A case report and literature review of heterotopic mesenteric ossification

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A B S T R A C T

Introduction and importance: Heterotopic mesenteric ossification is a benign bony tissue growth in the mesentery that mostly follows repetitive or severe abdominal injuries leading to reactive bone formation in the mesentery. There are only 73 cases (51 publications) identified in the literature up to the beginning of 2020.

Case presentation: 45-year-old Saudi male underwent multiple laparotomies to manage complicated appendicitis which ended with a diverting ileostomy and a colostomy as a mucus fistula. After 9 months, the patient was admitted to the General Surgery department in Al-Hada Armed Forces Hospital for an open ileostomy and colostomy reversal surgery where several irregular bone-like tissues of hard consistency and sharp edges with some spindle-shaped structures resembling needles were found in the mesentery of the small intestine and histopathology revealed of trabecular bone fragments confirming the diagnosis.

Clinical discussion: The majority of cases occur mid to late adulthood with a predilection in the male gender, and usually present with bowel obstruction or an enterocutaneous fistula. Although it has no malignant potential, it may cause severe bowel obstruction that can lead to mortality, it’s a rare occurrence and, therefore, is difficult to diagnose among many common abdominal disturbances.

Conclusion: Here we report a rare case of heterotopic mesenteric ossification, which should be considered as one of the delayed complications of abdominal surgery or trauma. The time range of expecting the presentation of heterotopic mesenteric ossification following major abdominal trauma or surgery should be extended and continuously considered during differential diagnosis.

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1. Introduction

Heterotopic mesenteric ossification (HMO) is a benign bony tissue growth in the mesentery that mostly follows repetitive or severe abdominal injuries leading to reactive bone formation in the mesentery [1]. It is an abdominal catastrophe, and it requires multiple abdominal surgeries to manage. There are only 73 cases (51 publications) identified in the literature up to the beginning of 2020. The pathogenesis of the HMO is currently not well recognized, it is thought to be formed by the stimulation of mesenchymal osteoprogenitor stem cells to differentiate into osteoblasts due to mechanical trauma, ischemia, or intra-abdominal infection [2]. It is also assumed to be caused by implantation of bone periosteum into soft tissue [3].

The majority of cases occur mid to late adulthood with a predilection in the male gender, and usually present with bowel obstruction or an enterocutaneous fistula [4,5]. Although HMO has no malignant potential, it may cause severe bowel obstruction that can lead to mortality in already sick patients [6]. The usual time elapsed from the time of the predisposing trauma to operation ranged from 2 to 4 weeks. However, this might extend to 7 years after the initial insult [1]. Because HMO is a rare occurrence and, therefore, is difficult to diagnose among many common abdominal disturbances, here we present a case of a 45-year-old Saudi male with a typical HMO discovered 9 months after right hemicolecotomy in addition to a comprehensive literature review of similar published cases since it was first described in 1983 until 2020.

This work has been reported in line with the SCARE 2020 criteria [7].

2. Case presentation

A 45-year-old Saudi male presented to the emergency department of a local hospital in March of 2018 with a typical picture of acute appendicitis; he was admitted for an open appendectomy. Intraoperatively, they discovered a perforated appendix; histopathology revealed a severely inflamed perforated appendix. After 4 days, his first operation was complicated by a feculent discharge from the peritoneal drain due to a complicated cecal fistula with a septic clinical picture. He was admitted for an exploratory laparotomy, and segmental resection of the involved bowel with primary anastomosis was done. Two days after
the second operation, he had an anastomotic leak with peritonitis, and he had feculent discharge from the wound site and the peritoneal drain; he was shifted to the operating room for an exploratory laparotomy where a right hemicolectomy was done with primary anastomosis.

On the seventh day, and despite the two operative attempts, the patient had intraperitoneal dissemination of fecal material and generalized peritonitis for the third time; he was sent for an exploratory laparotomy where a diverting ileostomy and a colostomy as a mucus fistula was done.

The patient did not have any remarkable family history, he is medically free, not a smoker or alcoholic and doesn’t have any significant medical history.

