

Traumatic Ventral Hypogastric Hernia: A Case Report and Review of Literature in Pediatrics

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Background: Pediatric traumas are routinely categorized into blunt and penetrating types. Bicycle handlebar exerts a biphasic or dual effect (it is primarily a blunt mechanism but due to its focused effect, it disrupts the muscles without cutting the skin). In 1964, Roberts reported a 9-year-old boy with acquired abdominal wall hernia after a fall upon a bicycle handlebar to be the second case of traumatic abdominal wall hernia after Landry report in 1956. Since then, more than 66 pediatric cases have been reported. In dealing with cases having this type of injury, radiologic studies are warranted to reveal the injured parieties and organs, address these injuries, and achieve optimum case stabilization. Here in this article, we present our experience in management of pediatric traumatic abdominal wall hernia case and literature review.

Case Presentation: An 11-years-old boy presented to the ER of Al-Houssain university hospital with traumatic ventral hypogastric hernia caused by bicycle handlebar impact to his lower abdomen. The case was initially assessed, stabilized, managed operatively and followed until improved and became ready for discharge.

Conclusion: Traumatic abdominal wall hernias occurs in response to concentrated impact by handlebar to the abdomen leading to muscle yielding but the resilient elastic nature of the skin keeps it intact. These injuries should be suspected in the setting of suggestive trauma mechanism followed by abdominal swelling and should be dealt with timely and seriously on an individual basis to restore the disrupted anatomy.

Keywords: Traumatic Hernia; Bicycle Handlebar Injury; Ventral Hernia; Blunt Abdominal Trauma; Exploratory Laparotomy; Conservative Management

Abbreviations

ATLS: Advanced Trauma Life Support; bpm: Beat Per Minute; CT: Computed Tomography; ER: Emergency Room; Hb: Hemoglobin; Hct: Hematocrit; MVC: Motor Vehicle Collision; NGT: Nasogastric Tube; OPD: Outpatient Department; PALS: Pediatric Advanced Life Support; PICU: Pediatric Intensive Care Unit; Plt: Platelets; RBCs: Red Blood Cells; RBS: Random Blood Sugar; S: Serum; SC: Subcutaneous Tissue; US: Ultrasonography; WBCs: White Blood Cells

Introduction

Acute abdominal wall hernias caused by traumatic forces as seat belt, motor cycle, or bicycle handlebar are very rare entity [1]. Bicycle handlebar acts as biphasic (blunt and penetrating) mechanism of trauma strong enough to disrupt the abdominal wall musculature but weak enough to affect the skin thus resulting in

traumatic abdominal wall hernia [2-4]. They were first described by Landry, *et al.* in 1956 [2]. Large portion of traumatic abdominal wall hernia cases is reported in children. Surgery is indicated for traumatic abdominal wall hernias to repair the fasciomuscular defect and possibly injured organs after case stabilization either in the emergency department or pediatric intensive care unit (PICU) for unstable cases at presentation. Prompt surgical repair is indicated to prevent incarceration or strangulation of the herniated viscera [5,6]. Here in this article, we present our experience in management of pediatric handlebar trauma victim as regard clinical scenario, diagnostic studies, operative details and follow up and also review the literature.

This article emphasizes the importance of meticulous caution during dealing with this type of abdominal injury to address the

injured organs without missing injuries or causing additional iatrogenic injuries, and to securely close the fasciomuscular defect.

Case Report

We present a case of 11-years-old male child referred from general hospital to ER of Al-Houssain university hospital complaining of absolute constipation and vomiting since 2 days. On quick examination and anamnesis, he was found to have hypogastric swelling and ecchymosis (Figure 1) caused by bicycle handlebar impact to his lower abdomen 2 days ago upon falling on the ground after crashing with immobile truck. Primary survey revealed that he was conscious but confused, had a toxic look, pulse 120 beat per minute (bpm), temperature: 38.5 °C, intact patent airway, equal bilateral air entry, mildly hypotensive (110/54 mmHg, normal age-adjusted diastolic blood pressure is 61). Secondary survey revealed that he had sutured 2 cut wounds in the forehead. Chest and Heart: No abnormality detected at time of examination. As regard the abdomen: generalized rigidity, tender contused hypogastric swelling (midway between umbilicus and symphysis pubis) with impulse on cough with gurgling sensation and bruises. He was admitted, resuscitated, and stabilized as per pediatric advanced life support (PALS) and advanced trauma life support (ATLS) protocol guidelines.

