Liver and spleen injuries in side impact: differences by side of the road driven

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INTRODUCTION

MORE RECENTLY, INJURY FROM FRONTAL IMPACT HAS BEEN GREATLY REDUCED due to the introduction of safety devices such as airbags and seatbelts. However, injury resulting from side impact still poses a problem. As the human body is asymmetric, the injury pattern and severity will depend on the side of the occupant that is hit by the impacting vehicle. Vehicles in Australia, Hong Kong, Japan and England travel on the left side of the road while vehicles in most other countries travel on the right side of the road. In many vehicles, the driver is the only occupant, hence the side of the road the vehicle is driving on becomes significant. Consequently, the objective of this research was to contrast the injury patterns and severity observed from lateral impact to the different sides of the body. This paper focuses on injury patterns to the liver and spleen. It is expected that drivers in left side travelling vehicles would have a greater chance sustaining injury to the liver while drivers in right-side travelling vehicles would have an increased chance sustaining injury to the spleen.

METHODS

Data from three in-depth databases was used for the study:

1. For right side travelling vehicles, crash data between the years 1993 and 2000 inclusive was used from the NASS (National Automotive Sampling System) CDS (Crashworthiness Data System), which is compiled by the National Highway Traffic Safety Administration (NHTSA) in the US.
2. For left side travelling vehicles, crash data from the years 1983 to 2001 inclusive was extracted from the CCIS (Co-operative Crash Injury Study) database, which contains information on crashes in the UK.
3. For left side travelling vehicles, crash data was used from the Crash Vehicle File (CVF) compiled by Monash University, Victoria, Australia.

Basic data analyses on the age, gender and weight distributions were initially performed. As drivers as the main occupant, the data pertaining to the drivers was separated from the data on the other occupants for a study of liver and spleen injuries as a function of impact direction.

RESULTS

During the 8-year period, the NASS database recorded 36,515 occupants who sustained a total of 167,420 injuries. There were 1229 occupants who sustained liver injuries (3.37%) and 1072 occupants who suffered spleen injuries (2.93%). The CCIS database reported a total of 24,832 injured occupants during a 10-year period. The incidence of liver injuries was 2.40% while the frequency of spleen injuries was 1.65%. The CVF reported an incidence of 0.76% of liver injuries and 0.78% spleen injuries out of a total of 606 injured occupants. Liver and spleen impairments were found to be predominant in the 16-25 age group. Heavier US males (+86kg) and lighter US females (56-65kg) suffered the greatest incidence of liver injury, while in the UK, mid-weight males and females (65-74kg) demonstrated the highest number. The Australian data supported the UK data.

The number of liver and spleen injuries in drivers and front seat passengers (FSP) against impact direction is displayed in Table 1. For example, when considering right lateral impact (2-4 o'clock), US drivers suffered a 51.1% of the total number of liver injuries. FSP data and information

regarding the spleen was calculated in the same way for each of the three databases studied. The shaded boxes indicate the impact directions most likely to result in liver or spleen injury in the occupant concerned. The US data indicates that left lateral impact is more likely to result in liver or spleen injuries to the driver, whereas right lateral impact is more likely to give these injuries to the FSP (i.e. near-side impact is more detrimental). On the other hand, data from the UK and Australia suggests that the reverse is true; drivers are more likely to suffer liver or spleen injuries from right lateral impact, whereas left lateral impact is more detrimental to the FSP with respect to these injuries.

Table 1: Percentage of liver and spleen injuries as a function of impact direction for the three countries studied

Country	Impact Direction	PDOF	No. liver injuries in drivers/ total no. liver injuries	No liver injuries in FSP/ total no. liver injuries	No. liver injuries in drivers/ total no. injuries	No. liver injuries in FSP /total no. injuries
US	Right lateral	2-4 o'clock	51.1%	40.0%	2.90%	2.29%
	Rear	5-7 o'clock	41.9%	32.3%	0.52%	0.40%
	Left lateral	8-10 o'clock	83.2%	7.8%	3.12%	0.29%
	Frontal	11-1 o'clock	70.7%	21.6%	2.16%	0.66%
UK	Right lateral	2-4 o'clock	77.2%	8.94%	0.87%	0.10%
	Rear	5-7 o'clock	50.0%	21.4%	0.13%	0.06%
	Left lateral	8-10 o'clock	42.7%	40.4%	0.38%	0.36%
	Frontal	11-1 o'clock	67.6%	18.3%	0.33%	0.09%
Australia	Right lateral	2-4 o'clock	77.8%	0%	0.50%	0%
	Rear	5-7 o'clock	0%	0%	0%	0%
	Left lateral	8-10 o'clock	18.2%	63.6%	0.19%	0.67%
	Frontal	11-1 o'clock	51.8%	22.2%	0.38%	0.16%
Country	**Impact Direction**	**PDOF**	**No. spleen injuries in drivers/ total no. spleen injuries**	**No spleen injuries in FSP/ total no. spleen injuries**	**No. spleen injuries in drivers/ total no. injuries**	**No. spleen injuries in FSP /total no. injuries**
US	Right lateral	2-4 o'clock	36.02%	50.3%	1.14%	1.59%
	Rear	5-7 o'clock	40.7%	37.0%	0.44%	0.40%
	Left lateral	8-10 o'clock	82.1%	11.4%	5.65%	0.78%
	Frontal	11-1 o'clock	65.5%	25.7%	1.48%	0.58%
UK	Right lateral	2-4 o'clock	78.7%	13.1%	0.43%	0.07%
	Rear	5-7 o'clock	56.2%	18.7%	0.17%	0.06%
	Left lateral	8-10 o'clock	43.1%	43.1%	0.46%	0.46%
	Frontal	11-1 o'clock	62.5%	19.1%	0.14%	0.04%
Australia	Right lateral	2-4 o'clock	50.0%	0%	0.07%	0%
	Rear	5-7 o'clock	0%	0%	0%	0%
	Left lateral	8-10 o'clock	19.05%	57.1%	0.38%	1.14%
	Frontal	11-1 o'clock	44%	28%	0.30%	0.32%

DISCUSSION/CONCLUSIONS

Despite the asymmetry of the liver and spleen in the body, this study did not support the hypothesis that drivers in left-side travelling vehicles (where the driver is on the right side) have an increased chance sustaining injury to the liver, while drivers in right-side travelling vehicles (where the driver is on the left side) have a greater chance sustaining injury to the spleen. Interestingly, the results indicated that near-side impact is more likely to result in both liver and spleen injury than far-side impact.