After 9 months, the patient was admitted to the General Surgery department in Al-Hada Armed Forces Hospital for an open ileostomy and colostomy reversal surgery. His abdominal examination revealed a normal soft and lax abdomen with a right ileostomy and left colostomy openings. On admission to Al-Hada Hospital, his white blood cell count was $6.12 \times 10^9/l$, mostly lymphocytes ($3.27 \times 10^9/l$). His hemoglobin was $146 \text{ g/l}$, platelet count was $370 \times 10^9/l$. C-reactive protein (CRP) was $1.5 \text{ mg/l}$, erythrocyte sedimentation rate (ESR) was $15 \text{ mm/h}$. Carcinoembryonic antigen (CEA) was $0.9 \text{ ng/ml}$.

White blood cell count normal range is $4$ to $11 \times 10^9/l$, lymphocytes normal range is $0.1$ to $1.1 \times 10^9/l$. Hemoglobin normal range is $135$ to $180 \text{ g/l}$. Platelets normal range is $150$ to $400 \times 10^9/l$, C-reactive protein normal range is $0.0$ to $5.0 \text{ mg/l}$, erythrocyte sedimentation rate (ESR) normal range is $0.0$ to $10.0 \text{ mm/h}$, and Carcinoembryonic antigen (CEA) normal range is $0.0$ to $5.0 \text{ ng/ml}$.

Pre-operative abdominal computerized tomography (CT) with the contrast given intravenously, orally, rectally, and through the ileostomy. The axial CT view is shown in (Fig. 1). The coronal and sagittal CT views are shown in (Fig. 2).

Pre-operative abdominal CT insured a patent passage of the bowel. But the calcified densities and fat stranding opacities were thought to be related to post-operative changes. Intraoperatively, laparotomy under general anesthesia showed adhesions and several irregular

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**Abbreviations**

| Abbreviation | Description                      |
|--------------|----------------------------------|
| HMO          | Heterotopic mesenteric ossification |
| HO           | Heterotopic ossification         |
| CRP          | C-reactive protein               |
| ESR          | Erythrocyte sedimentation rate   |
| CEA          | Carcinoembryonic antigen         |
| CT           | Computerized tomography          |
| BMPs         | Bone morphogenic proteins        |

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Fig. 1. Abdominal computerized tomography (CT) with the contrast. (a) Axial view of the mesentery shows irregular dense calcified shadows (white arrow) not connected to the adjacent bowel surface. (b) Axial view shows ill-defined diffuse fat stranding opacities (white arrow).

Fig. 2. Abdominal computerized tomography (CT) with the contrast. (a) Coronal view of the mesentery shows diffuse focal fat opacification of the mesentery with intervening dense calcified densities (white arrow). (b) Sagittal view shows very thin dense shadows appear longitudinal in position (white arrow) with surrounding mesenteric focal stranding opacity at the site related to previous operations.
bone-like tissues of hard consistency and sharp edges with some spindle-shaped structures resembling needles were found on the mesentery of the small intestine (Fig. 3). All the bone-like tissues were carefully removed.

The bone-like tissues were examined histologically (Fig. 4). It showed trabecular bone fragments, suggestive of heterotopic ossification. Post-operatively, the patient was advanced slowly to a normal diet, and he improved gradually. The patient’s last follow-up was in January 2021; he showed complete recovery with no complications.

3. Discussion and conclusion

Heterotopic mesenteric ossification (HMO) was first reported in the literature in 1983, where three patients developed heterotopic mesenteric ossification after abdominal surgery [8,9]. Ectopic calcification is classified histologically into dystrophic calcification (where deposition of calcium happens without osteoblasts) and heterotopic ossification (which differs from dystrophic calcification by the presence of osteoblasts and lamellar bone) [2]. Before 1983, multiple reports of ossification in the abdominal wall due to scars from previous laparotomies were published, and in 1973 a theory was proposed to explain the pathogenesis of abdominal scars heterotopic ossification, which is the differentiation of multipotent embryonic cells [10]. The differentiation of multipotent mesenteric cells as a result of trauma or abdominal surgery can be applied in our case. To date, there is no strong evidence to prove this theory. Another theory was introduced in 1975 in which heterotopic bone formation of laparotomy scars was theorized to result from osteogenic cells deposition from bones adjacent to the scar [11]. Symphysis pubis or xiphoid process irritation during the vertical abdominal incision can lead to periosteal cell implantation, which can be supported by the fact that when horizontal and vertical incisions are made in one patient, the vertical incision is the one that develops calcification [12]. In our case, where the heterotopic ossification developed in the mesentery, this theory can be challenged due to the lack of pre-formed ossified bone around the mesentery.

