

## A NEED FOR REEVALUATION OF SPORTS PARTICIPATION RECOMMENDATIONS FOR CHILDREN WITH A SOLITARY KIDNEY

BLAKE JOHNSON, CLINTON CHRISTENSEN, STEPHEN DIRUSSO, MUHAMMAD CHOUDHURY  
AND ISRAEL FRANCO\*

*From the Divisions of Urology (MC) and Pediatric Urology (IF), Department of Urology (BJ, CC) and Department of Surgery (SD), New York Medical College, Valhalla, New York*

### ABSTRACT

**Purpose:** We sought to evaluate the incidence and outcome of blunt renal injury in children by mechanism of injury. These data could then be used to provide the basis for more rational recommendations to parents and physicians regarding participation in sporting activities.

**Materials and Methods:** We analyzed data on 49,651 pediatric trauma cases collected by 92 trauma centers as part of the National Pediatric Trauma Registry from 1995 to 2001. Cases involving renal injury were isolated and the data were stratified according to age, sex and injury, as well as procedures required for treatment and outcomes.

**Results:** Of 49,651 pediatric trauma patients 813 incurred renal injury. There were 516 males and 291 females, and sex was not documented in 6 children. Average age was 10.6 years. There were no reports of a solitary kidney. In the sports group there were 4 nephrectomies, which were associated with sledding (2), skiing (1) and rollerblading (1), and 2 deaths related to skiing (1) and jet skiing (1). All 3 nephrectomies in the nonsports/other group were associated with equestrian activities, and 1 death occurred in this population. The nonsports/other group includes minor sports that are outlined by the American Academy of Pediatrics Committee on Sports Medicine and Fitness.

**Conclusions:** The majority of renal injuries in children associated with kidney loss (21 of 28) occurred as a result of motor vehicle accidents, pedestrians being struck by a vehicle or other object, and falls. There were no kidneys lost in any contact sport. Sledding, skiing and rollerblading resulted in kidney loss. Current recommendations of the American Academy of Pediatrics Committee on Sports Medicine and Fitness prohibiting children with a solitary kidney from participating in contact sports appear to be overly protective and need to be reevaluated. In some instances activities listed as limited contact sports resulted in renal loss, showing that the risk associated with these activities has been underestimated.

**KEY WORDS:** athletic injuries, child, adolescent, kidney, retrospective studies

In 1988 the American Academy of Pediatrics (AAP) Committee on Sports Medicine and Fitness recommended that children with a solitary kidney not participate in contact sports.<sup>1</sup> However, in 1994 and again in 2001 participation in sports for those with the “absence of one kidney” is granted a “qualified yes” with “individual assessment for contact, collision, and limited-contact sports.”<sup>2,3</sup> Although these guidelines are somewhat helpful, the lack of more specific guidelines and data regarding the incidence of renal injuries associated with these activities makes offering an informed recommendation difficult for the urologist. The personal experience of many urologists runs counter to the recommendations offered by the committee.

In our experience renal injuries, especially those requiring nephrectomy, have been associated with motor vehicle collisions and sledding accidents. It is our experience that no kidney has been lost as a result of a contact sport related injury.

Two recent incidents in our catchment area underscore the problems that ambiguous recommendations by the medical community can cause. In 1 case an adolescent male with a solitary kidney was not allowed to try out for the school soccer team. A court case ensued, which went to the New

York Supreme Court before the boy was allowed to play soccer. The other instance involved a patient of ours with a solitary kidney who had to sue the school district to be allowed to participate in physical education. Given the litigious nature of our society, cases such as these are common throughout the United States, and may alter our way of practicing medicine. More concrete guidelines may decrease this type of litigation and its social and economic impact on the community.

In an effort to provide data for more specific recommendations regarding sports participation for those with a solitary kidney we reviewed a national pediatric trauma database to evaluate the association of renal injuries in children participating in sports and other activities. In particular, the incidence of nephrectomy associated with different mechanisms of injury is important information, as nephrectomy in an individual with a solitary kidney would result in lifelong dialysis or renal transplant.