Figure 1: The patient photo showing hypogastric (suprapubic) ecchymotic bulge.

Two wide bore cannulas were inserted for resuscitation. Also, nasogastric tube (NGT) and urinary catheter were inserted. The case was investigated by laboratory tests and radiologic imaging studies.

Laboratory investigations

WBCs: $12 \times 10^3/\text{mm}^3$, Hb: 11 g/dl, Hct: 34.6, Plt: $279 \times 10^3/\text{mm}^3$, S. creatinine: 0.8 mg/dl, RBS: 98 mg/dl, pH: 7.41, S. sodium: 141 mEq/L, S. potassium: 4.1 mEq/L, HCO_3^- : 19.5 mEq/L.

Ultrasonography (US) abdomen and pelvis

Infra-umbilical swelling (hematoma versus hernia), mild perisplenic collection.

Computed tomography (CT) abdomen and pelvis (Figure 2)

Infra-umbilical herniated bowel loops with moderate pelvic collection.

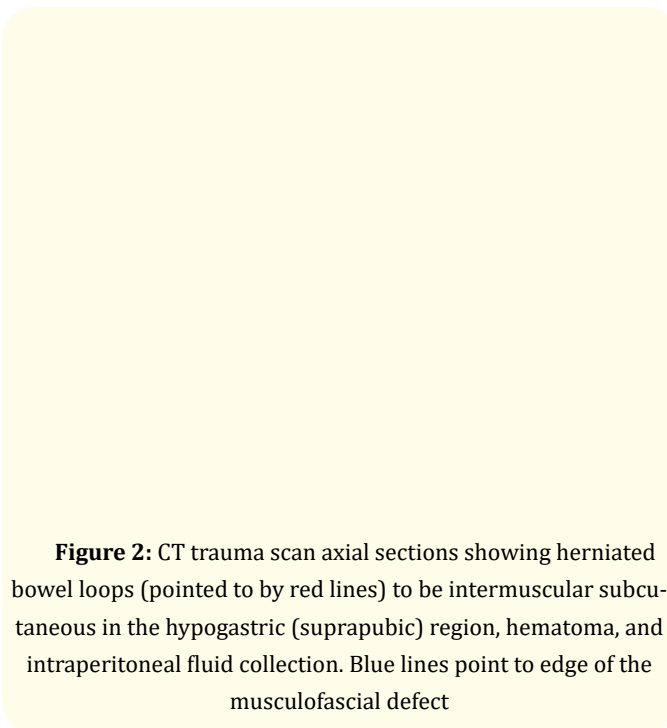


Figure 2: CT trauma scan axial sections showing herniated bowel loops (pointed to by red lines) to be intermuscular subcutaneous in the hypogastric (suprapubic) region, hematoma, and intraperitoneal fluid collection. Blue lines point to edge of the musculofascial defect

Operative details

Anaesthesia: General endotracheal with muscle relaxant.

Position: Supine.

Incision: Curvilinear Pfannenstiel incision.

Operative findings: After skin and SC tissue incision, pus was found, rectus muscle defect and an intact small bowel loop was found beneath the lower flap. With great care, muscle cut was completed till the peritoneum. Pus and stool were found filling the abdomen. Extensive adhesions and pyogenic membrane covering a large segment of small bowel were found. A big perforation (involves more than half circumference) of an ileal loop with dirty pyogenic edges approximately 150 cm from ileocecal junction. A subhepatic fixed cecum was also found. Palpation of the spleen revealed intact spleen with no injury.

Operative procedure

Repeated irrigation suction of the peritoneal cavity was done. Last time at the end of operation mixed with metronidazole (flagyl®). Adhesiolysis and appendectomy were done. Resection-anastomosis of the perforated ileal segment was done. A pelvic drain was inserted. Secure hemostasis was assured. Closure of the ab-

dominal wound in layers anatomically was done. Smooth recovery from anaesthesia and transfer to the ward.

