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A Case Series of Injury Profile Following a Special Stage Rallying Weekend Event

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Abstract

Background: Special Stage Rallying (SSR) involves drivers using modified rally cars to compete in timed, staged events. The objective is to attain the fastest speed thus serious injuries can occur. Collisions are common place as are injuries to spectators and fatalities. We sought to summarise the pattern of injuries presenting to a general hospital during a 15 stage, two day SSR event.

Case Series: We recorded all patients presenting to the Emergency Department (ED) at a general hospital with injuries caused during the event. We followed all patients until day of discharge to record inpatient hospital bed days required in our hospital and others where transfer had been made. Eight patients presented (3 drivers, 2 navigators and 3 spectators). All were male. Two patients incurred soft tissue injuries that were treated by ED staff and discharged home. One patient was directly transferred to the Orthopaedic Regional Centre with a mid-foot dislocation. Five patients were referred to the General Surgery team (1rib fracture, 1 head injury, and 3 spinal fractures). 1 in 4 patients required surgical intervention and average length of inpatient hospital stay was 4.125 days (range 0-9; total 24). €19,536 worth of hospital bed days were required for management of these injuries.

Conclusion: SSR events are growing in popularity but are associated with a high burden of injury and occasional fatality. Strict safety regulation is essential as is improved safety provisions for spectators.

Keywords

special stage rally; rally related injuries; Road Traffic Accident (RTA); spinal injury

Introduction

Special Stage Rallying (SSR) is a popular form of motorsport with growing popularity worldwide [1]. SSR involves drivers using modified rally cars which are based on standard saloon cars that are fitted with special competition tyres and many upgraded mechanical parts and competing in high-speed timed events[1]. Poor quality small roads of30 mph speed limits or forestry routes are usually selected for competition depending on the event. Events are won based on the fastest cumulative time performed during each stage [1]. Motorsport Ireland (MI) is the National Governing Body for four-wheeled motorsport in Ireland. MI is affiliated to the lead authority for world motorsport, which is the "Federation Internationale de l'Automobile" (FIA) based in Geneva and Paris [1]. Motorsport Ireland covers the 26 counties of the Republic of Ireland and has 34 affiliated motor clubs that organise sporting events. There

approximately 230 events organised annually which cover 11 different branches of the sport. Each participant requires a Competition Licence issued by MI or by another national governing body affiliated to the FIA and all must complete an Introduction to Motorsport course and medical assessment [1, 2]. An average of 4,000 Competition Licences are issued annually. As the objective of SSR is to attain the fastest speed, serious and sometimes fatal injuries can occur [3-5]. Head on collisions are common place as are injuries to spectators. Anecdotal accounts of severe injuries are often reported in local and national news but the overall pattern of injury during such an event in Ireland has not been investigated to date [4, 5]. We sought to identify in this case series the pattern of injuries presenting to a general hospital Emergency Department (ED) with on-site general surgery cover and orthopaedic management referred to a regional referral centre during a 15 stage, 2 day motor rally event in our local area and calculate the financial cost of hospital beds days to manage these injuries.

Case Series

Patient Identification and Management:

We recorded all patients presenting to the Emergency Department (ED) at our hospital with injuries incurred as a direct result of a local SSR event in anonymised format. Trauma presenting to our hospital is managed by Emergency Department (ED) staff and the General Surgery on call team, covering a catchment area of approximately 160,000 people [6]. Orthopaedic injuries requiring surgical intervention are transferred to a Regional referral centre, covering a catchment area of 450,000 [6]. Advice on management of brain and spinal injuries is sought from their respective National Referral centres and patients are transferred if surgical intervention is required. We followed all patients until day of discharge to record all treatment required in our hospital and in others where transfer to such had been made and calculated total hospital bed days required for injury management. We contacted our Regional Referral Centre for Orthopaedic Surgery and Regional University Hospital Emergency Department to question if patients had presented to them with rally related injuries over that weekend period. We calculated the overall cost of hospital bed days required as a direct result of these injuries.