### METHODS

We analyzed data on 49,651 pediatric trauma cases whose information was collected by 92 trauma centers as part of the National Pediatric Trauma Registry (NTPR) from 1995 to 2001. Individuals who suffered renal injury were selected and the data were stratified according to age, sex, mechanism of injury, treatment procedures, injury severity score (ISS) and outcome.

Submitted for publication December 1, 2004.

\* Correspondence: Pediatric Urology Associates, 19 Bradhurst Ave., Hawthorne, New York 10532 (FAX: 914-493-8564; e-mail: Isfranco@optonline.net).

TABLE 1. Renal injury data from National Pediatric Trauma Registry, 1995 to 2001

Injury Mechanism	No. Pts (%)	Mean Pt Age (yrs)	No. Deaths	No. Nephrectomies	No. Partial Nephrectomies	No. Renal Laceration Repairs	No. Renal Explorations
Motor vehicle accident	293 (36)	10.7	20	9 (2 deaths)	1	1	0
Pedestrian struck	119 (15)	7.8	12	7 (2 deaths)	0	0	0
Fall	107 (13)	9.5	0	5	0	1	0
Bicycle	92 (11)	11.3	5	0	1	1	1
Sports	85 (10)	13.6	2	4	0	0	1
Other	117 (14)	9.1	8	3 (1 death)	0	1	0
Totals	813	10.6	47	28 (5 deaths)	2	4	2

## RESULTS

Of 49,651 pediatric trauma patients 813 suffered renal injury. There were 516 males and 291 females, and sex was undocumented in 6 children. Average age was 10.6 years. Average ISS of those who suffered renal injury but did not undergo nephrectomy was 14.3 (median 9, range 4 to 75), and average ISS in those undergoing nephrectomy was 20.9 (19, 4 to 45). Mechanism of injury, intervention and outcome are listed in table 1. There were no reports of a solitary kidney in injured individuals. Unfortunately, the database did not specifically delineate whether a patient had a solitary kidney or 2 kidneys when a renal injury was recorded.

Of renal injuries 64% resulted from motor vehicle collisions (293 cases), pedestrians being struck by vehicles or other objects (119), and falls (107). These 3 mechanisms of injury accounted for a total of 519 renal injuries, 21 nephrectomies, 1 partial nephrectomy and 2 renal laceration repairs. There were also 4 deaths in this group.

Bicycle injuries accounted for 92 renal injuries, or 11% of all renal traumas, with an average patient age of 11.3 years (range 4 to 17). There were 51 isolated bicycle accidents, 31 riders were struck by a motor vehicle and 10 accidents were described as "other." Overall injuries were severe in the bicycle group as measured by the ISS system, with an average ISS of 12.2 (range 4 to 59). Although no nephrectomies were performed in these individuals, 1 partial nephrectomy, 1 repair of renal laceration and 1 renal exploration were performed. There were 5 deaths in the bicycle group, of which 4 were secondary to head trauma and 1 was due to hemorrhage.

A total of 85 individuals suffered a sports related renal injury (table 2). Renal injury grading is listed in table 3. Among sports related renal injuries 24% were associated with football. The ISS of all these football players was either 4 or 5. An injury was deemed to be sports related if it was caused by a sport classified by the American Academy of Pediatrics Committee on Sports Medicine and Fitness as contact, limited contact or noncontact.