Results and post-operative follow-up

The patient had smooth uneventful post-operative course and dramatic improvement of the general condition occurred. Vital signs all improved. Abdomen: soft and lax with clean wound. Wound seroma developed in the 4th post-operative day and managed conservatively. Skin and SC tissue healed nicely. Drain: revealed 50 cc serosanguinous within 36 hours then negligible amount afterwards so it was removed 2 days postoperatively. The patient passed flatus in the 2nd post-operative day morning and stool in the same day evening many times till the 3rd post-operative day (passed stool 3 - 4 times daily afterwards). Oral feeding was allowed on the 5th post-operative day and well tolerated and discharged home in good stable health status. Two months later, the patient was revised at the clinic outpatient department (OPD) with good outcome (Figure 3).

Figure 3: Appearance 2 months post operatively

Discussion

A traumatic abdominal wall hernia is defined as herniation of viscera through disrupted fascia and musculature with intact skin after focal significant trauma in absence of evidence of prior defect at the affected area [7,8]. It is generally caused by concise point of energy transfer such as handlebar or any other tough objects, blunt enough to penetrate the skin, but powerful enough to cause localized effect on the muscles and possibly internal viscera. In addition to the localized force, sudden increase in intra-abdominal pressure causes disruption of peritoneum, abdominal wall fascia, and muscles [4,9]. But due to its elastic resistant nature, the skin remains intact resulting in traumatic abdominal wall hernia [4,10].

Wood., *et al.* classified traumatic abdominal hernias into 3 categories according to the size and offending etiology: Type I, small defect caused by localized blunt trauma such as bicycle handlebars; Type II, larger defects developed by high-energy transfer events such as by motor vehicle collision (MVC) or falling from

height, and, rarely, Type III, intra-abdominal bowel herniation attributed to deceleration injuries [11-15].

Handlebar hernias belong to type I injuries and are rarely associated with intra-abdominal injuries [2,14]. In adults, blunt traumatic abdominal wall hernias are mainly assigned to seat belt injury in motor vehicle collisions and almost always accompanied by significant injuries. In pediatrics, bicycle handlebar abdominal injuries have high rate of associated morbidity with the typical picture of post-traumatic bruised lump under the skin. Associated injuries are uncommon because the impact is concise to single point [16].

A MEDLINE search via PubMed and Cochrane Library using keywords "handlebar hernia" and "traumatic abdominal wall hernias" revealed about 79 case reports on handlebar hernias in both pediatrics and adults (Table 1) [17].

Of these cases, 67 (84.6%) occurred in children aged 3 to 14 years old [4,7,13,18]. In adults, the hernias were noticed to happen at anatomical weak points as in inguinal region or the lower abdomen lateral to rectus muscle [14,19].

The site of herniation in pediatrics was more diverse, occurring mostly in the lower abdomen, with eight reports in the upper abdomen [20] and two over the rectus abdominis muscle [21]. This emphasizes the thin and weaker abdominal wall in children as a cause of the higher rate of such injury among this patients' population.

From the above table, we can conclude that 58 cases were male (86.4%) (with age ranging from 3 to 14 years) and 9 were female (with age ranging from 4 to 12 years).

As regard the offending tool, bicycle was the cause in 63 cases, motorbike in 2 cases, motor vehicle collision in 1 case, and scooter in 1 case.

As regard the site, right lower quadrant was affected in 32 cases, left lower quadrant in 16 cases, left upper quadrant in 5 cases, right upper quadrant in 3 cases, umbilical in 4 cases, left lumbar (1 of them above iliac crest) in 3 cases, trans-rectus in 2 cases, suprapubic in 1 case, and right iliac fossa in 1 case.

As regard the management, 50 cases underwent operative repair of the defect, 1 case underwent operative repair with concomitant bowel resection-anastomosis, 7 cases underwent operative repair with concomitant closure of bowel perforation, 1 case underwent operative repair with concomitant colonic resection-anastomosis and repair of small bowel injuries, 1 case underwent operative repair with concomitant repair of ruptured bladder, 1

