric acid, mg/dl	IMT, mm
Age, yrs	0.10‡	0.47‡	0.09†	0.43‡
Waist circumference, cm	0.40‡	0.25‡	0.39‡	0.18‡
Body mass index, kg/m2	0.24‡	0.19‡	0.19‡	0.10‡
Triglycerides, mg/dL	0.31‡	0.09	0.26‡	0.08
HDL-cholesterol, mg/dL	-0.18‡	-0.03	-0.18‡	-0.01
LDL-cholesterol, mg/dL	0.16‡	0.16‡	0.19‡	0.11‡
Total cholesterol, mg/dL	0.20‡	0.18‡	0.18‡	0.12‡
Systolic blood pressure, mmHg	0.16‡	0.39‡	0.14‡	0.30‡
Diastolic blood pressure, mmHg	0.23‡	0.21‡	0.20‡	0.16‡
Fasting insulin	0.18‡	0.07†	0.13‡	0.02
Fasting glucose, mg/dL	0.03	0.14‡	0.07	0.05†
HOMA-IR	0.13‡	0.11‡	0.14‡	0.02
Creatinine, mg/dL	0.40‡	0.12‡	0.43‡	0.09‡
uric acid, mg/dL	---	0.12‡	---	0.09†
CCA-IMT, mm	0.12‡	---	0.09†	---

†p<0.05; ‡p<0.001

Table 3. Adjusted IMT mean in four groups classified by uric acid levels (general linear model)

	Model 1	Model 2	Model 3	Model 4
Whole population (n=2790)				
<5 (group 1, n=627)	0.54	0.55	0.55	0.55
5-6.9 (group 2, n=1227)	0.55	0.55	0.55	0.55
7-8.9 (group 3, n=714)	0.55	0.54	0.55	0.55
≥9.0 (group 4, n=220)	0.59†	0.57†	0.58†	0.58†
healthy subgroup‡ (n=1629)				
<5 (group 1, n=453)	0.51	0.51	0.50	0.50
5-6.9 (group 2, n=740)	0.51	0.51	0.51	0.51
7-8.9 (group 3, n=355)	0.52	0.51	0.52	0.52
≥9.0 (group 4, n=81)	0.55†	0.54†	0.56†	0.56†

Model 1: adjusted age and sex
Model 2: adjusted age, sex, WC, SBP, cholesterol, glucose
Model 3: adjusted age, sex, WC, SBP, cholesterol, glucose, creatinine
Model 4: adjusted age, sex, WC, systolic blood pressure, cholesterol, glucose, creatinine, HDL-cholesterol, LDL-cholesterol
†$p<0.05$ for compared to group 1.
‡subjects without metabolic syndrome, hypertension and diabetes.

Table 4. Association between hyperuricemia and atherosclerosis (by multivariate logistic regression)

	Crude	Model 1	Model 2	Model 3	Model 4
Whole population (n=2790)					
Uric acid < 9.0 mg/dl (n=2570)	1.0	1.0	1.0	1.0	1.0
Uric acid ≥ 9.0 mg/dl (n=220)	1.93	1.97	1.68	2.43	2.67
	(1.45-2.56)	(1.44-2.69)	(1.21-2.32)	(1.44-4.11)	(1.55-4.59)
Health population‡ (n=1629)					
Uric acid < 9.0 mg/dl (n=1548)	1.0	1.0	1.0	1.0	1.0
Uric acid ≥ 9.0 mg/dl (n=81)	1.67	1.71	1.68	2.65	2.91
	(1.06-2.65)	(1.03-2.84)	(1.01-2.80)	(1.08-6.49)	(1.16-7.25)

Model 1: adjusted age and sex
Model 2: adjusted age, sex, WC, SBP, cholesterol, glucose
Model 3: adjusted age, sex, WC, SBP, cholesterol, glucose, creatinine
Model 4: adjusted age, sex, WC, SBP, cholesterol, glucose, creatinine, HDL-cholesterol, LDL-cholesterol
†The point of IMT at 75th percentile was ≥ 0.64 mm in overall samples, and was ≥ 0.60 mm in healthy group.

0.90–11.34; p = 0.0731). However, the association did not show a significant difference between genders (p-value for interaction = 0.9631).

Among the healthy subjects, women had a stronger association between high uric acid levels and atherosclerosis (OR = 16.46; 1.43–188.95; p = 0.02) than men (OR = 1.81; 0.63–5.18; p = 0.2682), but the difference was not significant (interaction for p-value = 0.1895). The extremely high odds ratio between high uric acid levels and atherosclerosis in women may due to the extreme prevalence of atherosclerosis (1.5%) in the subjects with uric acid less than 9.0 mg/dl.

Discussion

Our study showed that SUA was associated with many cardiovascular disease (CVD) risk factors; i.e., central obesity, hypertension, dyslipidemia, and elevated glucose. Furthermore, SUA had a threshold association with IMT of the common carotid artery, independent of the traditional CVD risk factors in the general population. The risk of having an IMT value >75th was much higher in those with uric acid over 9

mg/dl but not in those below 9 mg/dl. This phenomenon held even among subjects without hypertension, diabetes, and metabolic syndrome.

The association between SUA and IMT remains ambiguous in the literature. Uric acid has been associated with IMT in high cardiovascular risk populations including patients with diabetes [15], hypertension [16], elderly [12], and psoriatic arthritis [14]. SUA is also independently associated with CCA-IMT in elderly Japanese without antihypertensive drugs [12] and in elderly males without metabolic syndrome [27]. Relatively few studies examined the association between uric acid and atherosclerosis in the general population. Among 124 healthy adult Japanese, elevated uric acid levels were a risk factor for increased carotid IMT independent of other cardiovascular confounders [17]. However, the ARIC study [11] showed that uric acid is associated with IMT by univariate analysis, but not according to a multivariate model. Our results are consistent with a Japanese study [17] in that SUA was independently associated with IMT in subjects without hypertension, diabetes, and metabolic syndrome.

The association between SUA and atherosclerotic plaque or the presence of coronary artery calcium (CAC) is also controversial. The Family Heart Study [28] from the National Heart, Lung, and Blood Institute showed a dose-response relationship between uric acid and carotid atherosclerotic plaques in males only. Among high CVD risk individuals, uric acid had a significant univariate association with the presence of CAC, but not independently of conventional risk factors [29]. Moreover, high uric acid levels were strongly associated with the presence of CAC in those with MS only, but not in those without MS [30]. These studies attributed the phenomenon of a nonsignificant association between SUA and atherosclerotic plaques or the presence of CAC to the much low prevalence of atherosclerotic plaques in the general population.

Brachial-ankle pulse wave velocity (baPWV) is a measure of arterial stiffness. SUA was statistically associated with baPWV in Japanese [13,22] and Chinese [31] populations, independent of traditional risk factors. Moreover, SUA was associated with incremental arterial stiffness, independent of C-reactive protein [32]. Therefore, SUA may be a marker of arterial stiffness independent of the inflammation mechanism.

The treatment of asymptomatic hyperuricemia was not considered as a necessity [33] by rheumatologist for most patients, unless perhaps they had very high levels of uric acid or were otherwise at risk of complications, such as those with a personal or strong family history of gout, urolithiasis, or uric acid nephropathy. Our study showed a significant threshold association between uric acid and atherosclerosis. Our results suggest a uric acid level of 9 mg/dl and above could be a clinical indication for aggressive treatment, which was in concordance with Pollmann's [34] suggestion.

This study has some limitations. First, we used a cross-sectional design and a causal relationship cannot be inferred from the results. Second, very few subjects have plaque, so the association of SUA and atherosclerosis was not defined in a conventional way; instead, we used IMT ≥ the 75th percentile value as the atherosclerosis end-point. Third, the biochemical profile and carotid artery assessment were measured 2.5 years apart. Nonetheless, these limitations should not affect the internal validity of this study, due to the similar correlation between BMI and IMT in two cycles ($r = 0.185$, $p < 0.001$ for cycle 3 and $r = 0.175$, $p < 0.001$ for cycle 4). Fourth, we did not collect information on uricosuria medication at the baseline (1993–1997) and therefore the association may be slightly confounded.

Conclusions

SUA is significantly associated with atherosclerosis in the Taiwan population. Elevation of atherosclerotic risk was observed when uric acid levels were above 9 mg/dL and this association remained significant even in the population without hypertension, diabetes, and metabolic syndrome. This study adds to the growing evidence that SUA may play a potential role in the development of atherosclerosis

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Original Article

Improving the Accuracy of a CNN Model by Preprocessing Input Images with Modified Filtering-masks

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Abstract

We propose a concise method to improve the inference accuracy of a convolutional neural network model for image classification. The characteristics of the input images are sharpened by a modified 5 x 5 mask before training and testing. The practice data were acquired from liver cancer MRI scanning at a collaborative hospital. We established the datasets using separated scanned images, which were labeled 1 or 0 to represent images with or without a cancer focal area, respectively. Scanned files from 45 patients were adopted for this study with each of them providing hundreds of separated images. We predicted one patient's longitudinal cancer position in the liver to illustrate the merit of our approach.

Key words: Convolutional neural network; Image classification; Image sharpening; Mask-filtering; Spatial frequency

Introduction

Liver cancer is the second leading cause of cancer deaths and the fifth most common cancer in men and the ninth in women worldwide [1]. More than 75% of hepatocellular carcinoma (HCC) cases occur in the Far East and Southeast Asia. Liver cancer that is diagnosed at an early stage has a better chance of being cured with surgery, liver transplantation, or nonsurgical treatments such as radiofrequency ablation. Researchers are working to develop tests that could identify early-stage liver cancer. It is challenging to unveil small or early-stage liver tumors with traditional ultrasound exams, especially for people who are obese or have cirrhosis. A number of scientists are devising new kinds of imaging approaches using a CT scan or MRI that are more feasible for detecting small tumors [2].

Image classification in MRI files is quite demanding due to the hundreds of varying images saved from each session. However, use of a modified convolutional neural network (CNN) model may overcome this problem once the process is adjusted properly. A common measure to improve model efficiency is reforming the neural network architecture [3-5]. On the other hand, image preprocessing can also provide tools to ensure accuracy. Some well-known image preprocessing approaches are gray-scale conversion, standardization, contrast-limited adaptive histogram equalization, and gamma adjustment. By implementing these methods with input images, the amount of training data can be multiplied and the

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inference accuracy increased.

Preprocessing multiplication of the input data can consume computing resources and sometimes the stated methods make little progress and offer limited contributions. In this study, we demonstrate only one unique image sharpening technique to counter these drawbacks. By applying our algorithm with the input images as a neural network, the model precision will likely be improved and there will be less computing resource consumption.

A conventional filtering-mask is usually considered to be isotropic or rotation-invariant when employed to sharpen images. However, masking calculations are actually a superposition of directional components. Considering this, we propose a modified mask-filtering approach that utilizes nonlinear transfer functions. The illustrated technique effectively reduces the overshooting phenomenon and reveals fine characteristics better than traditional methods [6-14]. It is also helpful when applied within the image classification scope.

Materials and Methods

The input data in this study were acquired from MRI scanning files of 45 patients with liver cancer. For patient, the liver was scanned longitudinally from top to bottom to obtain tens of transverse-section images that included cancer focal areas (positive) and hundreds of images without cancer focal areas (negative). All the positive images of the 45 patients were labeled "1" and one-fifth of the whole negative images were labeled "0." Totally, there were 1,091 images labeled "1" and 2,103 images labeled "0."

We created the desired datasets using the labeled images. The training dataset comprised 80%, the testing dataset comprised 10%, and the validation dataset comprised 10%. For comparison, we carried out the experiment twice. The first time was with datasets that were not sharpened, and the second time was with datasets sharpened in advance with our method. Both experimental sessions employed the same neural network model with identical parameters.

It is common to use 3 x 3 masks to process object images. In this study, a set of masks derived from a 5 x 5 mask was developed to flexibly enhance the images. For a 5 x 5 mask of [0 −1 0 −1 0; −1 −1 −1 −1 −1; 0 −1 16 −1 0; −1 −1 −1 −1 −1; 0 −1 0 −1 0], there are sixteen coefficients surrounding the target pixel that resizes at the position of central coefficient 16. When used to sharpen an image f (m, n), the second derivative can be expressed as the following:

$$\begin{aligned}\nabla^2 f(m,n) = {} & 16f(m,n) - [f(m+1,n) + f(m-1,n) + f(m,n+1) + f(m,n-1) \\ & + f(m+1,n+1) + f(m-1,n+1) + f(m+1,n-1) + f(m-1,n-1) \\ & + f(m+2,n+1) + f(m+1,n+2) + f(m-1,n+2) + f(m-2,n+1) \\ & + f(m-2,n-1) + f(m-1,n-2) + f(m+1,n-2) + f(m+2,n-1)]\end{aligned} \quad (1)$$

The result of Eq. (1) is imposed on the original image to obtain an enhanced image g (m, n) as the following:

$$g(m,n) = f(m,n) + \nabla^2 f(m,n) \quad (2)$$

According to our previous studies, we found it rational to divide Eq. (1) into three parts as the following [15,16]:

$$\begin{aligned}\nabla^2 f(m,n) = {} & \{4f(m,n) - [f(m+1,n) + f(m-1,n) + f(m,n+1) + f(m,n-1)]\} \\ & + \{4f(m,n) - [f(m+1,n+1) + f(m-1,n+1) + f(m+1,n-1) + f(m-1,n-1)]\} \\ & + \{8f(m,n) - [f(m+2,n+1) + f(m+1,n+2) + f(m-1,n+2) + f(m-2,n+1) \\ & \quad + f(m-2,n-1) + f(m-1,n-2) + f(m+1,n-2) + f(m+2,n-1)]\} \\ = {} & \nabla^2 f_\alpha(m,n) + \nabla^2 f_\beta(m,n) + \nabla^2 f_\gamma(m,n)\end{aligned} \quad (3)$$