Patient Summary:

In total, eight patients presented to ED during this event. Our regional referral hospital reported no direct presentations to their department for management of rally related injuries. Two patients had soft tissue injuries and were managed and discharged by ED staff. One patient was referred directly from the ED to our regional Orthopaedic service with a complete mid-foot dislocation and five patients were referred to the on call General Surgery service in our hospital. Of the eight patients, three were spectators (38%), a further three were drivers and two were navigators (co-pilots). *Table 1* summarises patient characteristics, injuries incurred and treatment required. There were no fatalities reported from the event. The mean age of patients at presentation was 39.1 years (range 27-60). All patients treated were male. Here we describe four patients referred to the General Surgery service who sustained substantial injuries. The fifth patient referred to our service sustained 9th and 10th left sided rib fractures and was discharge the following day having completed treatment(analgesia, oxygen therapy and chest physiotherapy). The average length of hospital inpatient stay of the 5 patients admitted was 4.125 days (range 0-9; total 24 days).

Patient 1 - Head Injury:

A head injury was incurred by a 60 year old spectator who was positioned on an acute bend where a car collided at high speed with asign post which detached and made contact with his chest. This caused him to fall backward a distance of 2 metres and land on his occiput. On arrival to hospital his GCS was fluctuating between 11 and 12 following a brief episode of LOC at the scene. Examination revealed no focal neurological deficit or spinal tenderness. He had a contaminated scalp laceration over his occiput but no other external injuries. Plain radiograph of his cervical spine, chest and pelvis were normal and CT brain confirmed multifocal contrecoup contusions with a small associated SDH and occipital fracture (*Figure 1*). On consultation with our National Head Injuries Unit it was decided he was not for surgical intervention and proceeded for admission under our service for observation and analgesia, interval re-imaging, physio and occupational therapy. He recovered to a GCS of 15 by Day 2 and was discharged home on Day 12 following rehabilitation with physiotherapy and occupational therapy input.

Patient 2, 3 and 4 - Spinal Injuries:

Three patients sustained spinal fractures, none of which sustained cord injury. All three had sustained axial loading injuries due to head on collisions. The first patient sustained an unstable L1 burst fracture when he collided head on with a tree whilst reportedly travelling at 100kmph (*Figure 2*). He was transferred to the National Spine Injuries unit where he required operative intervention in the form of posterior decompression and fixation of his fracture. He was discharged home on post op day 5 following intensive physiotherapy and placed in a thoracolumbosacral orthosis (TLSO) brace for 6 weeks. The next two patients were travelling in the same car as driver and navigator. They collided head on with a concrete wall whilst reportedly travelling at 110 mph leading into a bend, causing the car to fall onto its left side and spin to a stop. The driver, who walked unaided from the car, sustained an L1 burst fracture on plain radiograph but self-discharged from hospital prior to further investigation. The navigator sustained T11 and T12 anterior wedge compression fractures and was assisted from the car by paramedics in full spinal precautions (*Figure 3*). He was transferred the following day to our regional orthopaedic referral centre and placed in a TLSO brace for an expected 12 weeks.

Economic Impact:

The economic impact of this event on the Irish Health Care System can be estimated using the number of hospital inpatient bed days required for management of all injuries. Based on data from the National Clinical Programme in Surgery it is estimated that a single hospital bed day costs €814 per patient per day [7]. The injuries described in this study required a mean hospital length of stay of 4.125 bed days and a total of 24 bed days. In financial terms, a cost of €19,536 for hospital bed days was required for treatment of the above injuries. This is estimated for hospital days alone and does not include costings for CT scans, ambulance travel, analgesia and other procedures required both operative and non-operative.