Case No	Author/Year	Age/Sex	Mode of Injury	Site of Trauma	Management
1	Landry (1956)	14/M	Motorbike	LLQ	Laparotomy
2	Roberts (1964)	9/M	Bicycle	LLQ	Layered closure
3	Maunola (1965)	9/F	Bicycle	LLQ	Laparotomy
4	Pendl (1970)	8/F	Bicycle	RLQ	Layered closure
5	Herbert (1973)	7/M	Bicycle	LLQ	Layered closure
6	Hollwarth (1977)	4/F	Scooter	RLQ	Layered closure
7	Hollwarth (1977)	6/M	Bicycle	RLQ	Closure
8	Hollwarth (1977)	7/M	Bicycle	LUQ	Closure
9	Hollwarth (1977)	13/M	Bicycle	Suprapubic	Closure
10	Dreyfuss, <i>et al.</i> (1986)	11/M	Bicycle	Rectus abdominis	Debridement with closure
11	Peters, <i>et al.</i> (1988)	9/M	Bicycle	Umbilical	Laparotomy with closure of jejunal perforation with layered closure
12	Schneegans (1988)	8/M	Bicycle	RLQ	Layered closure
13	Mitchiner (1990)	7/M	Bicycle	LUQ	Layered closure
14	Damschen, <i>et al.</i> (1994)	5/M	Bicycle	RLQ	Layered closure
15	Kubalak (1994)	6/M	Bicycle	RLQ	Closure
16	Kubalak (1994)	9/F	Bicycle	RLQ	Closure
17	Luchtman, <i>et al.</i> (1997)	7/M	Bicycle	RLQ	Closure
18	Perez, <i>et al.</i> (1998)	11/M	Bicycle	LLQ	Laparotomy with layered closure
19	Kubota, <i>et al.</i> (1999)	9/M	Bicycle	RLQ	Layered closure
20	Fraser, <i>et al.</i> (2002)	11/M	Bicycle	RLQ	Layered closure
21	Mancel and Aslam (2003)	7/M	Bicycle	LLQ	Layered closure
22	Goliath, <i>et al.</i> (2004)	11/M	Bicycle	RLQ	Layered closure
23	Prada Arias, <i>et al.</i> (2004)	10/M	Bicycle	RLQ	Layered closure
24	Prada Arias, <i>et al.</i> (2004)	6/F	Bicycle	RLQ	Layered closure
25	Chen, <i>et al.</i> (2005)	9/M	Bicycle	RLQ	Layered closure
26	Iinuma, <i>et al.</i> (2005)	8/M	Bicycle	RLQ	Appendectomy with closure
27	Matsuo, <i>et al.</i> (2007)	9/M	Bicycle	LLQ	Conservative
28	Mezhir, <i>et al.</i> (2007)	7/M	Bicycle	LUQ	Laparotomy with layered closure
29	Haimovici, <i>et al.</i> (2007)	15/M	Bicycle	Umbilical	Laparotomy with layered closure
30	Litton, <i>et al.</i> (2008)	13/M	Bicycle	RLQ	Conservative
31	Narci, <i>et al.</i> (2008)	12/M	Bicycle	RLQ	Layered closure
32	Nguyen, <i>et al.</i> (2009)	6/M	Bicycle	LLQ	Layered closure
33	Tonsi, <i>et al.</i> (2010)	14/M	Bicycle	RIF	Laparotomy with jejunal resection anastomosis
34	Yegane, <i>et al.</i> (2010)	4/M	Bicycle	RUQ	Layered closure
35	Van Bommel, <i>et al.</i> (2011)	7/M	Bicycle	Rectus abdominis	Layered closure
36	Rowell (2011)	14/M	Bicycle	RUQ	Laparoscopic repair
37	Mitchell, <i>et al.</i> (2011)	14/M	Bicycle	RLQ	Layered closure
38	Yan, <i>et al.</i> (2011)	8/M	Bicycle	RLQ	Layered closure
39	Hatti, <i>et al.</i> (2011)	5/M	Bicycle	LLQ	Layered closure
40	Bosemani, <i>et al.</i> (2011)	11/F	Bicycle	RLQ	Closure of jejunal perforation with layered closure
41	Bosemani, <i>et al.</i> (2011)	8/F	Bicycle	RUQ	Layered closure
42	Decker, <i>et al.</i> (2012)	13/M	Bicycle	RLQ	Layered closure
43	Thakur (2013)	9/M	Bicycle	RLQ	Layered closure
44	Upasani (2013)	12/M	Bicycle	LUQ	Conservative
45	Griffin, <i>et al.</i> (2013)	11/M	Bicycle	RLQ	Layered closure

