

Injuries sustained by children inside clothes dryers: a report of a fatality and review of the literature

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Abstract We report a case of a 4-year-old child found dead at his home inside a domestic clothes (tumble) dryer. The child had been reported missing in the morning by his mother and found a short time later inside the dryer with the door shut. The child was pronounced dead at the scene. A pre-autopsy computed tomography scan identified findings associated with aggressive resuscitation attempts. Post-mortem examination showed generalised blunt trauma to his head and limbs, a thin film subdural haemorrhage and burns from contact with hot components and hot air whilst being trapped alive inside the active dryer. A forensic examination of the dryer revealed that it was possible for the child to become trapped in the dryer by his own action and that the dryer could operate for sufficient time to allow for the causation of the injuries to the child. A review of the medical literature and media reports of deaths related to clothes dryer, injuries sustained to survivors and use of dryers as a body disposal site is presented.

Keywords Forensic · Child · Clothes · Tumble · Dryer · Burns · Head injury · Computed tomography

Introduction

The clothes dryer (also known as “tumble dryers” in the United Kingdom) was created in 1800 by M. Pochon [1]. It

consisted of a hand-cranked metal drum with ventilation holes used over an open fire. However, the clothes always smelt of smoke, were often covered with soot and sometimes caught fire. The first electric clothes dryer was invented by J. Ross Moore in the early twentieth century. Tired of hanging wet clothes outside in the winter, he built a shed, installed a stove and hung the clothes there to dry. He later developed both gas and electric models. The first automatic clothes dryer was named the “June Day” and went on sale in 1938, with the first electric dryer with a glass window been produced in the 1940s [2].

The discovery of a child, dead within a clothes dryer, is very unusual and raises a number of questions for the police and the pathologist, such as: how did the child get into the dryer, how did the door close, how did the dryer turn on, was the child dead before placement inside the dryer and what was the cause of death? Children can be placed alive into dryers by other children or adults, can climb into the dryer themselves for example to hide during play activities or a dryer may be used as a site of body disposal. The ability for the child to enter the dryer will depend upon the developmental age of the child, body size and capacity of the drying compartment. Once inside, injuries and fatalities can occur if the child remains in the dryer whilst the dryer is active.

We present a single fatality of a 4-year-old male child who became trapped within an active clothes dryer. We describe the scene, pre-autopsy multi-detector computed tomography scan which demonstrated post-mortem injuries due to resuscitation attempts, the autopsy and the forensic investigation findings. Deaths associated with clothes dryers are infrequent, and when one occurs, there is a paucity of medical literature to assist those investigating such a death. The majority of available information is derived from internet-based media reports [3–11]. This case

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report adds significantly to the current peer-reviewed literature in this area.

Case report

A 4-year-old male child was reported missing by his mother. He had not been seen at home for approximately 90 min. Police attended and searched the property. After a period of time, the police questioned the mother as to what clothing the child was wearing that morning. In an attempt to identify this, the mother searched the washing machine, located in the kitchen, for evidence of removal of clothing. She then went to the clothes dryer, also located in the kitchen. At this point, the child was observed through the glass window in the door to be inside the closed, inactive dryer. The dryer was immediately opened and the body pulled out. The police officer reported the body to be very difficult to remove due to stiffness. Cardiopulmonary resuscitation was commenced, but despite the attendance of a helicopter medical response team, resuscitation attempts at the scene proved unsuccessful.

The child had no known past medical history and was described as being in good health. Background research showed there was some concern from his nursery regarding his challenging behaviour and described him as a very lively and naughty child who was “into everything” and would escape at any given opportunity. He had been found hiding inside the clothes dryer approximately 2 months prior to his death. At that time, the door of the dryer was open and the child had been found asleep inside.

Scene

The Proline TDV 60 domestic front loading clothes dryer was situated in the kitchen next to the back door. The body of a partially dressed male child was present on the kitchen floor, approximately 1 m away from the opened clothes dryer. The body was supine with the arms across the top of the chest and the legs flexed. There were two defibrillator pads stuck on the upper torso with an endotracheal tube on the floor next to the head. The kitchen showed no evidence of disarray and was generally clean and tidy. A number of pieces of dried faeces, underwear and a dummy were found within clothes dryer.