Discussion

We can see from the above cases the complex injury pattern that may be associated with SSR. Of concern, 38% of injuries were sustained by spectators and 1 in 4 injured parties required surgical intervention. Motorsport Ireland (MI) outlines rules and regulations which are updated on an annual

basis with particular attention to rally participants, safety procedures and equipment and general event management [8]. However severe injuries and fatalities are frequently seen. Between 1970 and 2006, 22 fatalities have occurred during FIA World Championship rallies (9 drivers and 13 co-drivers/navigators) but many more are reported in national and local events [3].

An unduly high number of spectators are also involved in such accidents. Tragically in Ireland in 2012 during an SSR event, seven participants were seriously injured and 2 spectators killed, one of whom was a young pregnant lady and the other an event photographer [4]. This was preceded by the death of a spectator in the Donegal International Rally in 2008 [5]. While safety regulations were not officially changed following these events, awareness improved amongst the rally community regarding spectator safety and stewarding at events. However no formal guidelines addressing this issue exist.

The injury profile sustained by our patients is in keeping with previously described patterns of injury associated with road traffic accidents (RTA). It's estimated that severe traumatic brain injury (sTBI) occurs in 10% of RTAs[9]. Interestingly, sTBI is more commonly seen in pedestrian injuries (15%) as opposed to motorists (7.4%) [9]. Similar to our patient, haemorrhage (subdural/subarachnoid) and or cerebral contusion account for > 50% of TBI associated with RTA [10, 11].It's also widely reported that pedestrians are associated with the lowest rates of ICU survival (60%) and favourable long-term outcome (46%) [12]. Rib fractures are commonly seen due to direct seatbelt trauma following high impact collision.

The pattern of spinal injuries seen were also characteristic for axial loading and flexion-distraction injuries incurred during head on collision causing acute deceleration in keeping with AO Classification [11-14]. Wedge, compression fractures account for almost 70% of thoracolumbar fractures as a result of an axial load applied in flexion as seen due to a head on collision in an RTA [11, 12]. Burst fractures also occur to compressive forces that fracture the vertebral endplate combined with pressure from the nucleus pulposus which can cause retropulsion of bony fragments into the spinal cord canal [13-14]. This type of injury is most commonly associated with falls and RTAs and can also occur due to head on collision. Burst fractures account for 14% of thoracolumbar fractures and all should be considered unstable as up to 58% of patients develop neurological deficits [13]. All 3 of our patients were front seat passengers who sustained axial loading injury.

To improve overall road safety, in 2011 MI launched a Road Safety Initiative in conjunction with the Road Safety Authority (RSA), a project piloted by the United Nations entitled "*Decade of Action for Road Safety 2011-2020*" [14]. The aim of this initiative on an International scale is to save five million lives on the Worlds roads over the next ten years. In Ireland, MI is promoting road safety through motorsport and motorsport events [14]. However safety at SSR events is not specifically included in this memorandum due to the high speed nature of eventing. While much emphasis is placed on participant preparation and correct harness use, the injuries described above were not avoided by such use [8, 15, 16]. Therefore, better risk factor surveillance is needed at an official level to help prevent crashes and promote participant and spectator safety as patterns of injury observed in our cohort are in keeping with typical patterns of injury associated with other road traffic accidents (RTA) [11, 16].

To summarise, SSR is growing in popularity in Ireland and worldwide. With its growing popularity, an increase in SSR associated injuries and fatalities is seen. Here we highlight the complex

pattern of injuries presenting to a General Hospital during a single 15 stage, 2 day SSR event. Typical injuries observed in RTAs were seen in our patient cohort. Worryingly 38% of patients treated at our hospital were spectators. Spectator safety is an area of SSR event planning that needs to be addressed at an official level. From an economic point of view, injuries from the above event incurred a cost of almost €20,000 on hospital bed days, a worrying figure in the current economic climate.