46	Klimek., <i>et al.</i> (2013)	12/F	Bicycle	Umbilical	Layered closure
47	Yaylaci (2014)	11/M	Bicycle	LLQ	Closure of jejunal perforation with layered closure
48	Talutis., <i>et al.</i> (2015)	11/M	Bicycle	LLQ	Layered closure
49	Talutis., <i>et al.</i> (2015)	9/M	Bicycle	RLQ	Layered closure
50	Talutis., <i>et al.</i> (2015)	7/F	Bicycle	RLQ	Closure of ileal perforation with layered closure
51	Baderalmaarif (2015)	3/M	Bicycle	LLQ	Layered closure
52	Angel Buitrago and Lugo Vicente, (2015)	14/M	Bicycle	Umbilical	Layered closure
53	Hirose., <i>et al.</i> (2015)	14/M	Bicycle	LLQ	Layered closure
54	Hirose., <i>et al.</i> (2015)	13/M	Bicycle	RLQ	Repair of bladder rupture layered closure
55	Ahmed., <i>et al.</i> (2015)	8/M	Bicycle	RLQ	Closure
56	Deepak., <i>et al.</i> (2015)	12/M	Bicycle	LUQ	Closure of jejunal perforation with layered closure
57	Deepak., <i>et al.</i> (2015)	12/M	Bicycle	RLQ	Layered closure
58	Pederiva., <i>et al.</i> (2016)	9/M	Bicycle	LLQ	Laparotomy with closure of ileal perforation with layered closure
59	Volpe., <i>et al.</i> (2017)	12/M	Bicycle	RLQ	Conservative
60	Volpe., <i>et al.</i> (2017)	8/M	Bicycle	RLQ	Conservative
61	Tianyi., <i>et al.</i> (2017)	8/M	Motorbike	Left lumbar	Layered closure
62	Ramos-Irizarry., <i>et al.</i> (2017)	11/M	Bicycle	RLQ	Layered closure
63	Rinaldi., <i>et al.</i> (2017)	12/M	Bicycle	LLQ	Layered closure
64	Rinaldi., <i>et al.</i> (2017)	13/M	Bicycle	RLQ	Layered closure
65	Maria Aggelidou <i>et al.</i> , (2018)	6/M	Bicycle	Left lumbar above iliac crest	Conservative
66	Shukla., <i>et al.</i> (2018)	14/M	Bicycle	LLQ	Primary closure of perforation with layered closure
67	Theodorou CM., <i>et al.</i> (2019) ³⁶	7/M	High-speed MVC	Left posterolateral flank	Laparotomy with colonic resection-anastomosis and repair of 3 small bowel injuries with abdominal wall layered closure

Table 1: Published data about handlebar-induced traumatic hernia. Abbreviations: M: Male; F: Female; LLQ: left Lower Quadrant; RLQ: Right Lower Quadrant; LUQ: Left Upper Quadrant; RUQ: Right Upper Quadrant; RIF: Right Iliac Fossa.

case managed laparoscopically, and 6 cases were managed conservatively because of absence of internal organ injuries and no risk for incarceration or strangulation.

Diagnosis of traumatic hernia is mainly clinical [14,21]. History of blunt focused trauma to the abdomen followed by appearance of a bulge should raise suspicion of the physician to the possibility of traumatic hernia. On examination, there is usually a bruise at the affected area with a handlebar mark in light-skinned individuals around which a mild tender swelling, often reducible, giving an impulse on cough. Otherwise, abdominal examination is unremarkable. Classical signs of hernia are seen in only 50% of cases. There are cases of patients in which symptoms presented 48 h after the accident [22]. In severe neglected cases with bowel strangulation with resultant perforation and gangrene, signs of peritonitis develop [21].

In some rare examples, it is possible to have a hernia without the above signs. There are cases in which symptoms developed 48 hours after the trauma [23]. In these circumstances, further radiologic imaging such as ultrasonography (US) has been reported as useful to confirm the diagnosis and to assess intra-abdominal solid organs. Computed tomography (CT) scans can also be useful, as it confirms the diagnosis, define the anatomy of the disrupted abdominal wall layers, evaluate intra-abdominal structures, and distinguish a hernia from a hematoma or soft tissue contusion which are common differential diagnoses [1,14,21]. In our patient, presentation was delayed 2 days post traumatic and the diagnosis was clinched by physical examination and confirmed by CT scan. This supports the idea of importance of high index of suspicion in making prompt diagnosis of this type of injury that facilitates timely proper management and improves the outcome and preventing further morbidity and mortality risk.