Average ISS of the 11 females with renal injuries was 19.5, while the 73 males had an average ISS of 8.9. Average age, average ISS and grade of renal injury for all sports are listed in table 4. Nephrectomies associated with sports activities were attributed to sledding (2 cases), skiing (1) and rollerblading (1), while 2 deaths were related to skiing (1) and jet skiing (1). All 3 nephrectomies in the nonsports/other group were associated with equestrian activities, as was 1 death (the nonsports/other group comprises all sports not included

in table 4, which are minor sports that are outlined in the AAP sports list).<sup>3</sup>

## DISCUSSION

The estimated annual number of injuries secondary to sports and recreation in children and adolescents in the United States is 4,379,000, with 1,363,000 reported as serious sports related injuries.<sup>4</sup> It seems natural that with such a high number of childhood injuries there would be a hesitancy to allow children with a solitary kidney to participate in sports and recreation activities. A 1995 survey of members of the American Society of Sports Medicine revealed that 54.1% would allow an individual with a solitary kidney to participate fully in contact and collision sports at the high school or college level. If the participant were the son or daughter of the physician, the percentage decreased to 41.6%.<sup>5</sup> In 2001 a survey of members of the AAP Section on Urology was conducted by Sharp et al.<sup>6</sup> Of this group 68% recommended that patients with a solitary kidney avoid contact sports, although there was a general consensus that the risk of associated renal injury is low.

The current literature does not demonstrate that contact or team sports are major causes of renal injury resulting in kidney loss. A review of 68 renal injuries in children by Gerstenbluth et al showed that most renal injuries were associated with bicycle accidents rather than contact sports.<sup>7</sup> McAleer et al reviewed the incidence of renal injury among 14,763 trauma patients and found 98 renal injuries associated with recreational activities, with no kidneys lost among those participating in team sports.<sup>8</sup> More than 50% of these renal injuries were associated with bicycles or falls. The findings of both of these studies are consistent with our data.

Football is considered a contact sport and seems to be of particular concern due to the high impact nature of the game. It has been estimated that participation in organized football is in excess of 75,000 college athletes and 1.3 million high school athletes.<sup>9</sup> It is noteworthy that although there were more renal injuries associated with football than any other sport in the NTPR database, the overall severity of these injuries was low and no grade 3 renal injuries were reported. The NTPR database does not differentiate between those who are playing organized football or other sports and those who are injured while playing "backyard ball." Thus, we are unable to draw any conclusions regarding whether organized sports, where protective gear is worn, result in a higher or lower incidence of renal injury.

An observational cohort study by Radelet et al followed 1,659 children 7 to 13 years old during a 2-year period. There

TABLE 2. Sports related renal injuries

	Sex	
	Male	Female
No. pts injured	74	11
Age range (mean)	6-19 (13.64)	10-19 (13.45)
Age most frequently injured	16	15
Av ISS	8.9	19.5
No. deaths	0	2

TABLE 3. Grading of bicycle and sports associated renal injuries

Injury Grade	No. Sports Injuries (%)	No. Bicycle Injuries (%)
0 (unspecified)	8 (9)	8 (9)
1 (hematoma without capsular rupture)	31 (36)	43 (47)
2 (laceration)	36 (42)	36 (39)
3 (complete disruption of kidney parenchyma)	10 (12)	5 (5)

TABLE 4. Sports renal trauma data

Sports (No. injuries)	Sex		Mean Pt Age (yrs/range)	Mean ISS (range)	Renal Injury Grade (No. pts)*			
	Male	Female			0	1	2	3
Football (20)	20	0	14.4 (12–19)	4.1 (4–5)	1	7	12	0
Sledding (11)	7	4	12.55 (10–16)	13.82 (4–38)	3	2	6	0
Snowboarding (7)	7	0	13.29 (6–16)	7.71 (4–16)	0	4	1	2
Skiing (7)	4	3	15.71 (12–19)	23.71 (4–50)	1	1	2	3
Skateboarding (6)	6	0	13.5 (9–18)	14.83 (4–26)	0	3	2	1
Basketball (6)	6	0	14.33 (12–16)	7 (4–16)	2	2	1	1
Rollerblading (5)	5	0	12.8 (9–16)	9.6 (5–24)	1	3	1	0
Baseball (5)	5	0	14.4 (11–17)	8 (4–19)	0	2	2	1
Hockey (3)	3	0	15 (13–17)	5.67 (4–9)	0	0	2	1
Jet skiing (3)	1	2	11 (8–13)	20 (6–38)	0	2	1	0
Soccer (2)	2	0	12 (8, 16)	4 (4, 4)	0	1	1	0
Skating (2)	1	1	14.5 (14, 15)	4 (4, 4)	0	1	1	0
Other (8)†	7	1	11.88 (7–16)	8.88 (4–35)	0	4	4	0