Eq. (3) allows a conventional 5 x 5 mask with 17 coefficients to be separated into three masks, of which the second derivatives appear to be summations of the first derivatives along different directions, as shown in Eq. (4), (5), and (6):

$$\begin{aligned}\nabla^2 f_\alpha(m,n) = {} & 4f(m,n) - [f(m+1,n) + f(m-1,n) + f(m,n+1) + f(m,n-1)] \\ = {} & [f(m,n) - f(m+1,n)] + [f(m,n) - f(m-1,n)] \\ & + [f(m,n) - f(m,n+1)] + [f(m,n) - f(m,n-1)]\end{aligned} \quad (4)$$

$$\begin{aligned}\nabla^2 f_\beta(m,n) &= 4f(m,n) - [f(m+1,n+1) + f(m-1,n+1) + f(m+1,n-1) + f(m-1,n-1)] \\ &= [f(m,n) - f(m+1,n+1)] + [f(m,n) - f(m-1,n+1)] \\ &+ [f(m,n) - f(m+1,n-1)] + [f(m,n) - f(m-1,n-1)]\end{aligned} \quad (5)$$

$$\begin{aligned}\nabla^2 f_\gamma(m,n) &= 8f(m,n) - [f(m+2,n+1) + f(m+1,n+2) + f(m-1,n+2) + f(m-2,n+1) \\ &+ f(m-2,n-1) + f(m-1,n-2) + f(m+1,n-2) + f(m+2,n-1)] \\ &= [f(m,n) - f(m+2,n+1)] + [f(m,n) - f(m+1,n+2)] \\ &+ [f(m,n) - f(m-1,n+2)] + [f(m,n) - f(m-2,n+1)] \\ &+ [f(m,n) - f(m-2,n-1)] + [f(m,n) - f(m-1,n-2)] \\ &+ [f(m,n) - f(m+1,n-2)] + [f(m,n) - f(m+2,n-1)]\end{aligned} \quad (6)$$

Eq. (4) denotes the mask with four coefficients in the vertical and horizontal directions. Eq. (5) denotes the mask with four coefficients in diagonal directions. Eq. (6) has eight coefficients in other eight different directions. The three masks shown in Figure 1 essentially have different intrinsic properties due to the different distances from the coefficients to the target pixel. Eq. (4) extracts the finest characteristics from the original image, Eq. (5) indicates the higher spatial frequencies, and Eq. (6) indicates more high-intermediate spatial frequencies. In order to flexibly adapt to different image compositions, Eq. (3) was modified as the following:

$$\nabla^2 f(m,n) = \alpha \times \nabla^2 f_\alpha(m,n) + \beta \times \nabla^2 f_\beta(m,n) + \lambda \times \nabla^2 f_\gamma(m,n) \quad (7)$$

and Eq. (2) was rewritten as

$$g(m,n) = f(m,n) + \alpha \times \nabla^2 f_\alpha(m,n) + \beta \times \nabla^2 f_\beta(m,n) + \lambda \times \nabla^2 f_\gamma(m,n) \quad (8)$$

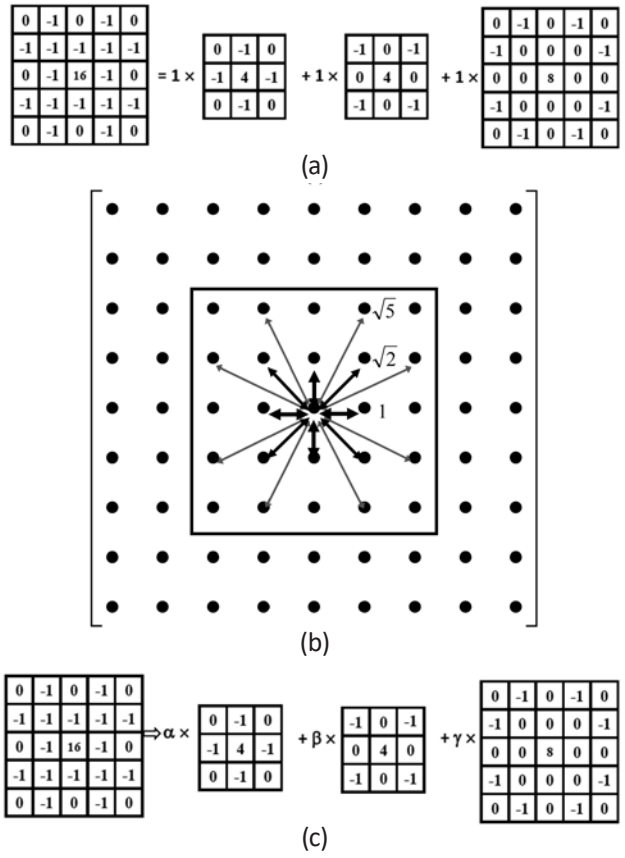


Fig. 1 (a) The 5 x 5 mask divided into three masks. (b) The distances to the target pixel from different mask coefficients. (c) Assigning weights to the three masks.

The above enhancement technique was developed to preprocess the datasets used in this study. Next, we built a modified Lenet-5 neural network for illustration. This simple model is compact but adequate for demonstrating the merit of our proposed method.

Figure 2 shows the entire neural network architecture. Images with and without sharpening can be input to the model for comparison. This modified Lenet-5 model consists of two convolutions followed by their own maxpooling. Flattening is done to convert the image matrix to a one-dimensional full connection layer. Afterward, dropout processing is combined with the hidden layer to help reduce the overfitting phenomenon. The output layer only performs binary classifications.

The intended input data shown in Figure 2 are all gray-scale images with a single channel. The two convolutions containing 5 x 5 masks both have 16 output channels. Because the maxpoolings totally rescale an image to one sixteenth its original size, the flattened layer contains the same pixel number as the input image (128 x 128 = 16,384).

The constants used for sharpening images the second time are (a, b, g) = (0.4, 1.6, 0.15) in Eq. (8). We emphasize the weight of b to magnify higher spatial frequencies, which are considered important for revealing the characteristics of the liver MRI images. All the constants are decided by empirical trial and error.

Results

The average inference accuracy is about 95.6% after 100 epochs of training for the first time. It is about 97.6% after 100 epochs of training for the second time. Table 1 illustrates the relevant results. These outcomes were calculated by implementing TensorFlow 1.14.0 in Python 3.7.

Finally, we loaded the trained model configuration and weights, aiming to predict a patient's longitudinal cancer position according to the serial numbers of the scanned images. This patient was among the original 45 patients who participated in the study.

As described previously, all the positive images were included in the datasets, while only one-fifth of the negative images were selected. That means four-fifths of the negative images remains as inexperienced by the prediction model. Consequentially, this prediction approach partially emulates a real medical diagnosis, which should contain all fresh images from a newly scanned patient.

The diagrams on the left side of Figure 3(a)–(d) are the prediction results using weights from the first experiment. The diagrams on the right side of Figure 3(a)–(d) are the prediction results using weights from the second experiment. The results are expressed in bar graphs. Because they are binary predictions, each bar in the graphs represents a predicted focal image position.

The diagram on the left in Figure 3(a) shows that there are some nonfocal images wrongly predicted as positive around the real focal positions 193–208. Because the false positive bars are more than those in the diagram on the right in Figure 3(a), it is evident that the prediction accuracy is escalated after

Table 1. The elaborate inference results from the two experiments.

	Images not sharpened		Images sharpened	
Inferred / labelled	1	0	1	0
1	95	8	97	6
0	5	191	1	195

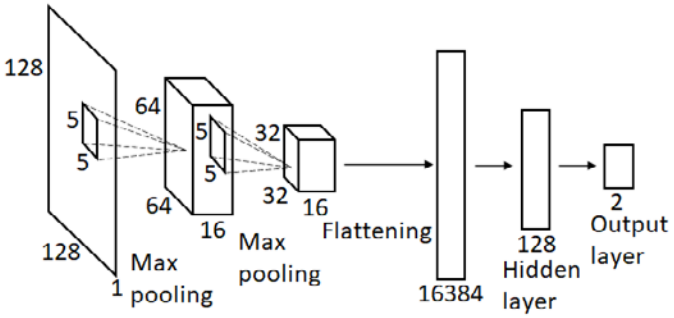
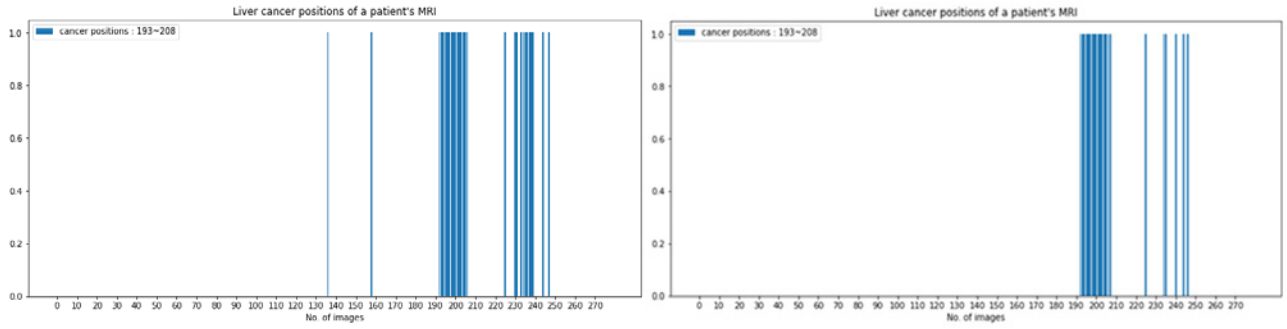
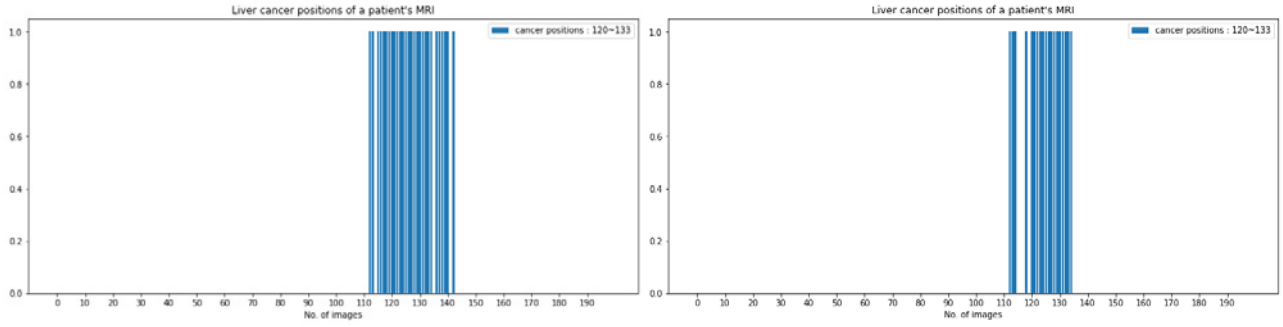


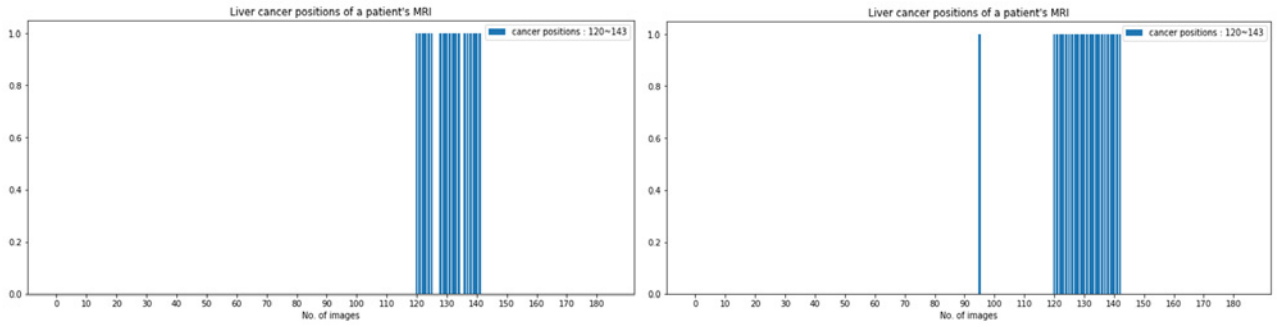
Fig. 2. The computational neural network model and its parameters used in this work.



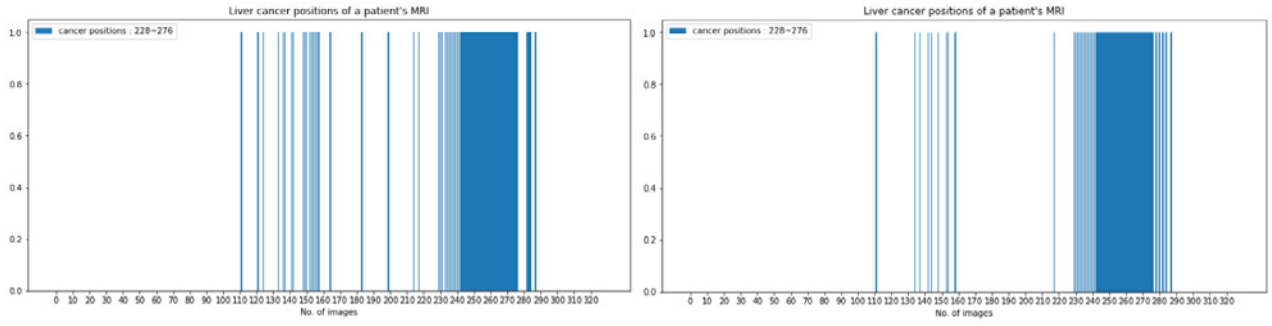
(a)



(b)



(c)



(d)

Fig. 3. (a) On the left is the prediction diagram of one patient using unsharpened datasets, and on the right is the prediction diagram of the same patient using sharpened datasets. (b)–(d) The results of three other patients.