HMO is extremely difficult to diagnose in patients presenting with abdominal pain and discomfort due to its rare occurrence and very low frequency worldwide. The diagnosis of mesenteric heterotopic ossification can be challenging: abdominal CT scans can help in identifying it preoperatively; however, the differentiation between dystrophic calcification, bone neoplasms, a leakage of contrast, foreign material, or extra-skeletal osteosarcoma from mesenteric heterotopic ossification can be difficult [13]. The only way to reach the definitive diagnosis is through excision and histopathological analysis [14].

We performed an extensive literature search of the Medline and Embase databases for articles published from 1983 up to 2020. No language restrictions were applied, and reference lists of all included studies were manually searched for other potentially eligible studies. We identified only 51 published case reports, including a total of 73 cases. One of whom was an 11-year-old child (Table 1). About (90%) of all the reported cases of mesenteric ossification were males, with a mean age of 48.38 ± 18.27; the most common presenting symptom was bowel obstruction (41%). About (16.4%) of the cases were discovered incidentally by imaging, while (13.7%) of the cases were discovered during surgery. Most (80%) of the reported cases had a surgical history of laparotomy, and (71.2%) of the ossification developed in the mesentery. Detailed statistical analysis of all reported cases is shown in (Table 2). The current case is in line with the majority of HMO cases, with a history of abdominal surgery that has preceded the formation of HMO.

The time that passed from the last surgical operation to the intra-operative discovery of HMO in the current case was 9 months. The time required for the formation and appearance of HMO clinical
symptoms is not exactly known but ranged from 2 weeks to 2 years [15]. Although HMO is rarely encountered, due to the increased cases reported in the last decade, it should be considered in the differential diagnosis in patients presenting with intestinal obstruction or if dense calcified shadows were observed on abdominal CT in patients who underwent previous abdominal trauma or surgeries.

Bone morphogenic proteins (BMPs) are multifunctional cytokines that are a part of the transforming growth factor-β family released from inflammatory cells at the site of inflammation, injury, wounds, or sepsis, and have been reported to stimulate the formation of abnormal cartilage and bone tissues [16,17]. BMP and its signalling were observed to be increased in experimental models of trauma-induced heterotopic ossification (HO); meanwhile, BMP antagonism has been shown to decrease HO expansion. Anticipated HO formation after abdominal surgical operations was prevented by the use of anti-inflammatory [18]. Interestingly, rapamycin, which decreases inflammatory signalling through inhibition of the mTOR mechanism of activation, was reported to alleviate HO formation [19]. Moreover, the levels of both local and systemic inflammatory markers were suggested to be increased in traumatic HO as there is a positive correlation between inflammatory cytokines levels and the likelihood of HO formation [20].

In our case, the patient was admitted with severe abdominal pain that reoccurred with each complication and necessitated multiple surgeries. This pain is sensed by substance P, a member of the tachykinin peptide family, that was demonstrated to transmit nociceptive sensation via primary sensory fibres to the spine and brainstem [21]. This substance P was demonstrated to increase and mediate BMP-dependent HO formation [22]. The serum level of substance P is elevated in HO patients, and serum from neurogenic HO mice was demonstrated to induce osteogenic transformation of mesenchymal progenitor cells in vitro [23].

Mesenteric ossification can recur after the removal of the mesenteric bony fragments surgically; calcium and alkaline phosphatase levels can predict the recurrence. If the patient had a low calcium level and a high alkaline phosphatase level, which might indicate an ongoing process of osteogenesis and an active osteoblast [2]. Our patient had normal calcium and alkaline phosphatase levels preoperatively (Fig. 5), suggesting that mature ossified bones has already been formed, which is confirmed by histopathology.