\* Grade 0—unspecified, 1—hematoma without rupture of capsule, 2—laceration and 3—complete disruption of kidney parenchyma.

† Other sports include boogie boarding, wrestling, lacrosse, running, bicycle racing, gym class and snow tubing.

were no documented renal injuries while these children participated in football, baseball, softball and soccer.<sup>10</sup> More than 4,000 varsity high school football players were followed for 1 football season by DeLee and Farney.<sup>11</sup> They reported 2,228 football related injuries during this period, with 97 injuries requiring hospitalization and surgical treatment, including 3 splenectomies and 1 appendectomy. However, there were no renal injuries observed. Goldberg et al reported no renal injuries in 5,128 boys participating in youth football.<sup>12</sup> Similarly, a prospective observational analysis of 915 football players 9 to 13 years old by Stuart et al identified no renal injuries.<sup>13</sup>

Winter sports were implicated in 3 of the 4 sports related nephrectomies reported in the NTPR database. Activities such as skiing, snowboarding and sledding, in which participants travel at a high velocity and which are associated with rapid deceleration, appear to present the greatest risk of renal injury and even renal loss. Radmayr et al identified 4 nephrectomies due to renal trauma among 254 children with renal trauma transferred to their institution in Austria from 1975 to 2001.<sup>14</sup> The majority of these traumatic injuries resulted from skiing accidents, with 18 children sustaining severe multiple trauma with laceration of other vital organs. However, the majority of the renal injuries were managed conservatively.

Skiing, rollerblading and horseback riding are listed by the American Academy of Pediatrics Committee on Sports Medicine and Fitness as limited contact sports. However, it was participation in these activities that led to renal loss, while there were no documented nephrectomies associated with traditional contact sports. Also, bicycling, which is classified as a limited contact sport, resulted in more renal injuries than all other sports combined, although there were no nephrectomies in this group.

The NTPR data we present here support the conclusions of other recent reviews of smaller but detailed trauma databases,<sup>7,11</sup> namely that although the actual incidence of renal injury in football and other sports is difficult to assess precisely, the incidence of renal loss associated with contact sports appears to be low. The risk of renal loss while participating in contact sports with a solitary kidney appears to have been overestimated in the past. The vast majority of renal injuries and kidney loss associated with childhood activities have been linked to bicycles, falls, motor vehicle collisions and sports classified by the AAP as involving limited contact. In general, these injuries were all associated with rapid deceleration.

Motor vehicle accidents and being struck by vehicles account for the overwhelming majority of renal injuries and nephrectomies. Falls also account for more renal injuries than all sporting injuries. Yet no one thinks twice about

putting a child with a solitary kidney in a car and driving to the urology office for an annual evaluation.

There are limitations to this type of study in which data are gathered in a large database and retrieved retrospectively. These limitations include the inability to know how many patients had a solitary kidney at the time of initial trauma, what the long-term outcome was regarding renal function and who cared for the patient primarily, ie a trauma surgeon or urologist.

#### CONCLUSIONS

The majority of renal injuries in children where a kidney is lost (21 of 28) were caused by motor vehicle accidents, pedestrians being struck by a vehicle or other object, and falls. There were no kidneys lost in any contact sport. There was documented kidney loss in children participating in sledding, skiing and rollerblading. Current recommendations appear to be askew, since limited contact sports are associated with a greater overall incidence of renal injury than full contact sports. A reevaluation of the current recommendations needs to be undertaken to remove ambiguity and define more specific guidelines.

