

## CASE REPORT

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# Blunt Pancreatic Trauma by a Wheelchair User Restraint System During a Traffic Accident

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**ABSTRACT:** Traffic accidents are the most common cause of blunt pancreatic trauma, and most injuries occur in unrestrained drivers. Blunt pancreatic trauma in a passenger or a restrained driver is rare. In this report, we describe a case of blunt pancreatic trauma caused by a restraint system for wheelchair users during a traffic accident.

**KEYWORDS:** forensic science, forensic pathology, pancreatic injury, wheelchair, traffic accident

Pancreatic injuries occur in 3 to 12% of abdominal trauma cases (1–3). Traffic accidents are the most common cause of blunt pancreatic trauma and most injuries occur in unrestrained drivers (1,3). Blunt pancreatic trauma in a passenger or a restrained driver is rare (1,3,4).

Safety measures intended to protect the vehicular occupants and passengers from injury are being rapidly improved. However, the safety of wheelchair users, who are often highly dependent on motor vehicles for mobility, presents several unresolved challenges. Recently, safety devices for wheelchair users have been developed (5–10) and installed in motor vehicles, mainly in buses and taxis. However, poor design and inappropriate use of the safety devices can be harmful. We present here a case of blunt pancreatic trauma caused by a restraint system for wheelchair users during a traffic accident.

### Case Report

A 59-year-old handicapped man in a wheelchair was a passenger in his wife's van when another motor vehicle in the oncoming traffic lane suddenly entered their lane and collided with their van. The right front areas (driver's sides) of both motor vehicles were involved in the accident. Although the van was nearly stopped at the time of the accident, the oncoming motor vehicle was moving at approximately 50 km/h. The impact of the collision caused the van to swing sharply to the right. The right front areas of both motor vehicles were crushed. The rear part of the van had been reformed to accommodate a wheelchair and the van was equipped with a sys-

tem of hooks and belts that could be used to connect the wheelchair to the floor of the van. The system was located centrally in the rear part of the van. To further secure the wheelchair user, there was a belt whose center had been stitched to the cloth seat of the chair between the occupant's thighs, and the ends of the belt were fastened with a buckle behind the back of the chair (Fig. 1). During the accident, the wheelchair restraint system would hold the chair in position, while the belt would prevent the wheelchair user from being ejected from the chair. The wheelchair user and both drivers were sent to a regional hospital. Although the wheelchair user did not complain of any pain and only a bruise was observed on the upper left abdominal wall, the man was admitted to the hospital because his wife had sustained multiple fractures of both legs and could not take care of him. Eight hours after the accident, the man complained of severe abdominal pain. An emergency peritoneotomy was performed 12 h after the accident. The operation was difficult to perform, because the patient had previously received an esophagogastrectomy and severe adhesions between the intestines were present. During the operation, a hemorrhage in the mesentery was observed, and ruptures of the duodenum, mesentery, and/or pancreas were suspected. The surgeon washed the abdominal cavity and closed, without performing any further exploration or procedures. The operation record contains a note stating that part of the patient's small intestine looked necrotic. The victim died 20 h after the accident.

A police inspection after the man's death revealed that the right arm of the wheelchair had been deformed during the accident (Fig. 2). Some of the threads that had fastened the belt to the seat of the chair had been snapped, and the remaining threads were on the verge of breaking (Fig. 1). When the belt was fastened in place, the belt passed over the both sides of the user's abdominal wall nearly at the level of the umbilicus (Fig. 3).

### Autopsy Findings

The deceased had been well-nourished, but his lower legs were atrophied. Recent signs of a peritoneotomy and drainage were visible on the abdominal wall. Old signs of an esophagogastrectomy in the neck, right chest wall, and abdominal wall were also present. A transverse bruise was present on the upper left abdominal wall. The bruise measured 17 by 2.5 cm at its widest point and located 9.5 cm above the umbilicus. The subcutaneous fat tissue under the bruise was partially damaged. Also under the bruise, the left 9th rib was fractured. About 30 mL of bloody fluid had accumulated in the abdominal cavity. The peritoneum and intestinal serous membrane

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FIG. 1—Wheelchair user restraint system. The center of the belt was stitched to the seat, but some of the threads have been broken. The arrows indicate the location of the buckle that is fastened behind the back of the chair.