Among the 52 HMO cases presented in the literature, only five cases showed elevated levels of alkaline phosphatase, of which four cases presented 3 weeks after the predisposing trauma or surgery while the patient in the current case was admitted 9 months after the inciting operation. This might indicate the vast variation in the speed of the HMO pathogenesis from case to case, which might be attributed to the levels of inflammation during and after the surgeries, amount of released cytokine, and the ability of the body to control and adjust the orchestra of inflammation. Moreover, the pathogenesis of the HMO might be accelerated or delayed depending on the post-operative management of the case, as precise management through proper anti-inflammatory drugs might prevent or delay the pathogenesis course of the HMO. Additionally, the delayed formation of the HMO, as we encountered in the current case, might indicate the need for long-time management with continuous monitoring of the serum inflammatory cytokines even after the subside of the pain associated with the surgical operation as to continue controlling the inflammatory milieu to avoid delayed HMO formation.

4. Conclusion

In summary, here we report a rare case of HMO, which should be considered as one of the delayed complications of abdominal surgery or trauma. The time range of expecting the presentation of HMO following major abdominal trauma or surgery should be extended and continuously considered during differential diagnosis, especially when there is a history of previous surgery or trauma. Diagnosis of HMO should be based mainly on the characteristic radiographic findings without relying on the level of alkaline phosphatase, which is elevated only in the period of active osteogenic stag. Continuous monitoring and controlling of the inflammatory cytokines not only for a short time post-operatively but for an extended period may prevent or delay the HMO formation.

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Ethical approval

The study was approved by the Research Ethics Committee at Al-Hada Armed Forces Hospital and is available upon request from the corresponding author. (reference number, 19200).
Table 1

| Year | Authors | Age | Gender | Surgical History | Presenting symptoms | Site |
|------|---------|-----|--------|------------------|---------------------|------|
| 1983 | Hanes et al. [8] | 55 | Male | Coloprotectomy for severe ulcerative colitis | Bowel obstruction | Mesentery & omentum |
| 1989 | Lemeshov et al. [9] | 44 | Male | Laparotomy for small bowel obstruction | Bowel obstruction | Mesentery & omentum |
| 1992 | Yannopoulos et al. [24] | 63 | Male | Aortic bifemoral bypass & and two laparotomies | Bowel obstruction | Mesentery & omentum |
| 1999 | Wilson et al. [25] | 75 | Male | Repair of an abdominal aortic aneurysm | Bowel obstruction | Mesentery & omentum |
| 2000 | Marucci et al. [26] | 25 | Male | Laparotomy | Bowel obstruction | Mesentery & omentum |
| 2001 | Hakim et al. [27] | 50 | Male | Nephrectomy and left colon resection with a colostomy | Bowel obstruction | Mesentery & omentum |
| 2003 | Lai et al. [28] | 60 | Male | Emergent laparotomy with total colectomy and end ileostomy | Mass & discomfort in the peri-ileostomy region | Mesentery & omentum |
| 2004 | Bovo et al. [29] | 76 | Male | No Surgical History | Bowel obstruction | Mesentery & omentum |
| 2005 | Tonino et al. [13] | 39 | Male | Abdominal gunshot injury managed Laparotomy with partial resection of small bowel and colon, and construction of a temporary ileostomy followed by Laparotomy for enterocutaneous fistulae reconstruction of an umbilical hernia and cholecystectomy and Proctectomy | Bowel obstruction & mild renal failure | Mesentery & omentum |
| 2006 | Goullo et al. [30] | 26 | Male | Blunt abdominal Trauma followed by 50-cm distal ileum resections and a temporary ileostomy | Bowel obstruction | Mesentery & omentum |
| 2007 | Jacob et al. [37] | 26 | Male | Post Blunt abdominal trauma and Laparotomy for abdominal compartment syndrome, distal ileum and ascending colon were resected due to intestinal ischemia. | Bowel obstruction + peritonitis | Mesentery & omentum |
| 2009 | Vlachos et al. [38] | 42 | Male | Two Laparotomies due to massive hematemeses with total gastrectomy with a Roux-en-Y oesophagogaestroduodenal anastomosis | Uncontrollable septic fever, | Omentum |
| 2010 | Abensur et al. [39] | 67 | Female | Uterine leiomyoma removal | Dysuria, urinary incontinence and nocturia | Mesentery |
| 2011 | Hayashi et al. [40] | 40 | Male | Exploratory laparotomy twice for suspect intraperitoneal hemorrhage and small bowel resection | Bowel obstruction | Mesentery |
| 2012 | Shi et al. [42] | 39 | Male | Left hemicolectomy was performed for the treatment of descending colon adenocarcinoma | Bowel obstruction | Omentum |
| 2012 | Reynoso et al. [43] | 59 | Female | Complicated gynecologic laparoscopic oophorectomy, abdominal sepsis, multiple small-bowel resections, and skin grafting for an open abdomen | Persistent enterocutaneous fistulae | Mesentery |
| 2013 | Baker et al. [44] | 29 | Female | Abdominal gunshot wound managed by right hemicolectomy, right nephrectomy, Whipple procedure with pancreatic and duodenal resection, repair of inferior vena cava, and provisional ostomy in the midline abdominal wound | Bowel obstruction | Mesentery & omentum |
| 2014 | Androulaki et al. [31] | 74 | Male | Reconstruction of an umbilical hernia and cholecystectomy and Proctectomy | Bowel obstruction | Mesentery & omentum |
| 2015 | Kao et al. [32] | 60 | Male | Hartmann procedure with ileostomy for treatment of diverticulitis | Bowel obstruction | Mesentery & omentum |
| 2016 | Zamolyi et al. [34] | 43 | Male | Almost all had previous abdominal surgery | Bowel obstruction | Mesentery & omentum |
| 2017 | Como et al. [36] | 51 | Male | Abdominal gunshot injury managed Laparotomy and transverse colon resection with end colostomy, then re-explored again due to extensive necrosis then developed and abdominal fistula | Bowel obstruction | Mesentery & omentum |

