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ORIGINAL ARTICLE

Climbing harness fit in kidney transplant recipients

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Objective.—The superficial location of renal transplants places them at risk for traumatic damage. Significant injuries have been reported from automobile seat belts, for example. This study was designed to assess the potential for direct transplant injury from the use of climbing harnesses.

Methods.—Ten patients with kidney transplants were fitted with a variety of climbing harnesses after the locations of their grafts were defined.

Results.—With the exception of two harnesses in a single patient, all devices came into contact with all transplants.

Conclusion.—Sports requiring the use of climbing harnesses (eg, rock climbing, rappelling, and challenge course participation) may be unsafe for recipients of kidney transplants.

Key words: kidney transplantation, rock climbing, equipment, challenge courses

Introduction

During the 4 decades that comprise the modern era of kidney transplantation, remarkable advances in rehabilitation have occurred [1]. Today, recipients of living donor or cadaveric kidneys can expect an overall graft survival at 5 years of 76% and 59%, respectively [2].

There have been similar advances in pretransplant management, including more efficient dialysis, the treatment of anemia with erythropoietin, osteodystrophy prevention with calcitriol and phosphate binders, and growth enhancement with recombinant human growth hormone to name a few. These improvements have resulted in patients coming to transplant in much better overall health and with fewer chronic morbidities than even as recently as 10 years ago.

These two trends have resulted in an increasingly large population of young transplant recipients in otherwise excellent health. As is the case today with many individuals with disabilities, these patients are increasingly participating in sports. Many take part at very high levels; there is now a national, highly competitive "Transplant Olympics" [3].

Transplant patients may also be drawn to more extreme sports. Climbing is a rapidly growing activity in the United States. The safety equipment and procedures utilized in rock climbing are shared by users of indoor climbing walls, as well as by participants in ropes (challenge) courses. Given the pelvic location of renal transplants and the design of most climbing harnesses, there would seem to be a potential for direct transplant injury by such equipment. This study was undertaken to address this possibility systematically.

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Methods

PATIENTS

A convenience sample of stable post-kidney transplant patients attending follow-up in the Children's Hospital Medical Center (CHMC) kidney center was recruited. The study was reviewed and approved by the Review Board on Investigations Involving Human Beings of the CHMC. Consent was obtained from all patients and from a parent of any patient under 18 years of age.

PROCEDURES

For each of the 10 patients, height and weight were measured and surface area calculated from a standard nomogram. The location of the transplanted kidney was then determined by palpation, and its borders were marked.

After locating the kidney, the patient was fitted for each of four harnesses (Blue Water, Ltd., Carrollton, GA; Petzl, Crolles, France; REI, Inc., Seattle, WA; Yates Gear, Inc, Redding, CA). These were all commercially available seat-type harnesses. Additionally, a Swiss seat

Table 1. Summary of patient data

Patient No.	Patient Age (y)	Sex	BSA, m^2*	No. of Harness Fittings in Each Category†			
				0	1	2	3
1	23	M	1.4	...	...	3	3
2	21	F	1.7	...	...	3	3
3	19	M	1.7	...	...	3	3
4	18	M	1.7	...	...	6	...
5	17	M	1.8	...	...	2	4
6	17	M	1.9	...	...	6	...
7	21	M	1.9	...	1	5	...
8	15	M	2.0	2	...	4	...
9	21	M	2.0	...	1	5	...
10	21	M	>2.0	...	...	5	1

* BSA = body surface area.

† Categories: 0 = no portion of graft covered by harness; 1 = >0, <⅓ covered; 2 = ≥⅓, <⅔ covered; 3 = ≥⅔ covered. See text for further details.

and a diaper seat were fitted using 1-inch tubular nylon webbing. Both of these widely used methods replicate seat-type harnesses by incorporating leg loops and a waist belt. Kidney localization and seat or harness fitting were all done by the author, a transplant physician and ropes course director.

With the patient in the upright position, a spring scale, calibrated by the Clinical Engineering Department of CHMC, was next attached to a carabiner on the front of the harness or seat. Sufficient upward force to deflect the scale to 10 lb was applied, directed about 20° from vertical. No attempt was made to simulate the actual forces or vectors likely to be generated in a fall, since the concern that stimulated this study made such maneuvers unethical. For each kidney-harness pair, the approximate proportion of the projected surface area of the graft covered by the device was recorded. Four categories were used: 0, no portion of graft covered; 1, >0, <⅓ covered; 2, ≥⅓, <⅔ covered; and 3, ≥⅔ covered.

Results

PATIENTS

The 10 subjects included nine males and one female. Although their ages ranged from 15 to 23 years, all were at or near their adult stature (ie, Tanner stage V). Their anthropometric data are summarized in the Table.

GRAFT/HARNESS POSITION

With the exception of two commercial harnesses in a single patient, every harness tested contacted at least a portion of the kidney in each of the 10 subjects (Table). As might be predicted, there was a tendency for the smaller patients (lowest body surface area) to have higher proportions of their kidneys covered by the harnesses.