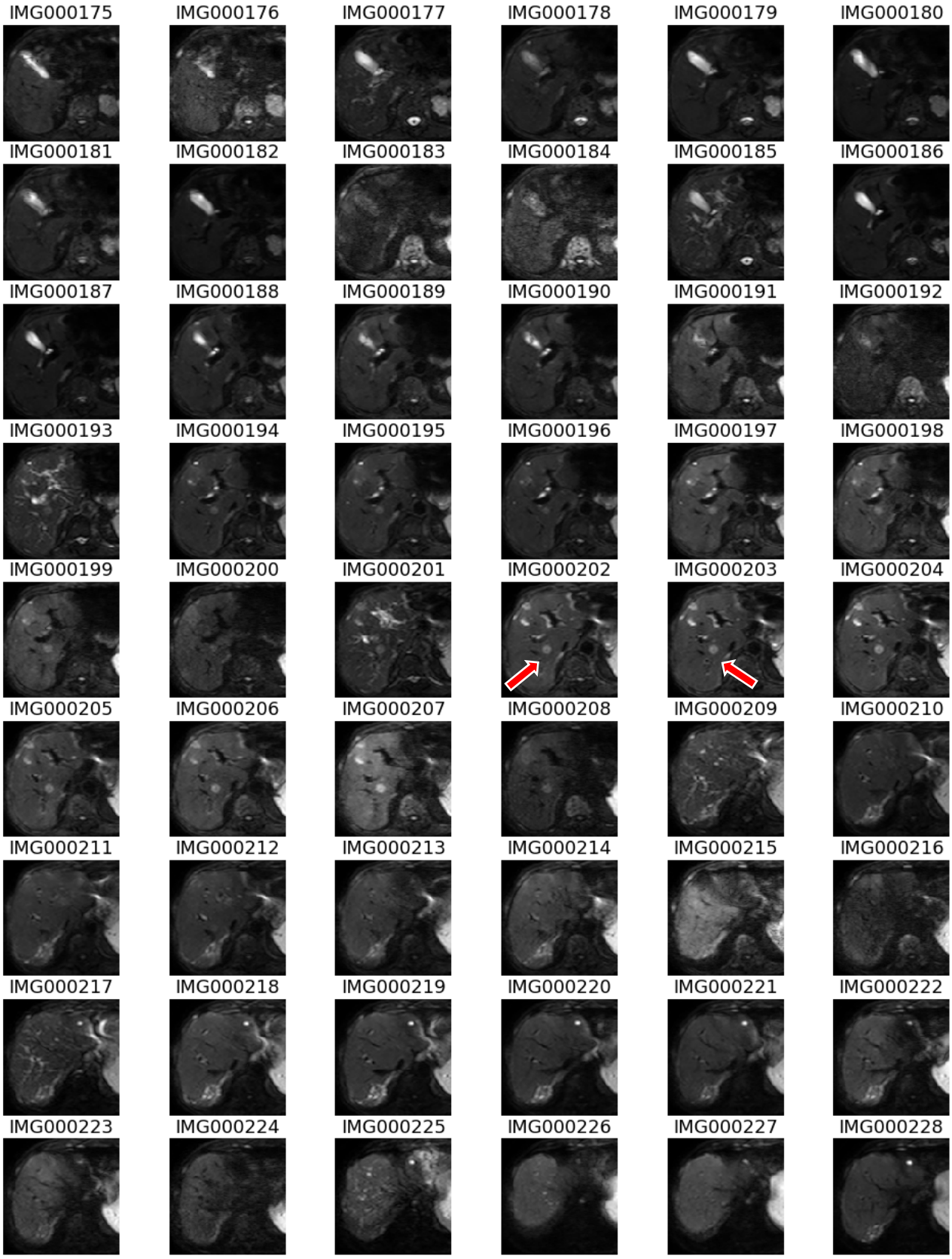


Fig. 4. Part of the original MRI images shown in Figure 3(a). The focal area is indicated with arrows. The longitudinal cancer positions are from IMG000193 to IMG000208.

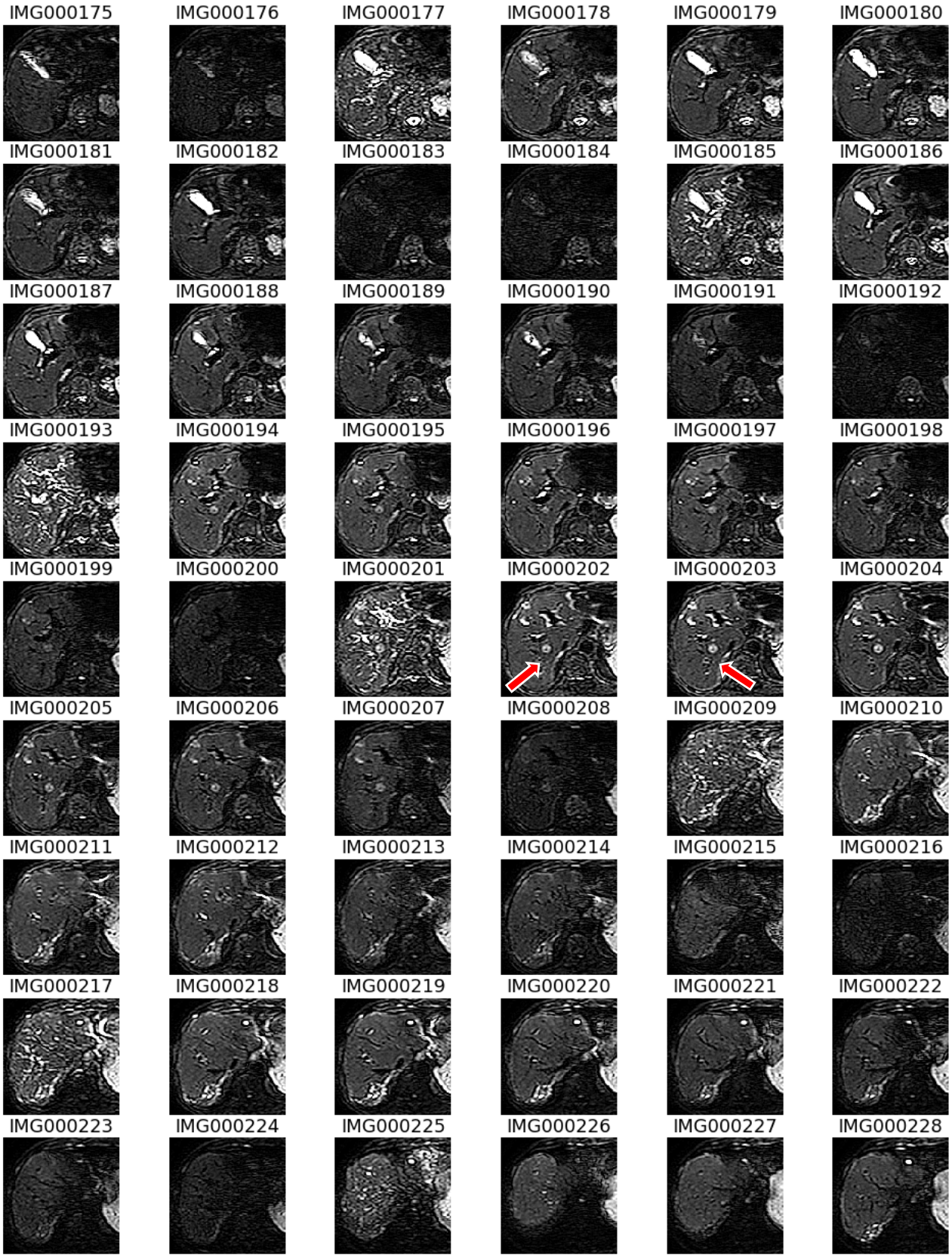


Fig. 5. The sharpened Figure 4 images by constants (a, b, g) = (0.4, 1.6, 0.15) in Eq. (8).

employing the proposed technique. Figure 3(b)–(d) are the results of three other patients. These results all have similar phenomena. Figure 4 shows part of the original images from Figure 3(a). Figure 5 shows the sharpened Figure 4 images.

Discussion and Conclusion

In this study, we first demonstrated a modified mask-filtering algorithm for image sharpening. Then we illustrated its application using a CNN model by introducing the amended preprocessing method. Finally, we carried out a simplified diagnosis emulation to predict a patient's cancer position.

This unique image sharpening technique mainly divides one mask into three related masks, which seemed to have some connection with the convolution operation in deep learning. Both perform mask-filtering to extract features of the image. The obvious difference is that one of them has fixed coefficients but the other has trained coefficients in multichannels.

The emulation of a diagnosis of cancer positions was not an easy task. Every separated image contains varying liver sizes and shapes inside and the cancer tumor also varies in appearance. Moreover, accidental breathing by the patient during scanning tends to blur several images.

The recommended method seems to be more suitable for enhancing the input datasets of knee osteoarthritis or lumbar spine osteoporosis, which have close image content for comparing characteristic differences after sharpening. The proposed approach not only reduces computing consumption but provides potential flexibility to accommodate various image compositions.

Acknowledgment

The authors would like to thank Tungs' Taichung MetroHarbor Hospital for providing the MRI scanning data, which had been permitted by the Institutional Review Board of the Hospital with IRB Number 109001. They had been images with pseudonymization and deidentification when adopted in this work.

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Case Report

Unscarred and Scarred Uterine Rupture in Pregnancy: A Six-case Series in Taipei Tzu-Chi Hospital

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Abstract

Objectives: This study included six uterine rupture in pregnancy cases over 12 years at Taipei Buddhist Tzu-Chi Hospital. We describe the clinical features and outcomes of rupture of unscarred uteri and scarred uteri following laparoscopic myomectomy.
Materials and methods: This case series was conducted by reviewing medical charts at Taipei Tzu-Chi Hospital from May 2005 to October 2017. Of 22,962 women who gave birth, six women with full-thickness disruption of all uterine layers during pregnancy or delivery were enrolled.
Results: Three cases had ruptures of unscarred uteri and three cases had in uteri scarring by previous laparoscopic myomectomy. The overall incidence of uterine rupture was 0.026%. In women with scarred uteri, the risk of uterine rupture was 0.21%. All uterine ruptures occurred after gestation for 34 weeks although ruptures occurred slightly earlier in the scarred group. All cases received hysterorrhaphy. One neonatal death occurred in the unscarred group and one intrauterine fetal death was diagnosed at admission in the scarred group.
Conclusion: Although uterine rupture is a rare complication, the risk is higher for uteri scarred by cesarean section, abdominal myomectomy, or laparoscopic myomectomy. Comparison of risk after abdominal and laparoscopic surgery remains a topic of debate. Regardless of the transmyometrial surgical approach, surgeons should limit electrosurgery and perform multilayer closure. Additionally, early detection and management not only improves maternal and fetal outcomes, but also preserves patient fertility.

Key words: Uterine rupture, Myomectomy, Unscarred uterus, Pregnancy outcome, Maternal morbidity

Introduction

Rupture of a gravid uterus is defined as a full-thickness disruption of all uterine layers during pregnancy or delivery. Uterine rupture is a rare, life-threatening obstetric complication that leads to maternal hemorrhage, as well as hysterectomy, stillbirth, or neonatal hypoxic brain damage. The most common clinical manifestation of uterine rupture is a nonreassuring fetal heart rate, while other symptoms include severe abdominal pain, loss of station, or hemodynamic changes [1]. Emergent surgical interventions are often necessary, such as delivery of the fetus and uterine repair or hysterectomy. The overall incidence of uterine rupture is 1.6 to 30 per 10,000 pregnancies [2]. The incidence is higher; i.e., about 50 per 10,000 deliveries, for women with a scarred uterus due to previous cesarean sections, myomectomies, or other transmyometrial surgery [3]. Moreover, the incidence of uterine rupture has sharply increased in recent decades, and this change is thought to be related to the increase in cesarean sections and myomectomies [4]. However, it is not

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clear whether laparoscopic myomectomy is associated with a higher risk of uterine rupture compared to previous abdominal myomectomies or cesarean sections. We retrospectively reviewed the medical records of six women who experienced uterine rupture in pregnancy. We describe the clinical features and outcomes of three cases without a previous surgical history and three cases that had previously undergone laparoscopic myomectomy.

Materials and methods

Patients

This case series was conducted by reviewing medical charts at Taipei Tzu-Chi Hospital from May 2005 to October 2017. The study was approved by the Human Investigation Review Board of Taipei Tzu-Chi Hospital (IRB no. 06-X33-104).

Data collection

Among a total of 22,962 women who gave birth, six cases of full-thickness disruption of all uterine layers during pregnancy or delivery were enrolled in this study.

Three cases of rupture of unscarred uteri in women that had not received prior transmyometrial surgery and three cases of rupture of scarred uteri in women who had previously received laparoscopic myomectomies were identified. The intrapartum courses and maternal and neonatal outcomes are described in detail.

Results

During the study period, a total of 22,962 women gave birth at our institution. Six women with uterine rupture were identified and reviewed, including three cases of rupture of unscarred uteri and three cases of rupture of scarred uteri in women who had previously undergone laparoscopic myomectomy. The overall incidence of uterine rupture was 0.026%. Among the 22,962 women who gave birth, 1,441 women had a previous history of transmyometrial surgery, including previous cesarean sections or myomectomies: 1,384 women had previous cesarean sections and 37 women had undergone myomectomies including laparotomy or laparoscopy. The risk of uterine rupture among women with scarred uteri was 0.21%, which was higher than the risk for women with unscarred uteri (0.014%). All uterine ruptures occurred after 34 weeks of gestation, although the ruptures of scarred uteri occurred slightly earlier. No risk factors, such as grand multiparity, instrumental deliveries or macrosomics, were identified in the unscarred group.

All six cases of uterine rupture were diagnosed after emergent cesarean sections due to indications of fetal distress. The average time interval between laparoscopic myomectomy and the last menstrual period was 539 days. All cases received hysterorrhaphy. One neonatal death occurred in the unscarred group and one intrauterine fetal death was diagnosed at admission in the scarred group. Case 4 and Case 6 (in the scarred uteri group) had uncomplicated cesarean deliveries two years after uterine rupture.

Details of each case

Case 1: unscarred uterus

A 37-year-old female, G2P0AA1, visited our delivery room at 39 + 1 weeks of gestation due to labor pains and a bloody show. An emergent cesarean section was arranged due to a nonreassuring fetal heart rate and the fetus was found outside the uterus. In addition, a 10-cm irregular laceration wound was found in the lower segment of the uterus. A female baby weighing 3,700 g with 1- and 5-min Apgar scores of 2 and 2, respectively, was delivered. The mother was discharged uneventfully but the baby died in a pediatric intensive care unit.

Case 2: unscarred uterus

This 35-year-old female, G2P0E1, was admitted for induction of labor at 40 + 3 weeks. An emergent cesarean section was arranged due to nonreassuring fetal heart rate. Uterine rupture was noted at the left post fundal site from the fundus, which was too close to the left cardinal ligament. A male baby weighing 3,085 g with 1- and 5-min Apgar scores of 6 and 9 was delivered. The mother and infant were discharged without subsequent complications.