(continued on next page)
Table 1 (continued)

| Year | Authors                  | Age | Gender | Surgical History                                                                 | Presenting symptoms                                      | Site                            |
|------|--------------------------|-----|--------|-----------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------|
| 2013 | Ioannidis et al. [45]    | 31  | Male   | Splenic, diaphragmatic, colonic, and small bowel injuries                        | No symptoms discovered                                   | Mesentry and Omentum           |
|      |                          |     |        | sustained in a motor vehicle collision, requiring partial colectomy             |                                                                 |                                 |
|      |                          |     |        | Spleenectomy and open cholecystectomy                                           | Esophagotracheal fistula                                  | Peritoneum                      |
|      |                          |     |        |                                                                                   | Bowel obstruction                                         | Mesentry                        |
|      | Jhanwar et al. [46]      | 25  | Male   | No Surgical History                                                              | Entero-cutaneous fistula                                  | Mesentry                        |
|      |                          |     |        | Intestinal resection due to perforated diverticulitis, then the                |                                                                 |                                 |
|      |                          |     |        | patient developed an enterocutaneous fistula                                   |                                                                 |                                 |
|      | Torgersen et al. [14]    | 11  | Male   | No Surgical History                                                              | No symptoms discovered                                   | Mesentry                        |
|      |                          |     |        | Intestinal resection due to perforated diverticulitis, then the                | Esophagotracheal fistula                                  | Peritoneum                      |
|      |                          |     |        | patient developed an enterocutaneous fistula                                   | Bowel obstruction                                         | Mesentry                        |
|      | Ma et al. [12]           | 53  | Male   | Emergency temporary ileostomy for the hemorrhagic Meckel's diverticula          | Discovered incidentally in the OR                         | Mesentry                        |
|      |                          |     |        | with anastomotic fistula following right                                         |                                                                 |                                 |
|      | Nabulyato et al. [47]    | 47  | Male   | Emergency cecectomy and loop ileostomy procedures for                         | Discovered incidentally in the OR                         | Mesentry                        |
|      |                          |     |        | peritonitis secondary to “spontaneous” sigmoid colon                           |                                                                 |                                 |
|      |                          |     |        | perforation                                                                      |                                                                 |                                 |
| 2014 | Honjo et al. [48]        | 88  | Male   | Abdominal aortic repair, followed by a second operation for an                 | Bowel obstruction                                          | Mesentry                        |
|      |                          |     |        | ileus tube insertion into the jejunum                                            |                                                                 |                                 |
|      | Caitlin et al. [49]      | 32  | Male   | Stab wound to the abdomen requiring exploratory laparotomy                     | Intermittent abdominal pain                                | Mesentry                        |
|      |                          |     |        | with small bowel resection                                                       |                                                                 |                                 |
|      | Obeid et al. [57]        | 36  | Male   | Bullet injury to the abdomen and multiple subsequent                          | Vague abdominal discomfort and foul-smelling discharge     | Mesentry                        |
|      |                          |     |        | laparotomies, complicated by a complex abdominal wall hernia                   | from abdominal wall defect                                 |                                 |
|      |                          |     |        | with enterocutaneous fistula                                                    |                                                                 |                                 |
|      | Nerus et al. [50]        | 64  | Male   | Blunt abdominal trauma, colectomy with primary anastomosis                     | Discovered incidentally in the OR                         | Mesentry                        |
|      |                          |     |        |                                                                                   |                                                                 |                                 |
| 2015 | Bakoš et al. [51]        | 30  | Male   | Four Abdominal Surgeries                                                        | No symptoms discovered incidentally by imaging            | Mesentry                        |
|      |                          |     |        |                                                                                   |                                                                 |                                 |
|      | Schiergens et al. [52]   | 34  | Male   | Colonic perforation with severe fecal peritonitis followed by a                | No symptoms discovered incidentally by imaging            | Facia and mesentry              |
