The Skeptik, 2017, Vol. 3, pgs. (1-3).

Machine perfusion of human livers by Belzer solution, Hypothermic Oxygenated Perfussion (HOPE) and by Subnormothermic Oxygenated Perfusion (SNOP) (Mini Review)

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Introduction of isolated human liver perfusion into clinical practice was suggested 14 years ago (1). We advocated that only introduction of isolated perfusion of human hepatic grafts into the clinical practice can make a big step for improving graft functions in recipients.

The first clinical perfusion of human livers by cold machine preservation was performed in 2010 year (2). These surgeons perfused human hepatic grafts by cold perfusions with low Oxygen pressure (in Belzer solution), while other grafts were preserved (see Materials and Methods (2)) in UW solution by a static preservation. While they found improvement a lot of parameters (2-4), actual 1-year graft and patient survival, (which are major determinants of the outcome of the liver transplantation process where the same in both groups of livers (2). This means that no improvement of major outcomes of liver transplantation was achieved by machine perfusion of hepatic grafts in Belzer solution (5).

Tissue ATP levels are very important factors for the outcome of liver transplantation (6). In the rat model of liver perfusion we found that after preservation period for up to 18 hours, the liver is able to withand severe warm ischemic insult (7). When rat livers were perfused after 18 hour of cold preservation by short-term warm oxygenated perfusion tissue ATP levels restored to appr. 90% of control values. When the preservation time was increasing for up to 18 hours extreme sensitivity to rewarming ischemia occurred and it was nearly blunted by short-term reperfusion (7). In line with this thesis it was found that severe recurrent viral hepatitis C to human livers was increased with the warm ischemic implantation times (8). Thus warm ischemia but not cold storage appear to be very harmfull for graft outcome after liver transplantation.

Two years ago, simple cold storage vs. machine perfusion by HOPE showed execelent results. Not only that most parameters of liver injury was observed, HOPE treatment increased 1-year graft survival from 69% to 90% Whereas 18 % of livers preserved by static cold preservation needed retransplantation, while HOPE-terated livers needed no retransplantation (9). It should be noted that Dutkowski and co-authors studie involves patients after warm ischemic insult prior to liver procurement.

A difference in graft outcome between the studie of Dutkowski and co-workers and the studie performed by Carrera and co-workers (2) may be due that Carrera and co-workers used low oxygen pressure in Belzer solution, while Dutkowski and co-workers continuously oxygenated livers by HOPE (9).

SNOP also provided beneficial results prior to liver transplantation (10).

In conclusion, introduction of machine perfusion of hepatic grafts by HOPE, SNOP and by short-term reperfusion after 18-hr of cold storage can further improve the outcome of the liver transplantation process.

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