An associated scalp hematoma was noted in one case [24]; one patient presented with incarcerated small bowel hernia with no associated visceral injuries [25]. Haimovici, *et al.* reported a case of traumatic abdominal wall hernia leading to rectus muscle separation with small bowel perforations and mesenteric disruption resulting in massive intraperitoneal bleeding [26]. Hernia may manifest immediately or has delayed presentation and is not always detected during the first examination. In 59 of 67 handlebar hernias published in the literature, the emergence of the hernia was immediate. In 7 patients, however, the hernia was not detected by the physical or ultrasound examination during the first 2 days [27]. In 63 of the 67 reported cases, the hernia was reducible; while four patients presented with an incarcerated hernia. Sixty five reported handlebar hernias were treated surgically some days after the trauma, although in two patient, surgical intervention was performed more than 3 weeks later [27].

In adults, presentation varies substantially and diagnosis may be difficult. Agarwal, *et al.* 2009 reported two adult cases with traumatic abdominal wall hernia with different presentations and treatment modality. The defect was closed by emergency mesh repair in one patient and the other case had ischemic bowel and underwent resection anastomosis and primary repair of the defect [28].

Abdominal wall bruises in a participant of an MVC has been shown to be a powerful indicator of intra-abdominal injuries in both children and adults. High index of suspicion for these injury types markedly improves their recognition and treatment by appropriately ordering timely observation with serial examinations, further imaging, and surgical exploration [29,30].

Della Porta, *et al.* 2008 in Italy reported a case of handlebar-induced traumatic hernia of the abdominal wall successfully managed by surgical repair [31].

Hassan, *et al.* 2008 reported a case of handlebar hernia resulting from an injury sustained during a vehicular collision and discussed the management of such injuries [14].

Goh, *et al.* 2008 reported a case of bicycle handlebar induced traumatic hernia with jejunal perforation. This case had delayed presentation and diagnosis was confirmed by computed tomography (CT) scan. Surgical exploration with primary repair of the defect is the definitive treatment in such cases [32].

Management of traumatic handlebar hernias is prompt surgical repair to avoid incarceration and strangulation and to restore the anatomical integrity [5,33].

In case of small localized defect, it can be repaired primarily with non-absorbable sutures. With larger defects, prosthetic ma-

terials as prolene mesh are often used [18]. Treatment controversies about the management of traumatic abdominal wall hernias are focused on 3 key points: possibility of conservative management, the timing of surgical repair, and the best surgical approach [14,21]. The timing of the surgery may be emergent or delayed (elective). The most important determining factor is the possibility of intra-abdominal injury, with immediate operation via midline laparotomy is indicated to enable full exploration, to rule out and deal with any intra-abdominal injury and prevent strangulation of any incarcerated bowel [13,14,18, 21]. But, if there is no immediate risk of strangulation and no signs of intra-abdominal injury such as blood or feces in the peritoneal cavity, local wound exploration and primary wound closure is usually enough intervention that can be done on an elective basis, and at the same time, conservative management plays an important role as Litton reported successful management of handlebar hernia case, discuss their management, and suggested that immediate surgical intervention may not always be required [5,15,34,35].

Volpe, *et al.* 2011 adopted the conservative approach in six cases. The defect size was up to 3 cm and the hernia contained omentum in three cases and bowel loops without incarceration in three cases. Spontaneous healing of the musculature and fascia defect occurred in all patients in 1 - 12 months (mean, 4.4 months) without any complications [35,36].

Conclusion

Although diagnosis of traumatic abdominal wall hernias is easy to reach on the basis of trauma mechanism and careful abdominal examination, radiologic studies are safe effective auxiliary tool to confirm the diagnosis and assess intra-abdominal structures for associated injuries. Direct closure is feasible in most cases, although prolene or biologic mesh may be required in some cases to achieve tension-free defect closure.

Patient Consent

Written informed consent was obtained from the parents to publish the images and details. No personal details or photos in this article could lead to identification of the case.

Authorship

The author attests that he meets the current ICMJE criteria for authorship.

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Conflicts of Interest

None.

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