|      |                          |     |        | Hartmann procedure                                                               |                                                                 |                                 |
|      | Christopher Vytlačil et al. [53] | 58 | Male   | Sigmoid colectomy for stage 2 colon adenocarcinoma                              | Bowel obstruction                                          | Mesentry                        |
|      | Nashed et al. [1]        | 24  | Male   | Sigmoid resection followed by another surgery of transverse colostomy           | Entero-cutaneous fistulas                                  | Mesentry                        |
|      | Penve et al. [54]        | 49  | Male   | Numeral exploratory laparotomies performed after a blunt abdominal trauma      | No symptoms discovered incidentally by imaging            | Mesentry                        |
|      |                          |     |        |                                                                                   |                                                                 |                                 |
| 2016 | Herrera-Toro et al. [55] | 14  | Male   | Neonatal colostomy and then posterior sagittal anorectoplasty.                  | No symptoms discovered incidentally by imaging            | Mesentry                        |
|      |                          |     |        | In addition to a Surgical decompression of tethered spinal cord                 |                                                                 |                                 |
|      |                          |     |        | syndrome.                                                                        |                                                                 |                                 |
|      | Musatto et al. [56]      | 55  | Male   | Sigmoid colon resection and washout due to perforated sigmoid                   | Discovered incidentally in the OR                         | Mesentry                        |
|      |                          |     |        | diverticulitis and fecal peritonitis                                            |                                                                 |                                 |
|      | Sapalidis et al. [57]    | 60  | Male   | Exploratory laparoscopy for intestinal obstruction,                             | Discovered incidentally in the OR                         | Mesentry                        |
|      |                          |     |        | Sigmoidectomy                                                                     |                                                                 |                                 |
|      | Georgios Sahsamanis et al. [58] | 55 | Male   | Hartmann’s colostomy                                                             | Discovered incidentally in the OR                         | Mesentry & peritoneum           |
|      | Sun et al. [59]          | 35  | Male   | Hartmann’s procedure followed by delayed abdominal closure                      | Discovered incidentally in the OR                         | Mesentry & peritoneum           |
|      |                          |     |        |                                                                                   |                                                                 |                                 |
| 2017 | Ferreira et al. [5]      | 45  | Male   | Segmental enterectomy and temporary ileostomy and                             | No symptoms discovered incidentally by imaging            | Mesentry and abdominal wall     |
|      |                          |     |        | subsequent multiple surgeries with small bowel resection                        |                                                                 |                                 |
|      |                          |     |        |                                                                                   |                                                                 | Mesentry and abdominal wall     |
|      |                          |     |        |                                                                                   |                                                                 |                                 |
| 2018 | Matthew Amalfitano et al. [60] | 70 | Male   | Hemicolectomy for adenocarcinoma                                                 | Post-mortem examination                                    | Mesentry                        |
|      | Michael et al. [61]      | 34  | Male   | Laparotomy for Grade III liver injury and pancreas-c-tail                      | No symptoms discovered incidentally by imaging            | Mesentry                        |
|      |                          |     |        | laceration complicated with transverse colon perforation and                    |                                                                 |                                 |
|      |                          |     |        | duodenal stump leak                                                              |                                                                 |                                 |
|      | Bosaily et al. [62]      | 52  | Male   | Ileostomy                                                                        | Discovered incidentally in the OR                         | Stomal site                     |
|      | Célik et al. [63]        | 41  | Male   | Emergency right nephrectomy, right hemicolecotomy with end                      | No symptoms discovered incidentally by imaging            | Mesenteric, omental, and peritoneal |
|      |                          |     |        | ileostomy, and applications of intraabdominal vacuum-assisted                   |                                                                 |                                 |
|      | 2020 Andrea Aurelio et al. [64] | 28 | Male   | No surgical history, patient had a history of blunt thoracic and                | Bowel obstruction                                          | Mesentry                        |
|      |                          |     |        | abdominal trauma                                                                 |                                                                 |                                 |