Discussion

This study was prompted by a report of kidney graft loss in a participant in a ropes course utilizing a standard climbing harness [Larry Patterson, MD, personal communication]. Although this is the only such injury with which the author is familiar, there are a number of other relevant reports in the literature.

At least three cases of serious injury to transplanted kidneys from automobile seat belts have been reported [4–6]; such belts overlie pelvic grafts in a fashion virtually identical to that of climbing harnesses. In a fourth case [7], a seat belt caused injury to a horseshoe kidney. Although this was a native kidney rather than a graft, its ectopic position in the abdomen made it similarly vulnerable.

In addition to their ectopic position (Figure), transplanted kidneys have other differences from native organs. After several months in place, they tend to become fixed within a hard fibrous capsule, unlike the freely ballotable native kidney. Thus, they have less potential to dampen a sudden impact [8].

There was no major difference in the likelihood of any particular harness coming into contact with the surface projection of the transplants in these 10 recipients. This is not surprising. The design principle common to all harnesses and webbing seat systems consists of a waist belt, independent leg loops, and a connection between the two. Such design virtually ensures some contact with pelvic structures. Minor variations in harness design and body habitus dictate the extent to which such contact occurs.

Are options available for transplant recipients who choose to participate in climbing, rappelling, or ropes courses? Obviously, the market would be far too small to attract a commercial design. In any case, it would be difficult to subject such a design to a realistic test without raising ethical and liability concerns.

The author is aware of some transplant patients who use padding over their grafts to protect them from injury in sports. Whether such protection would adequately dissipate the forces generated in a fall from a height would be pure conjecture. The use of a full-body harness rather than a seat harness would be another option. While such a device would obviously dissipate forces over a much wider area, such harnesses also include pelvic straps, so the potential for some contact would remain.

Are the benefits of climbing or similar activities requiring harnesses great enough to justify the risk in

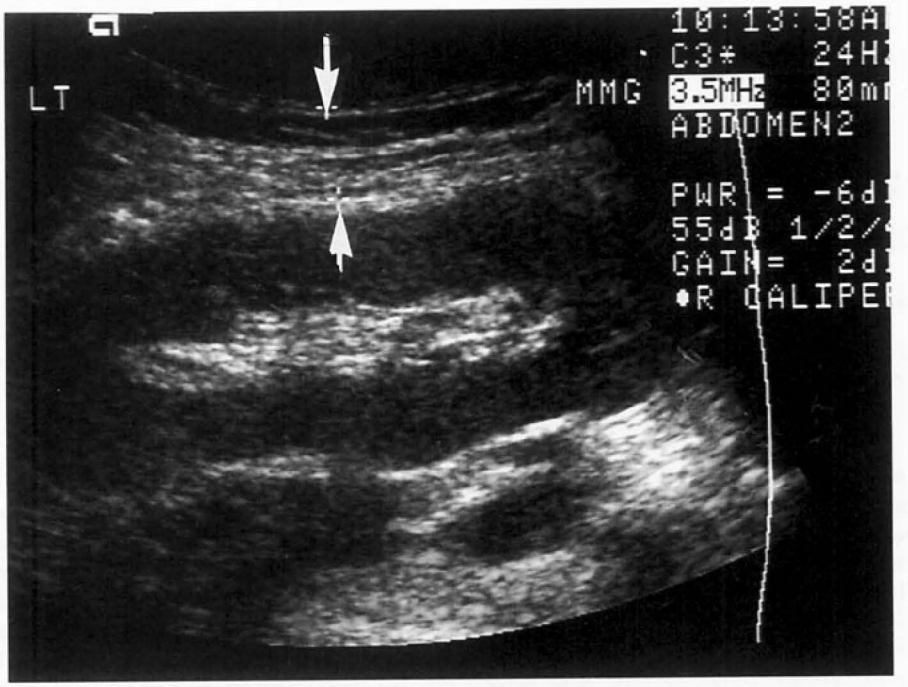

Fig. 1. Pelvic ultrasound in a 54-kg transplant patient. The distance between the skin surface and the kidney capsule (between arrows) is only 1.3 cm.

transplant patients? While this may be seen as a question for each individual, a few guidelines seem appropriate. First, patients below the age at which they can provide independent informed consent (18 years in most jurisdictions) should probably be excluded completely from such activity. Competent adults, on the other hand, should be discouraged from participation, but if they choose to do so, they should be provided with a full disclosure of risks and should provide any commercial operation with a hold-harmless agreement. While most such operations do not undertake any formal medical screening, it seems appropriate to alert the responsible professionals to this issue.

Kidney graft loss is often associated with the development of antibodies that make it difficult to find a compatible donor for a retransplant. Although participation in risky activities may be considered an issue of individual autonomy, it must be remembered that donor organs are in relatively short supply [1]. It may be unethical for a patient to subject his or her transplant to the risk of loss when other recipients are awaiting donor organs.

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