

Introduction of Carl Gustav Groth

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The Swedish surgeon Carl Gustav Groth has been a major figure in transplantation for more than 40 years. His full-time engagement in transplantation (Table 1) began at the University of Colorado, first as a Fulbright Scholar and then as an associate professor. In Denver, he was an indispensable team member in the first successful human liver transplantations in 1967. This was a signature achievement. However, it was only the tip of Groth's Colorado iceberg. His supporting studies in dogs resulted in improved liver preservation and standardization of antilymphoid globulin (ALG), demonstrated the dramatic decline of hepatic blood flow caused by liver rejection and established that transplantation of lymphoid tissues corrected canine hemophilia. His clinical reports included the first descriptions of the value of scintigraphy in liver transplantation, the first correction by liver replacement of an inborn error (Wilson's disease), the first successful human parathyroid alloengraftment, and the efficacy of "triple-drug" immunosuppression with azathioprine, prednisone, and ALG.

Similar high level innovations continued after Groth's permanent return to Stockholm in 1972 (Table 2). All were thematic. The foremost continuous theme was organ transplantation, with particular focus on the pancreas. This included his initially controversial advocacy of today's accepted enteric drainage of pancreatic exocrine secretions. His book *Pancreas Transplantation*, published in 1988, was the first of its kind and provided crucial incentives for continuation of such efforts. His demonstration that pancreas transplantation ameliorated diabetic complications was years ahead of its time. A second theme was improvement of immunosuppression. He was chief investigator for multinational clinical studies of cyclosporine, tacrolimus, mycophenolate mofetil, and sirolimus (including the first use of sirolimus as the baseline agent). A third theme was cell transplantation. After showing the viability of ectopically transplanted rat hepatocytes (in 1974), he corrected rat glucuronyl transferase deficiency with liver cells (in 1977) and ultimately delineated human inherited disorders that were correctable by bone marrow cells, beginning with Gaucher's disease. A related fourth theme was transplantation of pancreas islet xenografts, which culminated in an historical pig to human trial of 10 patients with islet survival and C-peptide secretion >1 year.

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TABLE 1. Phase I: University of Colorado

- Fullbright Scholar (1966–68)
- Associate Professor of Surgery (1971–72)
- 1. First successful liver transplantations (1967)
- 2. Experimental struts of liver replacement (in dogs)
 - A. Improved liver preservation
 - B. Effect of rejection on hepatic blood flow
 - C. Standardization of dog- and human-specific ALG
 - D. Correction of haemophilia with lymphoid allografts
 - E. Defined coagulation problems of liver transplantation
- 3. First of their kind clinical studies
 - A. The use of scintigraphy in liver recipients
 - B. Correction of hepatic inborn errors (Wilson's disease)
 - C. Triple drug immunosuppression (kidney → liver)
 - D. First documented successful parathyroid allograft

ALG, antilymphocytic globulin.

TABLE 2. Phase II: Karolinska Institute

- Professor (1972–2000), Chief of Service (1976–83)
- Founding Chair Department of Transplantation (1983–2000)
- Emeritus Professor (2000–2006)
- 1. Pancreas transplantation
 - A. 1st series of successful segmental pancreas grafts
 - B. Continuous advocacy of enteric exocrine drainage
 - C. 1st textbook of pancreas transplantation (1988)
 - D. 1st description of amelioration of diabetic complications
- 2. Chief investigator for multinational clinical studies:
 - A. Cyclosporine
 - B. Tacrolimus
 - C. Mycophenolate mofetil
 - D. Sirolimus (including first use as baseline agent)
- 3. Cell transplantation
 - A. Feasibility shown of ectopic rat hepatocyte engraftment
 - B. Correction rat glucuronyl transferase deficiency with A
 - C. Correction of other inherited disorders with bone marrow cells (e.g. Gaucher's disease)
- 4. Pig → human transplantation of pancreas islets with islet survival and C-peptide secretion >1 year

The quantity and quality of these contributions suggest a superhuman effort. It should be added that Groth also had very real human qualities, best exemplified by a few revealing photographs (Figs. 1–3). May I present Professor Carl Gustav Groth.



FIGURE 1. The medical student and his beautiful wife, Birgit.



FIGURE 3. Commander of every ship he sailed (here, the person in the red jacket).



FIGURE 2. The ambitious surgeon (left); the professor receiving his nation's highest award from the king (right).