the normal growth of children but "catch-up" growth rarely occurs. Growth appears to stop several years earlier than normal in both girls and boys. There is no correlation of growth with source of kidney, histocompatibility typing, maintenance dose of steroids, or renal function.

7. Early post-transplant hypertension is a problem which requires vigorous antihypertensive measures to avoid central nervous system changes.

8. Transplants have been carried out in two infants aged 2 to 4 months without technical difficulty. One infant rejected the transplant 3 months later and the other died suddenly on the 2nd post-transplant day.

9. The success of renal transplantation in children is equal to that in adults.

References

1. Bernstein, D. M.: After Transplantation—The Child's Emotional Reactions. Amer. J. Psych., 127:1189, 1971.
2. Broyer, M., Loirat, C., Kleinknecht, C., Rappaport, R. and Raymbault, G.: Eighteen Month's Experience with Hemodialysis in Children. Proc. Europ. Dialysis Transplant. Assos., 7:261, 1970.
3. Buselmeier, T. J., Santiago, E. A., Simmons, R. L., Najarian, J. S. and Kjellstrand, C. M.: Arteriovenous Shunts for Pediatric Hemodialysis. Surgery (In press).
4. Cerilli, G. J., Nelsen, C. and Dorfmann, L.: Renal Homotransplantation in Infants and Children with the Hemolytic-Uremic Syndrome. Surgery (In press).
5. Fine, R. N., Korsch, B. M., Stiles, Q., Riddell, H., Edelbrock, H. H., Brennan, L. P., Grushkin, C. M. and Leiberman, E.: Renal Homotransplantation in Children. J. Ped., 76:347, 1970.
6. Gonzalez, L. L., Martin, L., West, C. D., Spitzer, R. and McEnery, P.: Renal Homotransplantation in Children. Arch. Surg., 101:232, 1970.
7. Grupe, W. E. and Heymann, W.: Cytotoxic Drugs in Steroid-Resistant Renal Disease. Amer. J. Dis. Child., 112:448, 1966.
8. Herdman, R. C., Pickering, R. J., Michael, A. F., Vernier, R. L., Fish, A. J., Gewurz, H. and Good, R. A.: Chronic Glomerulonephritis Associated with Low Serum. Medicine, 49:207, 1970.
9. Kelly, W. D., Merkel, F. K. and Markland, C. A.: Ileal Urinary Diversion in Conjunction with Renal Homotransplantation. Lancet, 1:222, 1966.
10. Kelly, W. D., Lillehei, R. C., Aust, J. B., Varco, R. L., Leonard, A. S., Griffen, W. O., Markland, C. A., Herdman, R. C., Vernier, R. L., Michael, A. F. and Levitt, J.: Kidney Transplantation Experiences at the University of Minnesota Hospitals. Surgery, 62:704, 1967.
11. Kountz, S.: Personal Communication.
12. Mahoney, C. P., Striker, G. E., Hickman, R. O., Manning, G. B. and Marchioro, T. L.: Renal Transplantation for Childhood Cystinosis. New. Eng. J. Med., 283:397, 1970.
13. Simmons, R. L., Kelly, W. D., Tallent, M. B. and Najarian, J. S. Cure of Dysgerminoma with Widspread Metastases Appearing After Renal Transplantation. New Eng. J. Med., 283:190, 1970.
14. Simmons, R. L., Moberg, A. W., Gewurz, H., Soll, R., Tallent, M. B. and Najarian, J. S.: Immunosuppressive Assay of Antilymphoblast Globulin in Man: Effect of Dose, Histocompatibility, and Serologic Response to Horse Gamma Globulin. Surgery, 68:62. 1970.
15. Simmons, R. G., Hickey, K., Kjellstrand, C. M. and Simmons, R. L.: Family Tension in the Search for a Kidney Donor. JAMA, 215:909, 1971.
16. Starzl, T. E.: Experience in Renal Transplantation. Philadelphia, W. B. Saunders Company, 1964.
17. Weil, R. W., III, Simmons, R. L., Tallent, M. B., Lillehei, R. C. Kjellstrand, C. M. and Najarian, J. S.: Prevention of Urological Complications Following Kidney Transplantation. Ann. Surg. 174:154,, 1971.
18. Williams, G. M., Lee, H. M. and Hume, D. M.: Renal Transplants in Children. Transplant. Proc., 1:262, 1969.

Discussion

Dr. Joseph E. Murray (Boston): Dr. Najarian and his group, who have produced such a high standard of excellence in clinical transplantation, have presented a timely resume of this subject today. It was Dr. Starzl, I believe, who first popularized the technics of kidney transplants in infants and children, and Dr. Hume who first presented a series of transplants before the Transplant Society a few years ago. Today's study is really a magnificant review of this pediatric experience, and I will only make comments on two aspects: first, the need for extra-careful assessment of the lower urinary tract in prospective recipients of this age group; and secondly, the special socio-economic aspects of donor selection, usually a parent, in these young recipients.