**Consent**

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

**Guarantor**

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**Provenance and peer review**

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Table 2
Statistical analysis of all reported cases in the literature.

| Parameters                                    | Total reported cases (73) |
|-----------------------------------------------|---------------------------|
| Age mean (SD)                                 | 48.38 ± 18.27             |
| Gender                                        |                           |
| Male n (%)                                    | 66 (90.4)                 |
| Female n (%)                                  | 5 (6.8)                   |
| Not mentioned n (%)                           | 2 (2.7)                   |
| Surgical/trauma history                       |                           |
| Laparotomy n (%)                              | 59 (80.8)                 |
| Laparotomy due to gunshot wound n (%)         | 4 (5.5)                   |
| Laparotomy due to trauma n (%)                | 3 (4.1)                   |
| Trauma n (%)                                  | 2 (2.7)                   |
| No surgical history n (%)                     | 5 (6.8)                   |
| Clinical presentation                         |                           |
| Bowel obstruction n (%)                       | 30 (41.1)                 |
| Mass n (%)                                    | 2 (2.7)                   |
| Peritonitis n (%)                             | 1 (1.4)                   |
| Enterocutaneous fistula n (%)                 | 5 (6.8)                   |
| UTI symptoms n (%)                            | 1 (1.4)                   |
| Fever n (%)                                   | 1 (1.4)                   |
| Esophagotracheal fistula n (%)                | 1 (1.4)                   |
| Abdominal pain n (%)                          | 1 (1.4)                   |
| Incidental in the OR n (%)                   | 10 (13.7)                 |
| Incidental in the imaging n (%)              | 12 (16.4)                 |
| Incidental in the postmortem autopsy n (%)   | 1 (1.4)                   |
| Ossification site                             |                           |
| Mesentery n (%)                               | 52 (71.2)                 |
| Omentum n (%)                                 | 5 (6.8)                   |
| Mesentery and omentum n (%)                  | 8 (11)                    |
| Mesoappendix n (%)                            | 1 (1.4)                   |
| Colon n (%)                                   | 1 (1.4)                   |
| Mesentery and peritoneum n (%)                | 1 (1.4)                   |
| Mesentery and abdominal bowel n (%)           | 3 (4.1)                   |
| Mesentery and peritoneum and omentum n (%)   | 1 (1.4)                   |
| Stomal site n (%)                             | 1 (1.4)                   |

CRediT authorship contribution statement

Sara Assiri and Raad Althaqfi led the writing of the case report and literature review, Rawan Alouf, Fawaz Althobaiti, Budur Althobaiti, and Mohammad Al Adwani assisted with writing and revision of the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

No conflict of interest.

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Fig. 5. Calcium and alkaline phosphatase progression. The progression of calcium and alkaline phosphatase levels during our case’s admission and before discovering the ossified mesenteric bones intraoperatively. All readings were within normal suggesting that a mature ossified bone fragments are already formed.