Figures

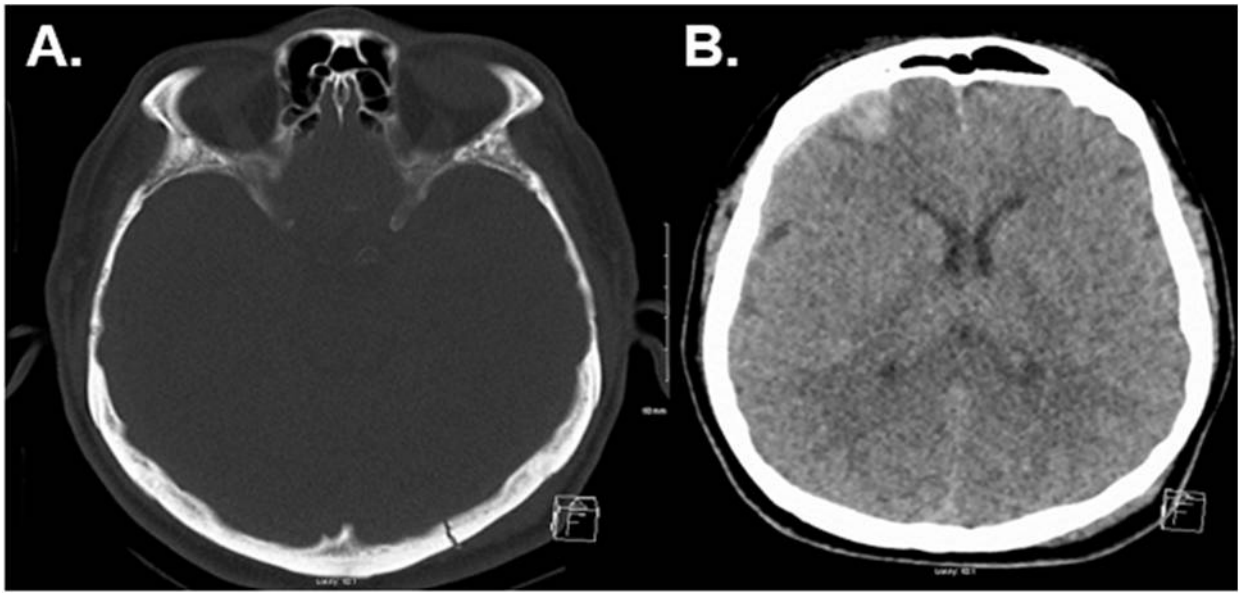

Figure 1: Axial CT Brain images
A. bone window showing left occipital fracture
B. Cerebral window showing multifocal cerebral contusion in right frontal lobe and right temporal lobe with small associated right frontal subdural haematoma.

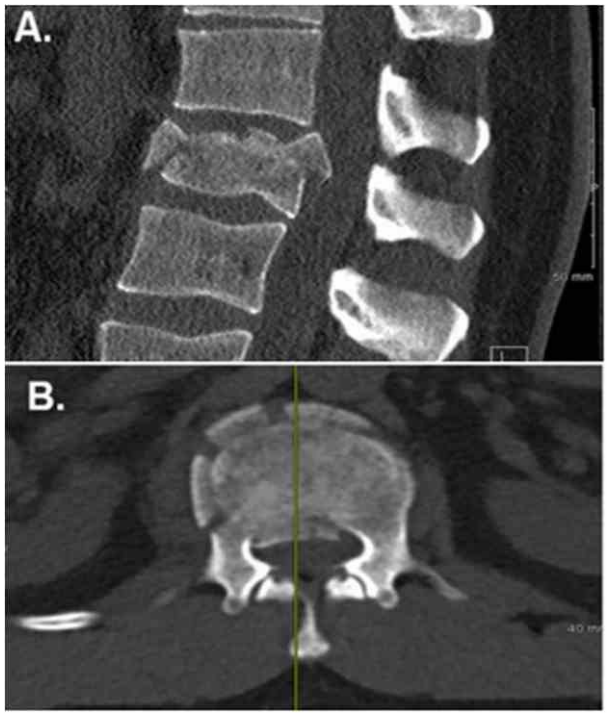

Figure 2: CT images of Lumbar Spine showing L1 unstable burst fracture. (A) Sagittal section through spinous process tip. (B) Axial section through L1 vertebra