Case 3: unscarred uterus

This 38-year-old female, G2P1, visited our delivery room due to labor pains at 39 + 1 weeks of gestation. An emergent cesarean section was arranged due to a nonreassuring fetal heart rate. Uterine rupture was observed from the left cornus to

the left lower segment. A male baby weighing 3,320 g with 1- and 5-min Apgar scores of 1 and 4, respectively, was delivered. The mother and infant were discharged without subsequent complications.

Case 4: scarred uterus

This 27-year-old female, G2P0AA1, was admitted at 39 weeks of gestation due to fetal bradycardia (70–90 bpm) and an emergent cesarean section was performed. The patient had undergone laparoscopic myomectomy around two years previously; an 8 × 7-cm myoma was noted at the posterior wall. While undergoing a cesarean section, a 3 × 3-cm uterine rupture was observed in the posterior wall (Pic. 1). A female baby weighing 3,130 g was delivered, and she had 1- and 5-min Apgar scores of 5 and 9, respectively. The mother and infant were discharged without subsequent complications. Two years later, the mother became pregnant again and a scheduled cesarean section went smoothly.

Case 5: scarred uterus

This 35-year-old female, G1P0, was admitted at 36 + 5 weeks of gestation due to severe lower abdominal pain. The patient had undergone laparoscopic myomectomy and oophorcystectomy around two years previously when a 15 × 14 cm myoma was noted at the left posterior wall. An emergent cesarean section was performed, and a 3 cm uterine rupture wound was found at the fundus. A male baby weighing 2,895 g with 1- and 5-min Apgar scores of 9 and 9, respectively, was delivered. The mother and infant were discharged without subsequent complications.

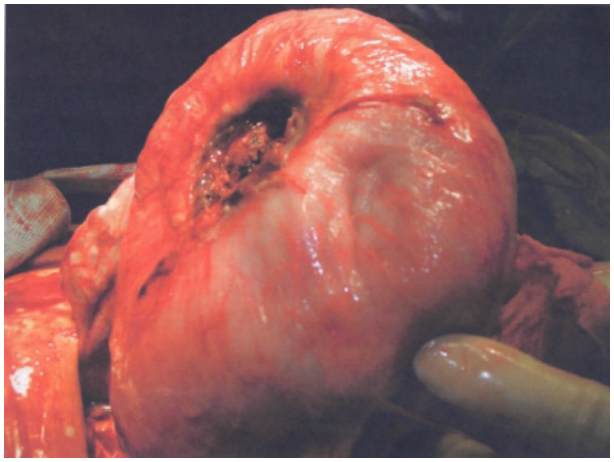

Fig. 1 This 27-year-old female, G2P0AA1, pregnant at 39 weeks of gestation had undergone laparoscopic myomectomy (an 8 × 7 cm myoma at the posterior wall) two years previously. While undergoing emergent cesarean section, a 3 × 3-cm uterine rupture was observed in the posterior wall.

Case 6: scarred uterus

A 39-year-old female, G1P0, was admitted at 34 + 5 weeks of gestation due to severe lower abdominal pain. The patient had undergone laparoscopic myomectomy approximately three years previously when a 2 × 2-cm myoma was noted at the anterior wall. An emergent cesarean section was performed due to suspected uterine rupture and intrauterine fetal demise. A 6 cm vertical rupture wound was found from the fundus to the anterior wall. A deceased male baby weighing 1,895 g was delivered. The mother was discharged without subsequent complications. Two years later, the mother became pregnant again and had a scheduled cesarean section, which went smoothly.

Discussion

This study presents six cases of uterine rupture during pregnancy. The overall incidence of uterine rupture at Taipei Tzu-Chi Hospital from 2005 to 2017 was 0.026%, which was slightly lower than the 0.058% risk of uterine rupture reported in another study in Taiwan [5]. According to a review by the World Health Organiztion, the prevalence of uterine rupture is below 0.1% in developed countries, and between 0.1% and 1% in developing countries [2]. Several reviews have reported the risk of rupture was 0.2% to 1% for women with a scarred uterus [6]. The rate of cesarean sections has continued to rise, as well as the rate of myomectomies. Laparoscopic myomectomy is favored by both gynecologists and patients, as the surgical outcomes including blood loss, postoperative pain, and the recovery time are better than those of abdominal myomectomy [7]. According to the study, the risk of uterine rupture for women with a previous cesarean section was 0.32%, whereas the risk of uterine rupture in pregnancies after myomectomy was 0.6%–0.8% [8]. Many studies have reported a higher risk of uterine rupture after laparoscopic myomectomy compared to abdominal myomectomy. Although this difference is not considered to be statistically significant, the risks may be underestimated due to the high rate of scheduled cesarean sections for women who previously underwent laparoscopic

myomectomy [9-10]. In our study, there were 37 pregnancies following laparoscopic myomectomy and uterine rupture occurred in three of them. The risk was about 8.1%, which was higher than other reports. The limited case number might be the reason for this discrepancy. On the other hand, Koo et al. stated that laparoscopic myomectomy was as safe as cesarean sections or abdominal myomectomies for women of reproductive age [11]. Overall, the pregnancy outcomes of laparoscopic myomectomy and abdominal myomectomy remain controversial, as the conclusions are only based on observational studies or small case series.

The largest myoma among our cases was 15 × 14 cm and the smallest was 2 × 2 cm. According to Koo et al., there is no significant association between uterine rupture and any characteristics of the myomas, such as their number, mean diameter. or location [11]. However, in one of our cases, uterine rupture occurred at the site of the previous myomectomy scar. Due to the rarity of uterine rupture, definitive evidence of uterine rupture sites being related to previous myomectomy scars may not apparent. In the future, sonography can be used to evaluate the thickness of the myometrium during pregnancy. Furthermore, surgical techniques, such as the use of electrosurgery, and the type of suturing may affect the risk of uterine rupture. Thermal damage may cause tissue necrosis and devascularization and thus impair wound healing and remodeling of the myometrium. Therefore, electrosurgery for hemostasis should be limited [10-12]. In theory, multilayer closure leads to a stronger repair of the defect and prevents the formation of hematomas in dead spaces. Bujold et al. reported that single-layer closure of the lower uterine segment is associated with a 4-fold higher risk of uterine rupture compared to two-layer closure [13]. To minimize the risk of uterine rupture, multilayer closure or barbed sutures should be used when closing uterine wounds [7,10].

Studies suggest it takes at least six months for a uterine wound to completely heal [14]. After three months, the myometrium is fully healed, as observed by MRI or 3-dimensional ultrasound [10]. The average time interval between a previous surgery and uterine rupture in our scarred group was 17.9 months, although there was an outlier case of uterine rupture at 34 + 5 weeks after an interval of 27.2 months. All patients in this case series had a time interval of more than six months. Although it is not a determining risk factor for women with scarred uteri, the time interval is still important.

The use of uterotonic drugs, including oxytocin and misoprostol, for both unscarred and scarred uteri is the strongest risk factor for uterine rupture; however, no data regarding the maximum dose were reviewed [15]. In patients with no history of cesarean sections or myomectomies, the major risk factors mentioned included advanced maternal age, higher parity, macrosomia, malpresentation, or abnormal placentation [16]. Unfortunately, these risk factors lack specificity.

The triad characteristics of uterine rupture including abdominal pain, vaginal bleeding, and fetal heart rate abnormalities are the most commonly described symptoms of uterine rupture [1]. Based on this study, the triad may not occur in all cases, though up to 70% of uterine ruptures present with abnormal fetal heart rates [17]. Other symptoms, such as loss of station, arrest of second stage labor, and shock, should also be taken into account as signs of uterine rupture. The nonspecific and heterogeneous symptoms of unscarred uterine ruptures lead to delayed awareness and management. Therefore, maternal and neonatal morbidity rates were higher when compared to scarred uterine ruptures [18].

Our analysis was limited to a retrospective study; thus, the data is likely to be incomplete. Furthermore, our analysis did not explore the statistical significance of any associations, as there only were a small number of cases at a single hospital. However, to improve the accuracy of the data, the case identification and review were conducted by same person to avoid bias.

In conclusion, uterine rupture during pregnancy is a catastrophic complication. Early detection and management are crucial. More good quality data is needed to determine the risk of uterine rupture during pregnancy and provide appropriate treatment for uterine myomas in women of reproductive age. Most surgeons accept that some techniques may minimize the risk of rupture; e.g., the use of electrosurgery for hemostasis should be limited and double or multilayer closure is needed to ensure the myometrial defect is repaired well and will heal completely.

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Case Report

A 7-year-old Boy with Hematochezia Caused by Thrombosis in Portal Vein, Splenic Vein, and Inferior Mesenteric Vein. A Rare Case Report and Literature Review

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Abstract

Mesenteric vein thrombosis is extremely rare in children, with only a few case reports in the literature. Most mesenteric vein thrombosis cases involve the superior mesenteric vein. Acute mesenteric vascular occlusion is associated with a high mortality rate. Early detection and aggressive management are imperative to prevent thrombus progression, bowel infarction, and death.

This report describes a 7-year-old boy who suffered from bloody stool for one week. Upper gastrointestinal endoscopy revealed no abnormalities, while a colonoscopy revealed only nodular lymphoid hyperplasia. A Meckel's diverticulum scan revealed negative findings. Abdominal computerized tomography showed thrombi in the right portal branch, main portal vein, splenic vein, and inferior mesenteric vein. Symptoms were relieved after the patient was treated with rivaroxaban 10 mg orally once a day.

This case report characterizes a rare cause of bloody stool in children. If a patient presents with hematochezia with or without abdominal pain, abdominal venous thrombosis should be considered as a differential diagnosis because of its high mortality and morbidity rate. Early diagnosis and proper treatment can save a patient's life.

Key words: Pediatrics, Gastrointestinal bleeding, Mesenteric vein thrombosis, Portal vein thrombosis, Splenic vein thrombosis

Introduction

Mesenteric vein thrombosis (MVT) is extremely uncommon in children, with only a few case reports in the literature. Most MVT cases involve the superior mesenteric vein (SMV). MVT can be classified into two types based on its etiology: primary MVT or secondary MVT. Primary MVT accounts for 21% to 49% of the cases. Inflammatory bowel disease (IBD), prothrombotic states, surgery, malignancy, pancreatitis, trauma, and oral contraceptives are all possible secondary causes [1]. MVT is a life-threatening disease with a high risk of mortality and morbidity. Therefore, early detection and proper management are significant to prevent thrombus progression, bowel infarction, and death [2-3].

We report a 7-year-old male patient who suffered from hematochezia caused by thrombosis in the portal vein, splenic vein, and inferior mesenteric vein (IMV). From the literature review, there are only a few published case reports of pediatric MVT in Asia [4-5].

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Case Report

A 7-year-old boy visited a teaching hospital to be

treated for daily bloody stool that had been happening for one week. According to his family's statement, the young boy was born at 40 weeks gestational age with birth body weight of 4,020 gm (85–97th percentile). There were no histories of coagulopathy, IBD, familial adenomatous polyposis, or Peutz–Jeghers syndrome in the family. He had a fever and was vomiting for nearly 10 days at this time. He started to have painless bloody stool 3–4 days later and began having abdominal pain one day before admission.

Physical examination showed the following: body weight, 21.2 kg (15–50th percentile); body height, 119.6 cm (15–50th percentile); body temperature, 36.7°C; heart rate, 111 beats/min; respiratory rate, 20/min; pink conjunctiva; no rash; soft abdomen without distension; normoactive bowel sounds; no palpable mass; no hepatosplenomegaly; and no tenderness. A complete blood count with differential was performed and the results showed: white blood count, 7,300/μL; hemoglobin, 10.4 g/dL; mean cell volume, 74.9 fL; platelets, 322,000/μL; neutrophils, 58.2%; lymphocytes, 28.9%; and monocytes, 12.1%. The coagulation profiles were as follows: prothrombin time, 13.3 seconds; international normalized ratio, 1.10; and activated partial thromboplastin time, 32.5 seconds. The alanine aminotransferase level was 13 IU/L and the erythrocyte sedimentation rate was 3 mm/h. An intravenous proton pump inhibitor and tranexamic acid were prescribed at admission for suspected massive bleeding of peptic ulcers. We checked the hemoglobin level once a day because hematochezia and intermittent abdominal pain persisted. On the second day of admission, the hemoglobin dropped from 10.4 to 8.4 g/dL, necessitating the addition of vitamin K1. Upper gastrointestinal endoscopic and colonoscopic examinations identified no active bleeding sites and ulcers; however, a nodular lymphoid hyperplasia was observed in the cecum area. On the third day of admission, his hemoglobin levels continually dropped unexpectedly from 8.4 to 8.1 g/dL, and octreotide 1.0 mcg/kg/h was administered intravenously. A Meckel's diverticulum scan revealed negative findings as well. Abdominal sonography revealed a thrombus in the right portal branch. Abdominal computerized tomography (CT) revealed thrombi in the right portal branch, main portal vein, splenic vein, and IMV (Figures 1 and 2). Further investigation of his coagulation status showed that factor VIII was 150.6% (normal range: 50%–150%), factor IX was 101.5% (normal range: 67%–127%), factor XI was 85.4% (normal range: 71%–134%), factor XII was 38.3% (normal range: 46%–113%), and D-dimer was >10,000 mg/L (FEU). Under the impression of multiple abdominal venous thromboses, he was treated with rivaroxaban (selective factor Xa inhibitor) 10 mg qd. He recovered and was discharged after 11 days of rivaroxaban treatment.

Fig. 1 Abdominal computerized tomography showed thrombosis in the main portal vein (white arrow) and splenic vein (white triangle).

Fig. 2 Abdominal computerized tomography showed thrombosis in the inferior mesenteric vein (white arrow).

Discussion

MVT, portal vein thrombosis (PVT), and splenic vein thrombosis (SVT) are all rare conditions. MVT affects approximately 1 in 100,000 people annually, with the age range being between 20 and 80 years generally [3]. The causes of MVT, PVT, and SVT are different.

Abdominal MVT is rare in children with the literature limited to case reports and series. Abdominal pain, tenderness, nausea, vomiting, diarrhea, and hematochezia are all symptoms of acute MVT. The abdominal pain of MVT is colicky and spreads over the middle-abdominal area. Hematemesis, hematochezia, or melena occurs in about 15% of patients. In these cases, the initial physical findings may be entirely normal. The occurrence of fever, abdominal guarding, and rebound tenderness indicates the progression of MVT to bowel infarction. Although CT will confirm the diagnosis in 90% of patients, it is less accurate in those with early thrombosis of small mesenteric vessels. Magnetic resonance imaging has excellent sensitivity and specificity for the diagnosis of MVT [6].