Examination of the dryer

The dryer was removed from the scene and subjected to forensic examination. The initial investigation discovered that the belt had broken. When the two broken ends were

placed together, the area around the break was distinctly curved and hardened. This is typically seen as a result of the motor spindle spinning on a single point of the belt causing a friction burn and ultimate failure due to melting. The weight of the child was 17.5 kg, therefore the dryer had operated at 250% above its 5 kg weight limit, this accounts for the observation of the burnt out belt. The overload rating of a dryer is based on a weight positioned the maximum distance from the drums centre of spin; therefore, it was hypothesised that the centre of gravity for the body would be closer to the fulcrum reducing the force needed for the drum to spin. Tests using a 17.5-kg bag of sand with the same body length of the child (114 cm) placed into the bottom of the dryer drum to simulate the child in a sitting position showed that the drum would rotate for up to 1 min and 14 s before the belt burnt out. It was also observed that the failure of the belt did not affect the function of the heater elements or blower. As long as the timer was set between 10 and 120 min, the heater element and blower functioned irrespective of whether the drum span. It was also observed that the door ratchet style latch could close with a gentle push but required use of a lever on the outside of the door to unlock it. The bowl of the door plugged a rubber seal entry to the machine. The fit of the door to the seal meant it was not possible to pull the door closed from inside. It was apparent looking at the bowl shape of the door that even with the door in a relatively wide open position it was still possible to knock the door from inside. When this occurred, it bounced on the hinge and would swing closed. The drum would only operate once the door had closed and the latch had fastened.

There were no findings to support that another human, be it a child or an adult, had closed the door. It was considered that one of the two large breed dogs within the house may have pushed close the door but there were no findings on the door to support or refute this. It was then hypothesised that, once inside, the child may have kicked or pushed the door from the inside causing the door to swing outwards and then inwards causing the latch to fasten. In five out of six manual simulations of the door being swung outwards, it rebounded and the latch was caused to fasten. Once this happened, the machine would operate providing the timer had been set. It was also noted that the door would not open unless the latch was released from outside.

The clothes dryer's heat setting was tested and found to be set on high. The heating element was controlled by a thermostat. When set on high heat, the technical specification stated that it had a 20°C operating range between 80°C and 100°C (50°C to 55°C on the low heat setting). As long as the timer was set between 10 and 120 min, the heater element would function; however, for the last 10 min, the heater element switched off with the machine continuing with ambient air to cool the contents. The element's power

supply had a thermally sensitive cut-out set to 106°C. If the thermostat malfunctioned allowing the temperature to rise above 106°C, then the cut-out would stop power to the machine. The cut-out would then reset after the machine cooled down. If this malfunctioned, there was a “one cut” thermally sensitive cut-out, which worked at 150°C stopping the machine. This would require replacement before the dryer could function again. At the time of testing, the thermostat was functioning correctly. The temporary cut-out was not tested and the “one cut” was intact and still functioning.

Multi-detector computed tomography

Prior to the autopsy, a full skeletal plain film radiological examination was undertaken which showed no evidence of recent or historic bone trauma. A full-body multi-detector computed tomography scan was then undertaken using a Toshiba Aquilion 64 slice scanner (120 kVp, 300 mA and 64×0.5 mm slice thickness, matrix 512×512) reconstructed to either 1- or 2-mm thick slices. This showed a left sided pneumothorax, a pneumoperitoneum with rupture of the left hemidiaphragm as well as the fundus of the stomach (Fig. 1). These were confirmed on internal examination (Fig. 2). They were attributed to aggressive cardiopulmonary resuscitation attempts at the scene rather than as a consequence of injuries sustained in the clothes dryer [12, 13].