#### REFERENCES

1. American Academy of Pediatrics Committee on Sports Medicine: Recommendations for participation in competitive sports. *Pediatrics*, **81**: 737, 1988
2. Committee on Sports Medicine and Fitness: Medical conditions affecting sports participation. American Academy of Pediatrics Committee on Sports Medicine and Fitness. *Pediatrics*, **94**: 757, 1994
3. Committee on Sports Medicine and Fitness: American Academy of Pediatrics: medical conditions affecting sports participation. *Pediatrics*, **107**: 1205, 2001
4. Bijur, P. E., Trumble, A., Harel, Y., Overpeck, M. D., Jones, D. and Scheidt, P. C.: Sports and recreation injuries in US children and adolescents. *Arch Pediatr Adolesc Med*, **149**: 1009, 1995
5. Anderson, C. R.: Solitary kidney and sports participation. *Arch Fam Med*, **4**: 885, 1995
6. Sharp, D. S., Ross, J. H. and Kay, R.: Attitudes of pediatric urologists regarding sports participation by children with a solitary kidney. *J Urol*, part 2, **168**: 1811, 2002
7. Gerstenbluth, R. E., Spirnak, J. P. and Elder, J. S.: Sports participation and high grade renal injuries in children. *J Urol*, **168**: 2575, 2002
8. McAleer, I. M., Kaplan, G. W. and LoSasso, B. E.: Renal and testis injuries in team sports. *J Urol*, part 2, **168**: 1805, 2002
9. Mueller, F. O. and Blyth, C. S.: Can we continue to improve injury statistics in football? *Phys Sportsmed*, **12**: 79, 1984
10. Radelet, M. A., Lephart, S. M., Rubinstein, E. N. and Meyers, J. B.: Survey of the injury rate for children in community

- sports. *Pediatrics*, **110**: e28, 2002
11. DeLee, J. C. and Farney, W. C.: Incidence of injury in Texas high school football. *Am J Sports Med*, **20**: 575, 1992
  12. Goldberg, B., Rosenthal, P. P., Robertson, L. S. and Nicholas, J. A.: Injuries in youth football. *Pediatrics*, **81**: 255, 1988
  13. Stuart, M. J., Morrey, M. A., Smith, A. M., Meis, J. K. and Ortiguera, C. J.: Injuries in youth football: a prospective observational cohort analysis among players aged 9 to 13 years. *Mayo Clin Proc*, **77**: 317, 2002
  14. Radmayr, C., Oswald, J., Muller, E., Holtl, L. and Bartsch, G.: Blunt renal trauma in children: 26 years clinical experience in an alpine region. *Eur Urol*, **42**: 297, 2002

#### EDITORIAL COMMENT

This is a sound article on an important topic, and it has tremendous medicolegal implications. While the retrospective nature of these data has its drawbacks, the data are consistent with previous smaller studies showing that traditional school sports such as foot-

ball, basketball, soccer and baseball are almost never associated with severe renal injuries. Activities more likely to produce a rapid deceleration type injury (such as sledding, snowboarding, skiing and biking) appear to involve higher risk. Pedestrian injuries, motor vehicle accidents and falls are all more commonly linked to renal injuries than team sports. Male teenagers and young men seem to be most vulnerable.

The patient with a solitary kidney warrants special consideration on entering adulthood. For example Army regulations stipulate that the absence of a kidney is an automatic disqualifier for enlistment or appointment to military service. I once had a young man ask me not to take out his severely lacerated kidney because that would disqualify him from a lucrative rodeo career. Risk reduction is justified as these children undertake adult activities.

*Allen F. Morey  
Urology Service  
Brooke Army Medical Center  
Fort Sam Houston, Texas*