In the literature, there are only a few case reports of pediatric abdominal vein thrombosis. Hayakawa T et al. reported a 5-year-old girl who suffered from abdominal pain and bloody stool, and type 2 protein S deficiency associated splanchnic venous thrombosis was diagnosed [4]. Yoon SH et al. reported MVT as a complication of appendicitis in an adolescent [5]. Walsh DS et al. reported SMV thrombosis in malrotation with chronic volvulus in a 13-year-old girl [7]. Olson JF et al. reported a 16-year-old girl with functional deficiency of protein C associated MVT who suffered from abdominal pain, hematemesis, and fever [8]. Clinical presentations in the cases above were totally different from the patient in this case report.

Children of various ages can develop abdominal thromboembolisms. Children under the age of 12 years account for 38% of the cases, with 11% of the children aged less than six years. Ulcerative colitis was significantly more frequently associated with thromboembolism events than Crohn's disease. Lazzerini M et al. reviewed 70 reported children with thromboembolisms in IBD. Twelve cases had an abdominal thromboembolism. Eleven cases were venous related (five Budd–Chiari syndromes, three portal veins, two SMV, and one splenic vein) and one case was arterial (multiple colon vessels). Reported symptoms included pain, ascites, hepatomegaly, abdominal distension, bloody stools, vomiting, fever, and elevation of transaminases [9].

A PVT may extend into the splenic vein or SMVs. It frequently occurs in neonates as a result of umbilical vein catheter insertion or sepsis. Many cases of neonatal PVT are diagnosed later in childhood secondary to symptoms of portal hypertension [2]. In older children and adults, etiologies of PVT include pancreatitis, cirrhosis, liver transplantation, splenectomy, and sickle cell disease [10].

Anticoagulation should be started as soon as a diagnosis is made as it significantly improves survival. Patients with persisting symptoms, worsening abdominal pain 48–72 h after initiation of anticoagulation, or development of signs of peritonitis may be considered for radiological or surgical intervention. Surgical resection of the necrotic bowel and anastomosis is the standard procedure. Outcomes in MVT are better compared with arterial thrombosis with a mortality rate of 44% compared with 66%–89%, respectively. Recurrence occurs most commonly in the first 30 days after presentation [1].

About 50% of childhood PVT cases have no identifiable etiology [10]. In this case, the patient experienced a combination PVT, SVT, and IMV thrombosis. No esophageal varices or splenomegaly was found. The growth curve of his body weight dropped from 85 to 97th percentile at birth to 15–50th percentile on this hospital admission. Colonoscopy showed nodular lymphoid hyperplasia. Based on this finding, we hypothesized that the boy might be at the early stage of IBD, and long-term follow-up is necessary. If a patient presents with hematochezia with or without abdominal pain, abdominal venous thrombosis should be in the list of differential diagnoses because of its high mortality and morbidity rate. Early diagnosis and proper treatment can save a patient's life.

Informed Consent Statement:

The parents of the patient agreed to anonymous use of the published data.

Conflicts of Interest:

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article. The authors declare no conflict of interest.

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Case Report

Preterm Spontaneous Rupture of A Scarred Unicornuate Pregnant Uterus: A case report

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Abstract

Uterine rupture is a life-threatening obstetrical complication. Most cases of uterine rupture are associated with a trial of labor with previous cesarean delivery or having a history of myomectomy. Herein, we describe a 33 year-old female with a spontaneous uterine rupture at 28 + 4 weeks gestation age resulting in a demised fetus. Fetal bradycardia and an irregular protruding "mass" over the left upper abdomen with no fetus in a boggy uterus were identified by sonography. An emergent cesarean section was performed and on entering the peritoneal cavity, a complete expulsion of the fetus and placenta from the uterine cavity was noted. A flaccid fetus without heartbeat with a large uterine ruptured scar extending from the left lower segment to left lateral wall were found. A right unicornuate uterus was confirmed later by hysterosalpingography and MRI. Spontaneous uterine rupture should be listed in the differential diagnosis of an acute abdomen during pregnancy.

Key words: Cesarean section, Uterine rupture, Unicornuate uterus, Acute abdomen

Introduction

Uterine rupture is a life-threatening obstetrical emergency. Sequential labor induction with prostaglandins and oxytocin, augmentation of labor with oxytocin, previous uterine surgery, the number and type of previous cesarean deliveries, congenital uterine anomalies, multiparity, interdelivery interval < 16 months after a previous cesarean delivery, and previous first-trimester miscarriages all increase the risk of future uterine ruptures [1]. Even though there are many factors known to be related to uterine ruptures, the actual overall incidence of uterine rupture is low. Since the clinical presentation of spontaneous uterine rupture is indiscernible from other acute abdomen issues in pregnancy, the clinician should have a high awareness of this condition when attending a pregnant woman.

We present a case of spontaneous uterine rupture in a 28 + 4 week gestational age nonlaboring woman with repair of a ruptured scar. Two years later, the patient gave birth to a healthy baby by a scheduled cesarean section with uneventful recovery.

Case report

A 26-year-old gravida 2, para 1 woman was pregnant at 28 + 4 weeks. She had a history of cesarean section on January 31, 2017 during her previous pregnancy due to arrest of descent. She had no known congenital uterine abnormalities or systemic medical diseases.

She became pregnant again about two years later and received regular antenatal care at a local clinic uneventfully. On the day of hospital admission, sudden onset of intractable low abdominal pain with vaginal spotting was noted. After an evaluation by a clinic obstetrician, uterine rupture was the initial

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impression. She was transferred to our emergency department for further management. Her initial blood pressure was 129/84 mmHg with a heart rate of 77 beats/minute, body temperature was 37.6°C, and the respiratory rate was 20 breaths/minute. She had clear consciousness and severe tenderness over the left lower abdomen. She denied any history of fever, cold sensation, or intercourse or trauma before this admission. Physical examination revealed tenderness over the entire abdomen, with rebounding pain and muscle guarding, and a noncompatible boggy gestational uterus. An ultrasound scan showed an empty uterus with a preterm infant displaced over the left upper quadrant, with a moderate amount of fluid over the bilateral Morison's pouch, splenorenal fossa, and cul-de-sac. The initial heartbeats of the infant were estimated to be around 30–45 beats/minute. Laboratory data revealed a white blood cell count of 19,600/mL, with 87.4% segmented neutrophils and hemoglobin at 12.7 g/L.

An emergent laparotomy was performed and total expulsion of the placenta and fetus occurred in the left upper quadrant of the abdomen upon entering the abdominal cavity. There was an irregular ruptured uterine scar over a previous incision site extending up to the left lateral wall. The site of the rupture was bleeding moderately (Figure 1). A neonatologist and an anesthesiologist performed neonatal resuscitation immediately, including intubation and chest compression after the umbilical cord was separated from his mother.

The preterm newborn expired after vigorous resuscitation attempts for about 35 mins. The birth weight was 1,164 gm. The uterus was closed in two layers with 1-O Vicryl suture, the peritoneal cavity was irrigated, and blood was evacuated completely before the abdomen was closed. Total blood loss (including amniotic fluid) was 450 ml, and the patient was discharged uneventfully from the hospital six days later.

She was subsequently followed at our outpatient department. Office hysteroscopy, MRI (Figure 2), and hysterosalpingogram (Figure 3) confirmed a right unicornuate uterus. Two years later, she became pregnant again. Regular antenatal care and level II sonography revealed no specific findings, and a cesarean delivery was scheduled with two doses of dexamethasone given before the procedure. A healthy baby weighing 2,702 gm with Apgar scores 9'→ 9 at 35 weeks and 3 days of gestation was delivered smoothly. A paper-thin uterine wall with impending rupture was found on the previous uterine scar site.

Discussion

Uterine rupture in a nonlaboring status is very rare. A literature review showed that most uterine

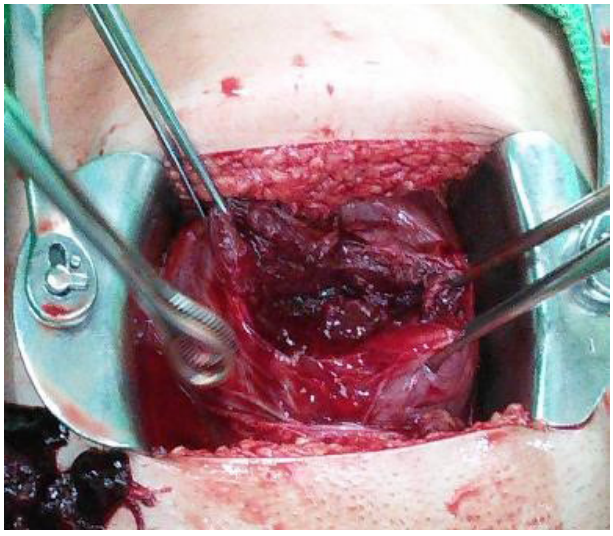

Fig. 1 The ruptured uterus with an irregular ruptured uterine scar over a previous incision site extending up to the left lateral wall in the abdominal cavity.

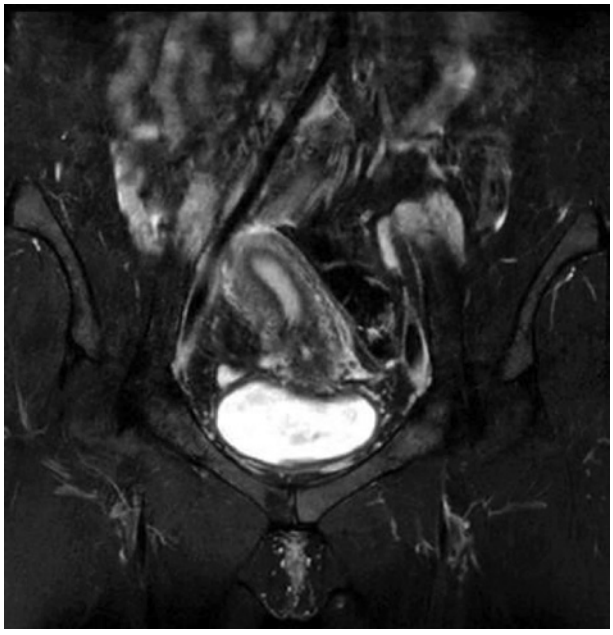

Fig. 2 MRI T2W coronal view showing the unicornuate uterus. The uterus is curved (to the right side), elongated, and has a banana-shape. The uterine volume is reduced. No rudimentary horn is noted on its left side.

ruptures occurring after a previous cesarean delivery are associated with previous fundal or high vertical hysterotomy, induction with medications, or the process of labor [2-5]. Other possible risk factors include increasing maternal age, gestational age > 40 weeks, birth weight > 4,000 grams, previous single-layer uterine closure, and more than one previous cesarean deliveries [1,6]. However, none of those factors existed in our patient. This scenario is not easy to diagnose because uterine rupture at a preterm gestational age in a nonlaboring woman may present with nonspecific findings and catastrophic consequences could follow both for the mother and baby if the patient has not been managed properly and in a timely manner.

Clinical findings of a uterine rupture may include abnormal fetal heart rate (bradycardia is the most common fetal heart rate presentation in a pregnant woman with a uterine rupture), severe abdominal pain, and vaginal bleeding [7]. Fetal heart rate abnormalities, maternal hemodynamic instability, and severe abdominal pain are generally an indication for an emergent delivery. The surgeon can attempt to close the uterine defect using a technique similar to that used in a traditional hysterotomy closure. If the defect cannot be surgically repaired, a hysterectomy is inevitable.

Patients with an unicornuate uterus have a higher risk of obstetrical complications, such as first trimester and second trimester abortion, intrauterine growth restriction, preterm delivery, intrauterine fetal demise, and uterine rupture [8]. Uterine rupture is a rare but devastating consequence that most frequently results in fetal death with life-threatening maternal hemorrhage. Previous studies describing maternal and perinatal outcomes after uterine rupture are limited, most likely due to the rarity of the event. A previous study showed that initiation of labor at a health institution, early treatment of hypovolemia, and prevention of postoperative anemia can decrease maternal morbidity secondary to uterine rupture [9]. One study indicated that after complete uterine rupture, if the time to delivery was >30 minutes and if there was placental separation and/or fetal extrusion, then intrapartum infant death was likely. Early differentiating diagnosis with emergent management within 20 minutes of uterine rupture is pivotal to save both the mother and infant [10].

Fig. 3 Hysterosalpingogram revealed a right unicornuate uterus with "Banana" shape, without an intrauterine filling defect lesion. Nonopacification of the left side of the uterus.

Conclusion

Obstetricians must be on high alert for life-threatening uterine rupture in pregnant woman with symptoms similar to acute abdomen during pregnancy, even in the absence of risk factors. In a hemodynamically stable patient, adequate fluid and blood transfusion may be considered as soon as the condition is suspected, and an emergent operation may possibly save both the mother and baby. A multidisciplinary team, including an anesthesiologist, neonatalogist, critical care staff, and maternal-fetal specialist, should be actively involved in the care of a pregnant woman with a uterine rupture event. An emergent laparotomy should be conducted first, and comprehensive postoperative care should be provided to the patient to achieve satisfactory maternal and fetal outcomes. With meticulous repair of the ruptured uterus, an uneventful delivery in subsequent pregnancies can be anticipated.

Acknowledgments

I hereby declare that the patient described in this article has been made aware of the publication and gave consent verbally.

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Case Report

Content Analysis to Improve Self-management in Case with Heart Failure

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Abstract

Heart failure is the ultimate deterioration of the heart due to disease. It is associated with high rates of hospitalization and mortality. Every hospitalization affects the patient physically and mentally and it also places a heavy burden of medical care on the patient's family and society. Patients often relapse after treatment and are readmitted due to too much water intake and other unhealthy lifestyles at home. Thus, proper posthospitalization care is essential to prevent hospital readmissions. Properly assisting patients with disease self-management at home is a primary priority. Communication content analysis is a methodology for objectively and systematically studying the content of patient communication in various formats. This study analyzed the clinical data from a patient's hospitalization and the follow-up interviews through phone and clinical visits. The care process was recorded as a behavioral process. In view of the patient's lack of understanding of disease care and water intake, we used content analysis to continuously observe feedback, treatment plans, and actions in the care of the patient to understand her real needs. The results of this study provide a care model that integrates individual and family care activities to provide efficacious health management. The patient also aimed to adjust her original lifestyle. As a result, the patient developed a better understanding of the disease and, thus, improved management of the disease.