Post-mortem examination

The body was that of a white, male child, in keeping with the stated age of 4 years, weighing 17.5 kg (50–70th

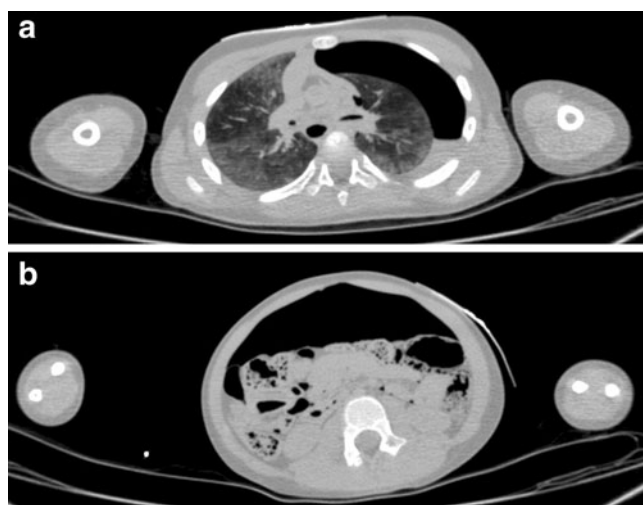


Fig. 1 Multi-planar reconstruction images of **a** the left-sided pneumothorax and **b** the pneumoperitoneum which were attributed to resuscitation attempts

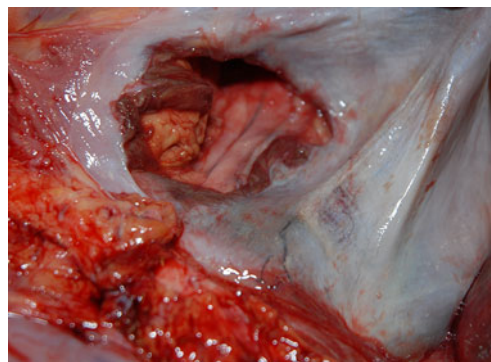


Fig. 2 Rupture at the fundus of the stomach attributed to aggressive cardiopulmonary resuscitation attempts at the scene

percentile) with a crown–heel measurement of 114 cm (99.6th percentile). He was dressed in a long sleeved top with a pair of adult female black pants wrapped around the left knee.

The external examination identified a number of fresh bruises in the head, right side of the face, the right shoulder and the back as well as in the front of the knees and top of the feet. Bruising was present in the bony prominences of the spine. There were florid petechiae present in the face, right side of the head, both ears and across the whole of the scalp, as well as the right shoulder and right arm areas. There was a range of partial to full thickness burns with parchment change in the left cheek, the front of both legs and the buttocks which showed a lack of vitality to the margins (Fig. 3). There were full thickness burns present in the back overlying both scapulae. Within these areas were well-defined circular areas of burning consistent with contact with the internal circular air vent components of the clothes dryer (Fig. 4). There were no significant old marks or injuries. Rigor was present to the arms, legs and jaw but was easily broken. Lividity was difficult to determine due to the widespread cutaneous burns.

The internal examination showed no evidence of natural disease that could have caused or contributed to death. Petechial haemorrhages were present at the front of the pericardium and at the front and back of the heart. There



Fig. 3 Partial and full thickness burns to the right and left legs, the latter of which shows parchmented change



Fig. 4 Areas of full thickness burns present at the back overlying both scapulae. Within this area were well-defined circular areas of burning consistent with contact with the internal circular air vents within the clothes dryer. Bruising can be seen running along the length of the spine

was burning and swelling of the epiglottis, pharynx and the upper part of the trachea. The right lung weighed 167 g and left was 108 g, and these were moderately oedematous. There was generalised deep soft tissue bruising over the right side of the scalp. There was a thin film of subdural haemorrhage covering both hemispheres of the brain. The brain showed no evidence of contusions or swelling. A neuropathological examination showed generalised ischaemia which was thought to be attributed to asphyxia, although a mild head injury could not be excluded. The toxicological examination identified no evidence of drugs or alcohol.

Discussion

We present an unusual child death that illustrates a number of findings to assist others investigating similar deaths. At the time of the death, the case raised issues related to how the child got into the dryer, how the door closed, how the dryer turned on, was the child dead before placement inside the dryer and how and why did the child die?