FIG. 2—The right arm of the wheelchair is deformed.

were dirty reddish. A hemorrhage with a diameter of 13 cm was found in the mesentery. The hemorrhage extended from the root of the mesentery, but a mesenteric rupture was not found. A second hemorrhage with a diameter of 7 cm was found in the posterior portion of the neck of the pancreas. The tissue of this hemorrhagic area was slightly damaged. Fat necrosis was also observed around the hemorrhage. Between the lower part of the duodenum and the upper part of the jejunum, ten bean-sized submucosal hemorrhages were observed. Although the serous surfaces of the intestines were dirty reddish, the mucosal membrane did not show signs of necrosis. The pancreatic and superior mesenteric arteries were not injured. Although the right lateral chest wall did not show any external signs of injury, a severe subcutaneous and muscular hemorrhage measuring 20 by 15 cm at its widest point was found and the right 8th and 10th ribs were also fractured. The brain showed



FIG. 3—When the belt is fastened, the belt passes over both sides of the user's abdominal wall nearly at the level of the umbilicus.

necrosis of the gray and white matters along the boundary zones between the posterior and anterior or middle cerebral arteries, the result of a cerebral blood flow disorder that had occurred five years previously and had caused his disability.

Histologically, a hemorrhage in the neck region of the pancreas was confirmed. The pancreatic tissue around the hemorrhage exhibited necrosis with an inflammatory reaction. Macroscopically, the common pancreatic duct did not appear to be injured. However, the duct did exhibit necrosis with an inflammatory reaction.

## Discussion

The pancreas lies in a relatively protected position within the retroperitoneum. In spite of this, pancreatic injuries are not infrequently seen in trauma centers. Pancreatic injuries also present a greater problem than most other types of organ injuries. Though pancreatic damage may appear trivial, the main pancreatic ducts are sometimes disrupted or obstructed. If the pancreatic ducts are compromised, mortality is inevitable because active pancreatic enzymes will extravasate into the peritoneum and retroperitoneum (1,2). In the present case, the dirty reddish appearance of the peritoneum and intestinal serous membrane strongly indicates that necrosis of the pancreatic tissue after the injury involved the duct, and that active pancreatic enzymes extravasated into the peritoneum. Thus a pancreatectomy seems to have been indicated in the present case (2). However, the patient only received a peritoneotomy, washing of the abdominal cavity, and drainage. Though blunt pancreatic trauma is infrequently encountered in most re-

gional hospitals in Japan and management of this injury is difficult, the present therapy may have been inadequate.

Considerable personal protection is afforded by seatbelts (11,12). A comparable level of protection is also necessary for wheelchair users during transportation. If safety restraints for wheelchairs are not installed, the drivers of vehicles containing wheelchair users may try to compensate by driving and braking more carefully. However, an emergency stop while traveling at a speed of even 7.5 km/h will create chaos for the wheelchair users if the users have no mean of bracing themselves (5). Wheelchair and wheelchair user restraint systems have been developed to protect wheelchair users during sudden impacts (5–10). In the present case, the wheelchair restraint system was supposed to hold the chair in position while the belt was intended to prevent the user from being ejected from the chair. Nevertheless, the victim's body was jerked abruptly during the accident. The threads that had fastened the belt to the seat of the chair were nearly or completely severed, and the right arm of the chair was deformed. The victim most likely knocked his upper left abdominal wall against the belt and then his right side against the right arm and back prop of the chair. The pancreatic and duodenojejunal injuries probably occurred during the former impact. The man's wife stated that the safety belt had been tightly fastened. However, no injuries were found on the victim's thighs where the belt should have been placed. Moreover, when the belt was passed over the arms of the chair and fastened behind the back of the chair, the belt passed over both sides of the abdominal wall. These findings suggested that the belt had been fastened loosely and that a large force was applied to the upper left abdominal wall via the belt at the time of the accident. Safety belts must be tightly fastened and pass over certain areas of the body in order to be effective. Shoulder belts should pass over the sternum, while lap belts should pass over the pelvic bone. Otherwise, the abdominal organs can be seriously damaged during a sudden impact. Loosening and/or inappropriate positioning of seatbelts can be harmful, even lethal (11,13). Recently, a lap belt has been developed for wheelchair users. The belt is anchored to the floor of the vehicle or to a bracket fastened to the back props of the chair. The belt passes over the pelvic bone of the wheelchair user when properly placed (5,6,8–10).

Wheelchair users constitute a small minority of vehicle passengers, but this group is highly dependent on motor vehicles for mobility. Moreover, special safety devices are often expensive. Con-

sequently, poorly designed but cheap safety devices are sometimes installed and used (9). However, wheelchair users are often moved more violently than standard seatbelt users during traffic accidents, and inadequate safety devices like the present safety belt can be harmful, if not lethal. To prevent the injury of wheelchair users during traffic accidents, adequate designs and the appropriate use of safety devices are necessary.

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