Key words: Heart failure, Content analysis, Self-management

Introduction

Heart failure is defined as failure of the heart's blood output to meet the body's needs, which leads to compensation disorders [1]. Chronic debilitation and acute deterioration of the heart often bring heavy stress to patients and their families. Patients at any stage could be threatened with sudden death. Researchers have pointed out that physical symptoms, such as sleep quality, fatigue, respiratory discomfort, and appetite changes, after discharge from the hospital are the main factors affecting the quality of life of patients [2]. The symptoms of heart failure often prevent them from carrying out daily chores at home or participating in normal social activities, which further results in melancholy reactions [3,4]. Studies have shown that self-management programs have a positive impact on self-care in heart failure patients.

Self-care programs not only reduce patients' symptoms but also reduce hospital admissions and the number of days staying in a hospital. In addition, they decrease readmission rates and even improve the life quality. Program case management includes self-monitoring of heart failure symptoms (edema, urine volume, and weight changes), smoking cessation, alcohol withdrawal, taking medications regularly, eating a low-cholesterol diet, and participating in moderate regular exercise [5,6].

With onset of the illness, cooperation with taking

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medical prescriptions is crucial to efficiently control a hospitalized patient's condition. By reviewing the results of clinical examinations and performing a physical examination, the nursing staff can understand the patient's condition. When the patient's condition has been stabilized, they can interview the patient to determine their understanding of the disease.

In this study, we collected complete information about the self-care ability of a patient. The content analysis method was used. The method of content analysis is a classification system in that the disease care is classified into health cognition, symptom identification, physical assessment, and clinical examination data. In addition, content analysis serves as an efficient way for the nursing staff to systematically identify the health care that patients require.

Content analysis is especially suitable for management of patients with heart failure. The reason is there are a wide variety of factors influencing the condition of patients with heart failure. To effectively control their disease, it is of importance to sort out related information and to recognize care related problems. The method of content analysis can deal with issues about the collection of information and the recognition of problems. Thus, the content analysis method was applied in this study to assess self-care issues of a patient with heart failure.

This study performed qualitative analyses from theoretical and practical perspectives to generate data that are informative and useful in practical applications. We describe how content analysis concepts such as unit of analysis, meaning unit (i.e., health cognition, symptom identification, physical assessment, and clinical examination data), category (i.e., nurse evaluation, plan, action, patient evaluation), and theme are used. Researchers observed and analyzed a patient's practical experience. The objectives of a patient's action were identified through exploration and personalized continuous monitoring as well as feedback. Finally, the researcher modified the care process in order to achieve the most appropriate care plan [7,8,9].

Case Description

Based on personalized guidelines, this study applied interview analysis in a clinical care setting. First, the present health condition of the patient was determined. Second, clinical data, including symptoms and physical assessment, and laboratory data were examined. Third, consent of the subject was obtained to participate in the self-management process. The aim was to improve self-management care in heart failure patients.

Present illness

The subject was a 71-year-old married woman who only had a primary school education. She lived with her family, which included her husband, the eldest daughter, one son, one daughter-in-law, and three grandchildren. The subject was usually responsible for the daily meals of the entire family. The subject also had responsibility for the three grandchildren's transportation to school in the morning and back home after school. The subject's husband was her primary caregiver when she was hospitalized. The subject had diabetes, high blood pressure, and arrhythmia for about 10 years. Due to these conditions, she was continuously followed up in the clinic for a long time.

Clinical data

After several days of experiencing chest tightness, breathing difficulties, and lower limb edema, the subject came to our hospital for emergency treatment on April 16, 2019 due to worsening symptoms. X-ray examination showed two-sided pleural effusion and electrocardiography (EKG) indicated atrial fibrillation. The heart ultrasound ejection fraction was 65%. B-type natriuretic peptide was 896 pg/ml. Low-density lipoprotein was 138 mg/dl. Glycated hemoglobin (HbA1c) was 6.3%. After examination, the subject was assessed as having heart failure with pleural effusion and atrial fibrillation with a rapid ventricular response. The subject was admitted to the hospital in the Department of Cardiology. During hospitalization, the subject received medication and oxygen treatment. She was discharged on April 20, 2019 after an assessment by a physician. The follow-up was continuously recorded as telephone and outpatient interviews. Vital signs and weight were continuously monitored. Medical records showed the following:

During the hospitalization, the researcher obtained consent of the subject to implement an action plan to participate in a self-management process as follows in Table 1 and Table 2.

	Pulse Rate	BP(mmHg)	RR	SaO2(%)	BW(kg)	I/O
4/16	99	131/89	24	95(room air)	59.5	-
4/17	105	130/95	22	98(O2)	59	-443
4/18	99	129/88	18	99(room air)	57.2	+200
4/19	88	118/75	18	96(room air)	56.75	-1256
4/20	94	108/67	16	97(room air)	55.2	-
4/29	72	108/72	16	-	54	-
5/20	86	118/72	16	-	54	-

Date	chest x-ray	EKG	Cardiac echo	Lung Function	Date	LDL	Bun	Cr	Na	K
4/16	Bilateral Pleural Effusion	AF	-	Normal	4/16	138	16	0.68	138	4.4
4/17	-	AF	EF(%): 65	-	4/20	-	12	0.76	141	2.6
4/19	Improvement of Bilateral Pleural Effusion	-	-	-	5/17	-	-	-	141	4.1

AF: Atrial fibrillation; EF: Ejection friction

Results

We performed the basic steps in content analysis, including patient data collection (i.e., health cognition, symptom identification, physical assessment, and clinical examination data), data confirmation by the patient and family, analysis unit identification and establishing category units (i.e., nurse evaluation, plan, action, and patient evaluation).

Our results indicated that the problems for patient self-care and treatment vary depending on the disease's stage and level of knowledge of heart failure. According to a category analysis, shown in Table 1 and Table 2, we developed a nursing care plan. The patient's symptoms at hospitalization were consistent with the literature in which the breathing difficulties and lower limb edema caused by fluid build-up with heart failure cases were important reasons for hospitalization [2,10].

After returning home from the hospital, the patient still felt that her physical condition was unstable. She also had problems eating and sleeping. The patient's symptoms were consistent with a previous study [2] in that physical symptoms such as sleep, fatigue, respiratory discomfort, and changes in appetite were the main factors affecting the quality of life. This study employed the content analysis method in order to help professionals conduct case management in the nursing process that is informative and useful in care applications.

The patient and her family were familiar with adequate water intake, weight recording, and walking exercising for cardiac rehabilitation. The relief of life-threatening symptoms, stable control of body weight, and family support made our patient willing to accept healthcare knowledge about physical strength, daily living, and illness awareness and have the motivation to make progress.

The patient started to follow the doctor's orders and took her medication on time. The patient frequently monitored her blood pressure, skin moisture, and weight changes. It is known that when heart failure patients return home, the care cannot be as regular as in the hospital.

Finally, the patient was able to adjust her daily activities according to moderate progression in her physical condition. The patient's disease course and self-care gradually improved. A patient's understanding of the disease and confidence in the treatment can affect the execution of self-care [3]. Our patient's progression also echoed studies that showed self-management programs have a positive impact on self-efficacy in heart failure cases [5,6].

Conclusion

Although we only applied content analysis interview methods to a single case, nursing case managers aim to develop a nursing process to assist professionals in collecting patient health problem data.

Table 1. Health issue one: Insufficient knowledge/lack of awareness about water intake and heart disease

Content Analysis: Symptoms and Body Weight	"I felt chest stuffing and difficulty breathing at home in the past two days. I thought that I needed oxygen and didn't feel well so that I came to the hospital." "I felt tightness on my feet and the feet's skin looks shinny. I didn't know that is was edema that can cause wheezing." "My diabetes doctor told me that taking too little water might lead to inefficient metabolism. That is why I kept drinking water." Patient's lower extremity edema was ++ and she weighed 65 kg.
Nurse Evaluation	The patient lacks knowledge about the symptoms of heart failure; therefore, she is unaware of changes in breathing difficulties.
Plan	The patient needs to improve her knowledge of heart disease and improve her ability to take care of herself.
Action	Nurses should use the healthcare booklet to provide information to the patient and her family regarding the symptoms of heart failure. Therefore, she will become familiar with adequate water intake and difficult cardiac rehabilitation.
Patient Evaluation	The patient chiefly identifies the symptoms of heart failure and observes edema by touching the end of her feet. Nurses continuously phone track the patient's water intake and heart rehabilitation (i.e., living activity and regular exercise).
Content Analysis: Water Intake	"Everyone told me that I couldn't drink too much water. So, I took water by licking, not drinking."
Nurse Evaluation	The patient is confused about how much water she should be drinking. She was encouraged by the diabetes doctor to take more water but also was asked to limit water intake because of edema. The patient is often afraid to take too much water, which leads to body fluid accumulation that further causes breathing difficulties. As a result, she worries about water intake and does not know how much water intake is adequate.
Plan	We showed the patient how to measure water intake.
Action	1. We discussed a plan with the patient and developed a customized self-monitoring form for heart failure, including drug intake, weight, blood pressure, heart pulse, and edema. 2. The patient uses a measurable bottle for daily water intake of 1,000 ml. 3. The patient made a promise to measure her weight at 6 o'clock every morning.
Content Analysis: Control of Water Intake and Body Weight	"I take medication, measure my weight and blood pressure, and check if my feet are swollen every day." "My daughter gives me one bottle of water every day. So, I know the amount of water I should take and I don't have to worry about drinking too much." After one week, the patient did not have lower extremity edema and weighed 60–61 kg.
Nurse Evaluation	The patient was able to measure her daily water intake gradually. The chest X-ray on April 16 indicated pleural effusion on both sides of the chest. Lasix 20 mg/2 ml/amp b.i.d. IV was ordered for her treatment. Follow-up chest X-ray on April 19 indicated improvement in pleural effusion. The patient was discharged on April 20 with prescribed medications of aldactone 25 mg/one tab b.i.d. po. A return visit on April 29 shows no need for diuretic medications.
Action	Providing the patient with positive encouragement on managing daily water intake and weight recording and performing follow-up evaluation at a return visit.

Through the process of recording data, problem classification, and application of clinical information, patients and their families can be assisted and self-care of heart failure can be managed.

Healthcare personnel have routinely provided healthcare booklets to patients as an attempt to education them with updated healthcare knowledge. However, because of the heavy burden of clinical work, healthcare personnel do not have time to check whether patients really understand the contents of the healthcare booklets and properly follow instructions at home.

Content analysis is a revolving practice of continuous observation, planning, action, and reflection. It is a great tool for determining whether patients are doing well at home. We therefore implemented the interview content for the treatment planning of one heart failure patient. In the beginning, we found

Table 2. Health issue two: Insufficient behavioral compliance/Insufficient compliance with cardiac rehabilitation

Content Analysis: Daily Living and Illness Awareness	"My heart failure really disturbs my daily life, including diet and sleep. I feel too tired to cook or even chat with a neighbor."
Nurse Evaluation	Disease symptoms affect the patient's daily physical and social activities.
Plan	Improve the patient's awareness of heart rehabilitation to help with daily activities and following medication orders.
Action	1. Refer to the rehabilitation team to jointly develop a cardiac rehabilitation plan. 2. We discussed with the patient and developed a customized self-monitoring form for heart failure, including blood pressure, pulse, movement patterns, and daily workout frequency. 3. We made a workout plan for the patient. She gradually increased 5–10 minutes of walking exercise every two days based on the principle of no discomfort such as chest tightness or wheezing.
Content Analysis: Heart Rehabilitation	"I forced myself out to walk about 10 minutes and I didn't walk too fast." "The eldest daughter and daughter-in-law take time off to bring the children to school or cook meals at home. I'm really thankful!" The patient returned to the follow-up outpatient clinic with a fully-filled out daily record of the "heart failure self-monitoring form."
Nurse Evaluation	The patient is gradually adjusting due to walking exercises and the family's help, but still dares not go for too long due to concerns about her physical condition.
Action	Arrangements were made for family members to accompany the patient to discuss and evaluate her cardiorespiratory endurance again with the outpatient rehabilitation team. The patient feels positive and supported by the family encouragement.
Content Analysis: Awareness of Physical Strength	"My physical strength is much better and I can go to the market or walk for 20 minutes." "It is common to feel fatigued when people get old. As long as the patient follows the doctor' instructions, everything will go well."
Nurse Evaluation	After the patient developed heart failure, she had the whole family's support and gradually adjusted her daily role in her family. Relief from life-threatening symptoms lets the patient return to normal life with progressive exercise. Accumulating self-confidence as a result of the progress increases the patient's ability to control the disease.

the patient's awareness of the disease and self-care was inadequate. The patient did not understand the health information that she received from the hospital and did not follow medication orders.

Then, we constantly observed, planned, and reflected on the patient's condition. With our intervention, the patient was able to continuously resolve the main problems that she had and achieved appropriate goals. Because of the complexity of an individual's environmental and social interactions, it is impossible to meet all patients' needs with a fixed self-care protocol. Therefore, an individualized care plan with follow-up to ensure the patient's understanding and execution of the medical suggestions plays an important role in the successfulness of the treatment.

Our study showed that content analysis is an excellent tool to achieve that goal. We suggest hospitals conduct continuous follow-up to ensure the outcome of self-management for an individual case. Our study showed that patients can avoid heart failure recurrence and readmission when the case manager truly tracks progress through health education.

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Case Report

Ectopic Pancreatic tissue of Stomach: Pathology, Endoscopy, Endoscopic Ultrasonogram and Abdominal CT Findings

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Abstract

We present an intresting case of heterotopic pancreas(HP) of the stomach in the posterior wall of antrum in a 60-years old female. The endoscopy, endoscopic ultrasonogram (EUS) and abdominal CT showed typical characteristics and with some vaiable appearances of this gastric lesion. The preoperation differential diagnosis includes gastrointestinal stromal tumor, leiomyoma, schwannoma and ectopic pancreatic tissue. The patient underwent laparoscopic wedge rsection. The frozen section and final pathologic diagnosis all confirmed ectopic pancreatic tissue. We also discuss the characteristics in correlation of the pathology with endoscopy, EUS and abdominal CT findings.

Key words: Heterotopic pancreas(HP), Endoscopic ultrasonogram(EUS).