Only two papers concerning injuries or deaths associated with clothes dryers were identified within the peer-reviewed literature to assist in considering this case. The first of these papers describes a 3-year-old girl hiding in a clothes dryer, when the door closed and the dryer started up. She suffered blunt trauma especially to her back and arms, with full thickness burns to exposed areas of her body. The cause of death was not specified [14]. The second reports a non-fatal case of a 5-year-old child who climbed inside a clothes dryer when encouraged by two friends, who then closed the door and turned on the dryer [15]. The child was promptly rescued by her mother. The child suffered partial thickness

burns to 8% of her body (arms and back) and bruising to her head and shoulders. She made a full recovery. Three papers describing upper limb injuries associated with children putting their arms into older type top opening spin dryers were also identified [16–18]. A wider internet search identified a number of media reports on deaths of children across the world related to clothes dryers. The descriptions of the injuries sustained in these cases are poor, although they briefly describe the children suffering from head injuries, burns and blunt trauma when the dryers have been active. Suffocation is given as the cause of death in the cases where the dryer door was closed, but inactive [7]. Deaths are not limited to children; in 1989, an 18-year-old male died inside a large commercial dryer in California. The dryer was closed and activated accidentally by a co-worker. The individual died of severe head injuries from hitting the metal baffles inside the dryer.

As well as being a mechanism of death, clothes dryers have also been used to conceal bodies following homicide. A woman from Illinois hid the bodies of three children (aged 7, 2 and 1) in a dryer, after drugging and drowning them in a bath [4]. Another case involved a 14-year-old boy who drowned his 4-year-old neighbour and hid his body in a dryer after the child was going to disclose that the boy had been molesting him [11]. Thus, from reviewing the available literature from all sources, death as a result of being inside a clothes dryer can be due to blunt trauma, head injury, suffocation, burns, inhalation of hot gases or any combination of these when the dryer is active. When inactive, the cause of death is more likely to be related to suffocation.

In our case, the child was known to frequently hide around the house. He had been found asleep inside the drier before. The dimension of the dryer drum could accommodate a child the size of the deceased but it would be a tight fit. The possibility that the child had been killed or drugged prior to placement in the dryer in order to conceal the body was considered but there was no evidence to support this scenario. There were no injuries resulting from forced placement of the child, whilst alive or dead, into the machine.

Once inside the dryer then the dryer would not operate until the door was closed and the latch fastened. The possibility that the door had been intentionally or accidentally closed by another child or adult was considered and unproven. The possibility that a domestic animal had accidentally caused the door to close could not be excluded although there was no evidence on the door to support this happening. It was shown, through experiments, that the door could be closed accidentally by the action of the child within the dryer itself. Once the door was closed, as long as the timer was set, the dryer would operate for a short period of time before the weight of the child caused the belt to

burn out and the drum to stop rotating. However, hot air at a temperature of between 80°C and 100°C would still enter the drum compartment for the timer's duration.

The injuries to the child are explained by two mechanisms and supported by the peer-reviewed literature and media reports. Firstly, the child was tumbled for a short duration inside the active dryer. The locations of bruises on the body were mainly to the head, right side of the face, the right shoulder and back, as well as to the front of the knees and tops of the feet suggesting that the child was in a sitting position at this time. However, these injuries by themselves were not considered sufficient on their own to have caused the death of the deceased.

The second mechanism was that of exposure to hot air and contact with the air vents to the drum. The area of circular burning on the back of the body matched the dimensions of the air vents within the dryer, supporting the child's back had come into contact with the back of the drum. There was burning and swelling of the epiglottis and pharynx. These features are consistent with inhalation of hot air whilst the child was alive inside the active clothes dryer. The burns seen at the body could be caused by exposure to the hot air. The historical work of Moritz suggests this could occur within a matter of seconds [19]. The combination of the burns both to the skin and airways, as well as the blunt trauma to the head resulted in the death of the deceased.

The tears in the left hemidiaphragm and the fundus of the stomach with the pneumothorax and pneumoperitoneum initially raised the question of ante-mortem trauma. However, rupture of the stomach and the diaphragm, particularly in children, are a recognised complication of cardiopulmonary resuscitation. Due to the lack of a vital reaction associated with these findings and the absence of a component within the drum to cause blunt trauma injury sufficient to result in these injuries, these were attributed to aggressive resuscitation attempts at the scene. The use of post-mortem computed tomography (PMCT) in this case illustrates how these findings can be demonstrated prior to autopsy examination. Our case adds to the paucity of medical case reports relating to deaths associated with clothes dryers, assisting those investigating such deaths in terms of the scene, dryer, autopsy and PMCT findings.

Conflict of interest None.

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