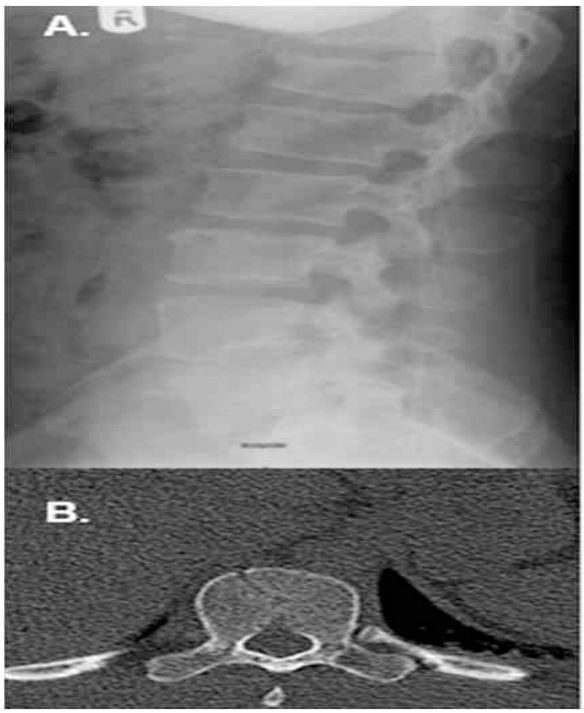

Figure 3: X-ray and CT images displaying T11 and T12 anterior wedge compression fractures. (A) X-ray showing T12 anterior wedge compression fracture. (B) Axial CT image through T11 vertebra showing anterior vertebral body fracture.

Table

Patient	Age	Role	Mechanism of Injury	Injury	Imaging	Management	Outcome
1	27	S	Fall when running to avoid car collision with signpost	Tibial Laceration	XR	Washout Suture Tetanus	Full recovery LOS – 0days
2	52	S	Car rolled over foot low speed anterior wheel	Soft Tissue foot injury	XR	R.I.C.E.	Full recovery LOS – 0days
3	29	D	Head on collision with grass embankment	Complete Mid-foot dislocation	XR	Transfer Regional Orthopaedic Unit	ORIF Casting and fracture clinic follow up LOS – 6days
4	60	S	Head on collision with grass embankment	Contrecoup multifocal contusions, SDH, occipital #	XR, CT	NFNSI Observation Interval Re-imaging Physiotherapy Occupational Therapy	Recovery to GCS 15 LOS – 9days
5	47	D*	Car collided with pole, which detached and hit patient on anterior chest wall causing a fall, landing on occiput	L1 Burst # Nil neuro	XR	NA	Self-D/C against medical advice
6	32	N	Head on collision with concrete wall (110 mph)	Left rib #s 9th and 10th	XR	Analgesia Chest Physio Oxygen Therapy	LOS – 1 day
7	29	N*	Head on collision with grass embankment	T12# Nil neuro	XR, CT	TLSO Brace (6 weeks) Physiotherapy	LOS – 3 days
8	37	D	Head on collision with concrete wall (110kmph)	L1 burst # (unstable) Nil neuro	XR, CT	T12-L2 Posterior Decompression and Fusion Physiotherapy	LOS- 5 days

Table 1: Patient characteristics, injuries incurred and treatment required, outcome.
S=spectator, D=driver, N=navigator; * travelling in same car; GCS=Glasgow Coma Scale; SDH= subdural haematoma; #=fracture; XR= x-ray; NFNSI=not for neurosurgical intervention; ORIF=open reduction and internal fixation; TLSO=Thoracolumbosacral Orthosis; LOS=Length of Stay

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