A 60-years old female had history of gastric benign tumor for six years. Endoscopic gastric biopsy showed benign lesion in two hospital. She suffered from epigastric fullness in recent one month, so she went to our out patient department and asked for prophylactic operation. She was admitted to our ward for preoperation study. The admission rountine examination including physical examination, laboratory data, abdominal ultrasound were all unremarkable. On endoscopic examination showed one small submucosal bulging mass with central depressed lesion located in the gastric antrum of posterior wall and measuring about 2 cm in dimension. (Fig 1).

The endoscopic ultrasonogram showed a 2.7 x 1.2 cm tumor, arising from 2nd to 4rd layer with mixed echo pattern (Fig 2). Biopsy was not performed. The bdominal constrast-enchanced CT showed a flat-ovoid shape submucosal cystic tumor (2.5 x 1.5 cm) located at pocosterior wall of gastric antrum with endoluminal growth pattern and an ill-defined border tubular-like hypoenchanced area in anterior part of tumor (Fig 2).

The preoperation differential diagnosis includes gastrointestinal stromal tumor, leiomyoma, schwannoma and ectopic pancreatic tissue. The patient underwent laparoscopic wedge resction. Intraoperative frozen sections revealed a yellow color, soft, irregular margin and cystic tumor mass in the submucosal layer measuring around 2 x 1.5 cm(Fig 3) and confirmed the diagnosis of ectopic pancreatic tissue.

Microscopically examination of the cystic lesion showed heterotopic pancreatic tissue in the submucosa with a lobular pattern of ectopic pancreas. The pancreatic tissue was located mainly in the gastric submucosa (Fig 4) and focal in the muscularis mucosa layer (Fig 4) consisted of pancreatic ducts and acini tissue but absent the islets of Langerhans. The overlying gastric mucosa showed superficial erosive gastritis. This confirmed a gastric ectopic pancreatic tissue.

The firstt case of heterotopic pancreas(HP) report was Jean Schultz in 1727. The Incidence of HP in autopsies finding is around 0.6–13% o [1] But in gastrectomy study of 105 cases in one center with five years period, HP was found in only one case (1/105, 0.9%) [2]. The median age was 49 years (range form

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14-82) with female predominance (male/female ratio, 0.94) [3]. The usual symptoms are non-specific including nausea, vomiting and abdominal epigastric pain. The possible explanation of pain is due to endocrine hormones and exocrine enzymes secretion induced.

The complicaitons of HP also includes the haemorrhage, erosion, ulcer and perforation. Even perforation may foundin the small intestine [2] Malignant transformation of the HP in the stomach may occur. Only 15 cases in the stomach have been reported [4].

In the gastroscopy showed a broad based umbilicated submucosal lesion that corresponds to a draining duct of HP tissue [4] Our present case, the endoscopy showed submucosal bulging mass with central depressed lesion (Fig 1). Endosocpic biopsy are superficial and usually non diagnostic. Endoscopic ultrasonography (EUS) has typical finding which shows in the submucosa, ranging 0.5-2 cm lesion [2], and a homogeneously hypoechoic lesion in the third and fourth layers. EUS fingins showed such as indistinct borders, lobulated pattern, presence of anechoic duct-like appearance increase the possibility of HP [5]. Our present case, the EUS showed the gastric lesion arising from 2nd to 4rd layer with mixed echo pattern (Fig 2).

CT examination that may help differentiate pancreatic rests from other submucosal lesions identified in one study, included: A. A flat-ovoid shape (long diameter to short diameter ratio >1.4), B. Lesion in the gastric antrum or pylorus, and duodenum, C. An endoluminal growth pattern, D. An ill-defined border and E Prominent enhancement of the overlying mucosa. The study showed that the presence of at least two of the above findings had a sensitivity of 100 percent and a specificity of 82.5 percent for HP diagnosis in the upper gastrointestinal tract. The specificity increased to 100 percent if three of the above findings were present [6]. Our present case, the abdominal CT showed typical finding (Fig 2). The HP location in order is stomach (97; 52.7%) and small intestine (48; 26%) [3].

Grossly, HP diameter measured less than 0.5 cm (35.3%), 0.6 to 1 cm (34.8%) and, larger than 1.1 cm (29.9%) [3]. On cut surface, HP lesion lke normal pancreas with soft tot firm, yellow color,

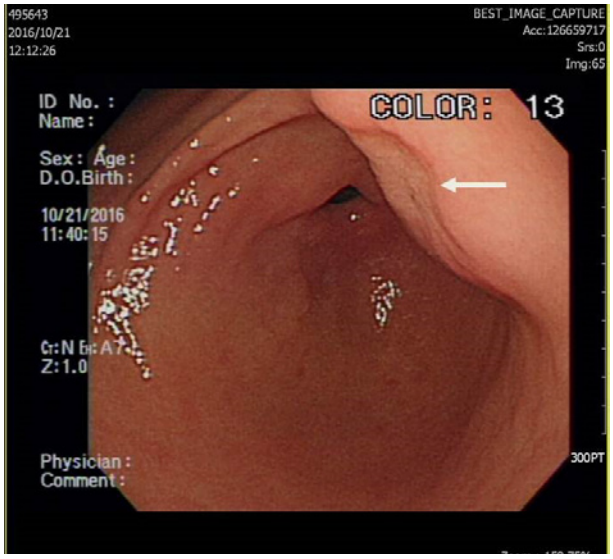

Fig. 1 Endoscopy showed one small submucosal bulging mass with central depresed lesion located in the posterior wall of the gastric antrum measuring around 2 cm in diameter (arrow).

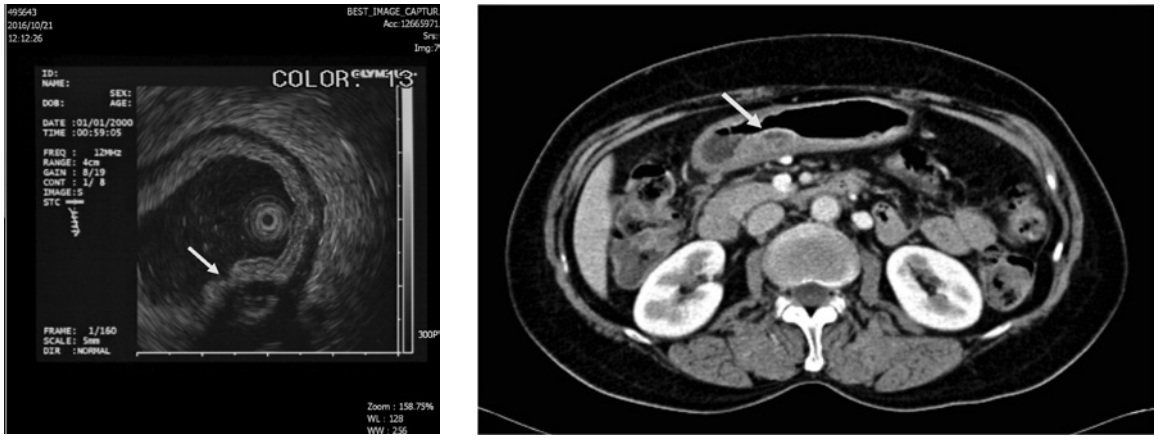

Fig. 2 (Left): The endoscopic ultrasonogram showed a 2.7 x 1.2 cm tumor, arising from 2nd to 4rd layer with mixed echo pattern (arrow). (right): The abdominal CT showed a flat-ovoid shape submucosal tumor (2.5 x 1.5 cm) in the posterior wall of gastric antrum with intraluminal growth pattern, an ill-defined tubular-like hypoenchanced area in anterior part of tumor (arrow).

well-circumscribed, lobulated pattern with cystic change (central ductal orifice) [3]. Our present case had typical gross finding (Fig 3).

Micoscopical examianiton, the gastric HP involved the submucosal layer (73%), muscularis (17%) and subserosal layer (10%). Our presented case the pancreatic tissue involved both the submucosa and muscularis mucosa (Fig 4).

Fig. 3 Grossly, a yellow color, soft, irregular margin, cystic tumor mass in the submucosal layer measuring around 2 x 1.5 cm.

Histologically, HP has been classified into three types by Heinrich in 1909 [7]. Type I shows the presence of ducts, acini and islets of Langerhans cells (commonest), Type II shows ducts and acini, and Type III has only ducts. The definition was later modified by Gasper et al. [8] Type I had ducts, acini and Langerhans cells (complete heterotopia), and like normal pancreas, Type II had ducts only (canalicular heterotopia), Type III showed acini (exocrine pancreas) and type IV islets (endorine pancreas). Our Present case showed mixed ducts and acini (Fig 4), and to be identical with Heinrich's type II + type III. Malignant change of the gastric HP may rarely occur.

Only 15 cases have been reported so far [4] .Guillou et al. proposed the fulfillment of three criteria is necessary to conclude a malignancy has arisen from an ectopic pancreas: 1) the tumor must be within or near the ectopic pancreatic tissue; 2) a direct transition between the pancreatic structures and carcinoma must be present; 3) the non-neoplastic pancreatic tissue must be fully developed and must contain well developed acini and ductal structures [9].

In conclusion, in this present case, we has preoperative accurate diagnosis including gastroscopy, EUS, CT examinations, and intraoperative frozen section diagnosis.

Therefore, it is important for gastric HP to establish a standard pattern of examination and treatment.

The patient agreed to publish this article.

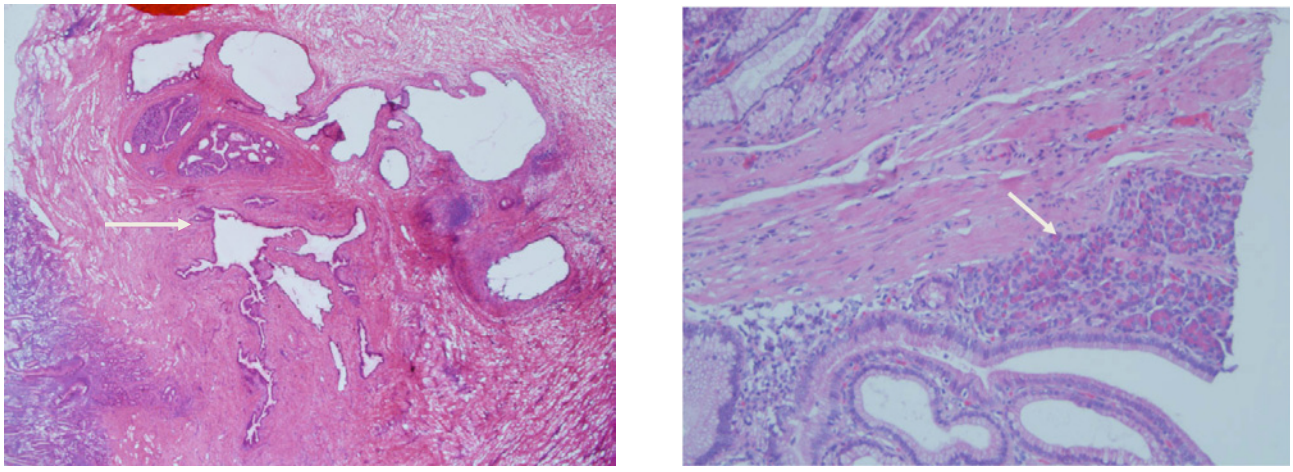

Fig. 4 (left): Nuermous pancreatic ducts with cystic dilatation mixed some acini in the submucosal layer(Frozen section, H &E stain x 40). (right): Some pancreatic ducts with pancreatic acini tissue located in the muscularis mucosal layer(H &E stain x 200).

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Image

Neonatal Meconium Plug Caused Severe Proximal Small Bowel Dilatation and Made A Misinterpretation of Pneumoperitoneum

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Abstract

There is a high mortality rate for infants with visceral perforations. Clinical imaging of this condition includes free air in the abdomen with abdominal plain radiography or lateral decubitus radiographs. An important disease that is easily ignored in the perinatal period is meconium plug syndrome, which causes functional obstruction in the colon that leads to dilated bowel loops in abdominal plain radiography. We report a female newborn who had a suspected bowel obstruction during prenatal examination because of polyhydramnios. The initial plain abdominal film showed a large volume of air accumulation in the peritoneum. An emergent exploratory laparotomy was performed and it revealed that there was no free a3 ir nor ascites in the peritoneal cavity. The proximal small bowel was severely dilated and a meconium plug at the splenic flexure was found. The image of air in the patient's small bowel and peritoneal cavity in the anterior–posterior view and image of the left decubitus view of the abdomen were similar in this case to the degree that the clinicians could not differentiate them, leading to an unnecessary exploration laparotomy.

Key words: Pediatrics, Pneumoperitoneum, Meconium plug syndrome, Abdominal plain radiography

We report the case of a female infant with gestational age of 36 weeks and birth body weight 2,950 g. The prenatal examination showed polyhydramnios at the gestational age of 28 weeks, and a scheduled cesarean section was arranged as a result. The appearance, pulse, grimace, activity, and respiration score at 1 to 5 minutes was 7 to 8. After a smooth delivery, the newborn was transferred to the sick baby room.

Physical examination revealed minor facial dysmorphism, mild up-slanting eyes, epicanthal folds, protruding tongue, mild subcostal retraction, bilateral coarse breathing sounds, mild distended abdomen, hyperactive bowel sounds, no hepatosplenomegaly, and no abdominal mass palpable. Vital signs showed a body temperature of 36.6°C, pulse rate of 136 beats per minute, respiratory rate of 46 breaths per minute, and blood pressure of 74/46 mmHg. Laboratory studies showed the white blood count was 21,450/μL, hemoglobin was 16.1 g/dL, platelet level was 259,000/μL, neutrophilic segments were 45%, lymphocytes were 28%, monocytes were 1%, and eosinophils were 5%. The high sensitivity C-reactive protein level was lower than 0.02 mg/dL.

The plain abdominal film showed large volume air accumulation and suspected pneumoperitoneum (Figure 1). Therefore, an emergent exploratory laparotomy was performed. However, the operator did

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not observe any evidence of free air and ascites within the peritoneal cavity. However, they found a severely dilated proximal small bowel and a meconium plug at the splenic flexure. The pediatric surgeon released the small intestine with segmental resection and end-to-end anastomosis. The meconium plug was squeezed out of the bowel, and the distal intestinal patency was checked with normal saline instillation from the distal atresia site. She had no family history of cystic fibrosis. After the operation, she recovered gradually and tolerated oral feeding on the 12th postoperative day and was discharged on the 18th postoperative day. A follow-up plain abdominal image showed no abnormal findings.