Regarding the lower urinary tract, uremia and dilatation *per se* can produce bladder malfunction and ureteral reflux and dilatation without any anatomical abnormality; and Drs. Harrison and Gross may recall a girl we studied about 7 years ago when we wondered whether or not we ought to transplant because of the presence of ureteral reflux and poor bladder function. Both of them

advised, correctly, that a correction of uremia by a well-functioning transplant might well improve her particular type of lower urinary tract function, and such was the case. This patient has had normal lower urinary tract function for the past 7 years, following a successful transplant from her mother.

So, an evaluation of the mechanism and etiology of the lower urinary tract malfunction in children deserves extra-careful investigation.

Whether or not everyone should be transplanting patients who have ileal loops is an individual group decision. With the great numbers of recipients who are flooding all transplant centers, it would seem probably wiser to have only a few centers doing transplants into recipients with ileal loops and obtaining the results before every center utilizes this type of recipient.

The second point, the socio-economic aspects of donor selection. These little children have young parents, and if there are other siblings in the family, we find that the selection of one parent does create family problems in some instances. If the family live at a distance, it means that one parent—the donor—must be at the transplant center. The other parent is at home coping with the family problems, and if there are complications for the recipient or infections, or second transplants, requiring longer hospitalization, it can divide the family as far as the parents are concerned, for a considerable period of time. I would like Dr. Najarian to comment further on this point.

Finally, there is no reason why children should do any worse than adults immunologically. They probably have better survival chance than older recipients even if cadaveric donors are used because children have more resilient cardiovascular and pulmonary systems.

DR. THOMAS EARL STARZL (Denver): For reasons that have never been very clear, the pediatric patient has been considered in many centers to be an unfavorable candidate for organ transplantation. In fact, we agree with Dr. Najarian that the pediatric patient is actually a favored recipient.

Perhaps I can support this view by giving a follow-up of the first series of pediatric renal transplantations—20 in all—which we reported in the *Pediatric Clinics of North America* (13:381, 1966). The article was written in 1965 at which time 14 (70%) of the 20 recipients were alive with maximum follow-up of up to 3 years. Today these same 14 patients are still alive, now 7 to 8½ years post-transplantation, and in all but two of the 14 cases their original transplants are still functioning.

We have continued over the subsequent years to perform renal transplantation in pediatric recipients. In fact, in this month's journal *Pediatrics* (47:548, 1971) we reported about 60 pediatric patients including the original 20 I just mentioned, all with minimum potential follow-ups at least 3 years. This latter study has confirmed much of what Dr. Najarian has told you today.

However, there is one point concerning the growth of the patients about which we might have a disagreement with Dr. Najarian's conclusions. In our experience, especially in the pre-ALG days before 1966, there was often a real cessation of growth for the first year or two after transplantation or even longer. Then, as long as 4 and 5 years postoperatively, a surprising catch-up growth spurt occurred. Consequently, I think it is necessary, before concluding that there will not be catch-up growth, to follow these patients for 5 years or longer. In our experience, catch-up has been seen as late as 18 or 19 years of age, at which time growth of almost a foot has occurred over a year's time.

Finally, I would like to confirm that for pediatric patients the use of ALG is an especially important factor in their social rehabilitation, for it permits one to use smaller doses of steroids. At one time we were extremely wary of using cadaveric kidneys for pediatric patients, because of the predictable need for greater steroid doses, the consequent stunting of growth of these children, and the very real possibility that they could thereby be turned into iatrogenic pariahs. With ALG this problem has been largely circumvented since steroid dosages can be kept lower. Now, more than ever, we are satisfied with the results of transplantation in these little patients even when non-related cadaveric organs must be used.

DR. JOHN S. NAJARIAN (Closing): First, as far as Dr. Murray is concerned, the socio-economic problem he has presented in the two parents is a real one, and we have encountered the same sort of problem.

In this area I would like to make one point; the children themselves become rehabilitated very rapidly. As a matter of fact, of all the children that we have done that are living and well (when you talk about survival of children, it is almost 95% survival) all but one in the school age group has returned to school, which is remarkable rehabilitation.

The one that did not—and it touches on the problem that Dr. Starzl brought out—was a young Indian girl who was markedly cushingoid and was too embarrassed to go back to school, and is being tutored at home. So, we do create socio-economic problems. She was transplanted prior to the time that we started ALG therapy, and little by little her cushingoid appearance is receding.

I thank Dr. Starzl for his comments. He certainly has a large group with a long follow-up which we have all admired for a long time.

Catch up growth does occur. I said it does not occur, but it does occur rarely. We have followed some of these patients now 7 years. We have not seen the spurt that you talk about, except in two isolated instances. In our experience—and I am sorry I didn't have time to show the slide—all of these parallel, but don't catch up, and there are only two exceptions.

There is no question that ALG therapy has made a difference in the reduced doses of steroids, and better growth patterns.