To the best of our knowledge, we are the first to report meconium plug syndrome based on images obtained with plain abdominal film, which is a very rare presentation. Fetal structural or chromosomal abnormalities are the most common causes of polyhydramnios' cases. It is therefore crucial to check the structural formation of the patient's bowel with radiographic investigation. Meconium plug syndrome is very difficult to diagnose during the fetal stage. Imaging with plain abdominal film is the first choice, however, the image is always nonspecific in patients with this problem [1].

Pneumoperitoneum results from visceral perforation in approximately 85%-95% of patients with this sign [2]. The mortality rate in infants with visceral perforation has been shown to be 16.7%. Therefore, most clinicians regard the signs of pneumoperitoneum as an emergency and take proper and timely actions for patients with this condition [3].

Our case illustrates that the diagnosis of visceral perforation should be based on a correlation between the radiograph and the clinical presentation. When the patient shows no evidence of unstable vital signs, peritonitis or sepsis, conservative management is preferred.

It is preferrable to wait and observe whether the patient passes the meconium within the first 48 hours of life.

A subsequent abdominal X-ray or abdominal computerized tomography scan is helpful to confirm the diagnosis if a visceral perforation is still highly suspected.

Informed Consent Statement:

The parents of the patient agreed to anonymous publication of the data.

Conflicts of Interest

The author has no conflicts of interest relevant to this article.

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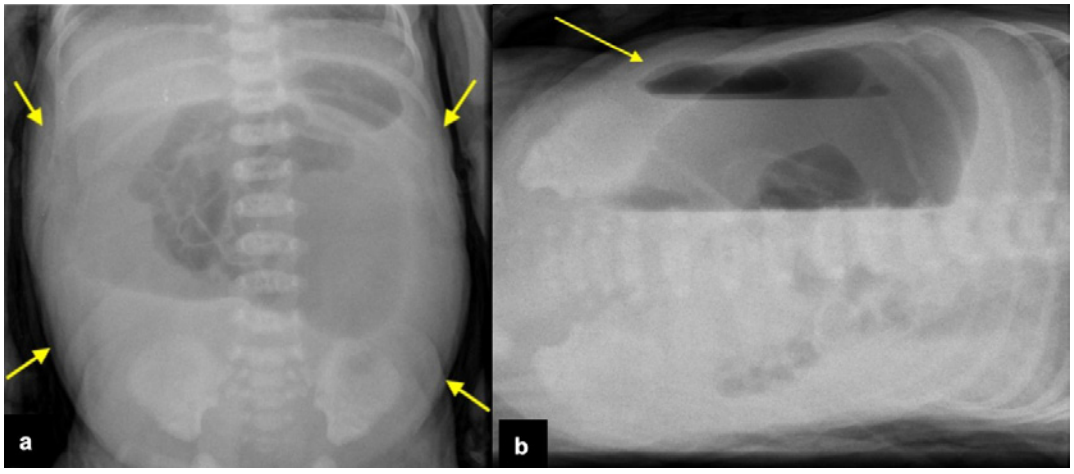

Fig. 1 (A) Plain abdominal view showing a large area of air density over the central abdominal area (short arrows) that is suspicious of pneumoperitoneum. (B) Left lateral decubitus showing lower density free air (arrow) in the abdominal cavity.

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Manuscript should be double-spaced, line number, numbered pages, and comply with the “uniform requirements for manuscripts submitted to biomedical journals”. The first page is the title page, which include title, name of author(s), organization and unit, contact name, phone number, e-mail address and mail address. The second and the third page is for abstract and key words (please include 3 to 5 keywords or phrases), and should be written in paragraphs following by background and purpose, methods, results and discussion.

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magazines but not published yet, please note the name of magazine, year and note “in press”.

Original researches, case reports, review articles, communications (includes brief communications), images in clinical medicine, editorial follows the following format:

1. Abbreviations used should follow the format of Index Medicus for all journal titles. When authors are less than 6 people, list all author(s), when more than 6, only list the first 6 followed by “et al.” for the rest.
2. References in the text should be placed where relevant. When a reference article is cited, only the primary author is cited; however, if only two authors are present, both should be listed.
3. Citation should show as [numbers] and use Superscript mark.

Examples of Reference:

1. Periodicals:

   Yang KTA, Chen HD: A semi-automated method for edge detection in the evaluation of left ventricular function using ECG-gated single-photon emission tomography. Eur J Nucl Med 1994;21:1206-11.

2. Monographs:

   Plum F, Posner JB: Diagnosis of Stupor and Coma. 3rd ed. Philadelphia: Davis, 1980:132-3.

3. Monographs with multiple authors:

   Levinsky NG: Fluid and electrolytes. In: Thorn GW, Adams RD, Braunwald E, Isselbacher K, Petersdprf RG eds. Harrison’s Principles of Internal Medicine, 8th ed. New York: Mcgraw-Hill, 1977:364-75.

4. References from website

   Please indicate the title, source, and the retrieving date

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童綜合醫學雜誌投稿相關規則

95.9.01 製訂
110.06.23. 修訂（第 13 版）

童綜合醫學雜誌線上投稿暨評閱系統：http://www.ipress.tw/J0143。本雜誌刊載與醫學有關之論述，包括原著論文（Original Articles）、病例報告（Case Reports）、綜論（Review Articles）、短論（Communications、包括 Brief Communications）、影像判讀（Images）、臨床病理討論（Pathology Page）、編著的話（Editorials）等。惠稿請送 43503 臺中市梧棲區臺灣大道八段 699 號童綜合醫學雜誌編審委員會。（E-mail:Tungs_Journal@ms3.com.tw）

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1. 惠稿請以英文撰寫，本雜誌接受電子檔投稿或經由線上投審稿系統：http://www.ipress.tw/J0143 投稿，電子檔投稿請直接將稿件 WORD 檔寄至編審委員會信箱：Tungs_Journal@ms3.com.tw。
2. 著作中若牽扯到版權所有之內容，作者需取得其使用權，法律責任由作者負責。
3. 投稿同時請附上著作權讓與同意書。所有作者必須實際參與並同意該論述。本院於接受稿件且印刷完成後，將致贈稿酬並贈送 20 份抽印本給通訊作者，如需額外抽印本請於校稿時言明，並酌收成本費用。第一作者若需抽印本可提出申請，依份數酌收成本費用。
4. 本刊對於原稿經徵得作者之同意得伸縮或修改之。如不合本刊宗旨者，得退還之。
5. 凡刊載於本雜誌之著作，若涉及「研究用人體檢體採集」及「人體試驗」等情事，應遵守該注意事項。除不須 IRB 審查之細胞、細菌、動物實驗外，回溯性研究、資料庫分析、問卷量性研究等皆須於文章中註明 IRB 編號〔需含機構名稱〕；病例報告及影像判讀等文章需取得病人知情同意並於內文註明，以落實保障受檢人權益。
6. 論文中如涉及使用脊椎動物進行科學應用計畫者，應檢附該計畫業經所屬機構動物實驗管理小組審議認可之文件，以落實實驗動物之人道管理。

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1. 原著論文（Original Articles）按下列順序撰寫：摘要、前言、材料與方法、結果、討論與結論、誌謝、參考文獻、附表、圖片說明、圖片（含照片）。每篇字數 3000 字以內，摘要 300 字以內，參考文獻 40 篇以內。
2. 病例報告（Case Reports）按下列順序撰寫：摘要、前言、病例、討論、參考文獻、附表、圖片說明、附圖、照片。凡病患顏面部位之相片必須遮去眼睛部位，表示尊重隱私。診療資料或臨床經過之圖表，原則上均限六個月以內。每篇字數 1500 字以內，摘要 150 字以內，參考文獻 10 篇以內。
3. 綜論（Review Articles）不必按原著論文格式撰寫，但每篇字數 3500 字以內，摘要 300 字以內，參考文獻 60 篇以內。
4. 短論（Brief Communications），臨床上、技術上的精簡論著，每篇字數 750 字以內，摘要 150 字以內，參考文獻 7 篇以內。
5. 影像判讀（Images）、臨床病理討論（Pathology Page）圖例說明每篇字數 500 字以內，摘要 150 字以內，參考文獻 3 篇以內。
6. 編者的話（Editorials），每篇字數 2000 字以內，摘要 150 字以內，參考文獻 7 篇以內。
7. 其他細節，請參閱國際指導委員會（International Steering Committee）發表之生物醫學雜誌稿件統一規格（Uniform Requirements for Manuscripts Submitted to Biomedical

Journals，見 The New England Journal of Medicine 336:309-315,1997）。

8. 將可接受投稿之稿件種類之摘要字數、字數、參考文獻及圖表相關上限規定，整理於下表：

稿件種類	字數限制		參考文獻	圖 / 表
	摘　　要	內文字數		
原著論文 (Original Article)	≦ 300	≦ 3000	≦ 40	≦ 5
病例報告 (Case Report)	≦ 150	≦ 1500	≦ 10	≦ 3
綜論 (Review Article)	≦ 300	≦ 3500	≦ 60	≦ 6
短論 (Brief Communication)	≦ 150	≦ 750	≦ 7	≦ 1
影像判讀 (Images)、 臨床病理討論 (Pathology Page)	≦ 150	≦ 500	≦ 3	≦ 2
編者的話 (Editorial)	≦ 150	≦ 2000	≦ 7	≦ 1

參、投稿須知

1. 稿件須符合「生物醫學雜誌投稿之統一規定」[1]，請以電腦隔行 double space 書寫，並編行號及頁碼，中文字型以標楷體，英文字型以 Time New Roman 12 號字大小，稿紙之左右緣爲 2.54 公分，上下緣爲 3.17 公分。
2. 第一頁爲標題頁，須列出中文及英文之論文題目、中英文作者姓名、所屬機構及單位之中英文稱號（分屬不同單位，請以阿拉伯數字標出作者與單位）、聯絡人姓名、電話及中英文通訊錄。
3. 第二、三頁爲中文及英文之摘要及關鍵詞（請提供 3 至 5 個關鍵詞或簡短片語），中英文摘要須完全相同，摘要分段撰寫，依序爲背景及目的（Background and purpose）、方法（Methods）、結果（Results）及討論（Discussion）。
4. 相同貢獻作者請加註說明，如研究主題的設定、參與決定研究設計、進行統計分析、詮釋研究結果、以及各章節撰稿等貢獻。
5. 圖表應專業製作，一張紙僅一個附圖或附表，依引用順序以阿拉伯數字標出排列。附表須有標題及說明且不可以照片形式。圖片或照片電子檔（.jpg）必須清晰、分明。附圖須有簡單說明（Legend），並另頁撰寫。光學或電子顯微鏡照片，請註明擴大倍率或比例。

註：[1] 根據「生物醫學雜誌投稿之統一規定」第五版，刊載於 Annals of Internal Medicine 1997;126(1): 36-47.

肆、參考文獻

未經發表之論文或摘要不得列爲參考文獻，但可於本文中說明並註明「未發表」（unpublished observations）。博碩士論文可引用。已被任何雜誌接受刊發但仍未發表之著作，請列出雜誌名稱及年份，並註明「in press」。

原著論文、病例報告、綜論、短論、影像判讀、臨床病理討論、編著的話按下列格式撰寫：

A. 雜誌及期刊

中文例〔作者姓名：題目。雜誌簡稱 年號；卷數：起訖頁數〕

薛玉梅、陳建仁：皮膚砷癌之流行性病學特徵與危險因子。中華衛誌 1996; 15: 1-26。

英文例〔英文原稿中引用的參考文獻，其雜誌或期刊之簡稱應參照 Index Medicus 型式〕

1. Feely J, Wilkinson GR, Wood AJ. Reduction of liver blood flow and propranonol metabolism by cimetidine. N Engl J Med 1981;304:691-6.

2. Kaplan NM. Coronary heart disease risk factors and antihypertensive drug selection. J cardiovasc Pharmacol 1982; 4(suppl 2): 186-365.（引用雜誌附冊時）
3. Tada A, Hisada K, Suzuki T, Kadoya S. Volume measurement of intracranial hematoma by computedtomography. Neurol surg (Tokyo) 1981; 9: 251-6.〔In Japanese: English abstract〕（引用文獻之作者之本文爲非英文，但有英文摘要）。
4. Bhasin S, Storer TW, Berman N, Callegari C, Clecenger B, Phillips J, et al. The effects of supraphysiologic doses of testosterone on muscle size and strength in normal men. N Engl J Med 1996; 335: 1-7.（作者超過 6 位時，只須列出前 6 位，其它以「等」(et al) 代替）

＊期刊若有「數位物件識別碼 (digital object identifier, DOI)」，則於文獻末。

＊＊內文文獻標示以中括號、數字、上標呈現。

B. 單行本：

中文例 [作者姓名：書名，版數（卷數）。發行地；出版公司，年代：引用部份頁數]。

楊志良：生物統計學新論，一版。台北；巨流圖書公司，1984：33-8.

英文例 [英文單行本的書名，除介系詞及連接詞外，第一字母需大寫]

(1) Plum F, Posner JB. Diagnosis of Stupor and Coma. 3rd ed., Philadelphia: Davis, 1980:132-3.

C. 多重作者之單行本：

中文例 [有關文章作者姓名：題目 。編輯者姓名：書名 。版數（卷數）。發行地：出版公司，年代；引用部份頁數]。

蔣欣欣：護理與健康。顧乃平：護理專業導論。一版。台北：匯華出版公司，1991：83-121。

英文例 Levinsky NG: Fluid and electrolytes. In: Thorn GW, Adams RD, Braunwald E, lsselbacher K, Petersdprf RG eds. Harrison’s Principles of Internal Medicine. 8th ed. New York: Mcgraw-Hill, 1977;364-75.

D. 參考文獻引用時，若兩名以下作者請列出姓氏。兩名以上則列出第一名之姓氏，其他以「等」(et al) 代替，並以阿拉伯數字方括弧表示於引用之後。

例：One of the first well documented reports of ECH poisoning with fatality in young children was reported by Miller et al. in 1970[2].

E. 參考文獻引用網路資料請列出文獻名稱及出處以及引用時間

(Accessed Month day, 2016, at http://www.house.gov/xxxx/min/inves_xxx/index_accord.htm.)

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