小児心臓移植において3D画像によりサイズがより合致する可能性がある (Abstract 17469)

小児心臓移植における3D復元はドナーのサイズマッチングを改善する可能性がある

Potential of 3D reconstruction to improve donor size matching in children receiving heart transplants

新たな3Dコンピュータモデリングシステムは、心移植を受ける小児に対する最良のサイズのドナー心臓を外科医が選択する能力を有意に改善する可能性がある、と2015年American Heart Association学会で発表された。今のところ移植センターでは、可能性のあるドナー心をドナーの体重とレシピエントの体重を比較し患者の胸部X線上の心臓サイズに基づき上限と下限を拾い上げ適合性を評価している。しかしこの評価法は正確ではなく、大きさや容積の差異がレシピエントの転帰に多大な影響を与え得る。今回の新たな3Dシステムを開発するために研究者らは、99パウンドまでの小児において、MRIおよびCT画像を用いた健常小児の3Dによる心臓復元の新しいライブラリーを作成した。その後、このライブラリーを用いて小児移植レシピエントが必要とする正しい心臓サイズを確実にするための最良のドナー体重を予測した。そして既に心移植を受けた小児の移植前後の画像を用いた。実際に移植された小児の術後データと移植仮想イメージを比較すると、3D画像システムは正確に適切な大きさの心臓を見極めることが明らかになった。

Full Text

A new 3D computer modeling system may significantly improve a surgeon's ability to select the best sized donor heart for children receiving heart transplants, according to research presented at the American Heart Association's Scientific Sessions 2015.

Transplant centers currently assess compatibility of a potential donor heart by comparing the donor weight to the recipient weight and then picking an upper and lower limit based on the size of the patient's heart on chest X-ray. But the assessment is not precise and variations in size and volume can have a major effect on the recipient's outcome.

While survival in pediatric heart transplantation have improved, there are still too few donors to meet the demand, so "it is critical to optimize the range of acceptable donors for each child," said study author Jonathan Plasencia, B.S., a Ph.D. student at Arizona State University's Image Processing Applications Lab in Tempe, Arizona.

"3D reconstruction has tremendous potential to improve donor size matching," he said. "We feel that we now have evidence that 3D matching can improve selection and hope this will soon help transplant doctors, patients, and their parents make the best decision by taking some of the uncertainty out of this difficult situation."

To develop the new 3D system, the researchers created a novel library of healthy children's 3D reconstructed hearts using MRI and CT images in children weighing up to 99 pounds. They then used the library to predict the best donor body weight to ensure the correct heart size needed for pediatric transplant recipients. Then they used before and after images from infants who had already received a heart transplant. When they compared the post-operative data from the real infants with the virtual transplant images, they found that the 3D imaging system accurately identified an appropriate size heart.

"As the virtual library grows, the ability to accurately predict donor heart volumes will improve, and analyzing future transplant cases using 3D matching will allow us to predict the true upper and lower limits of acceptable donor size," he said. "This may allow more effective organ allocation on a national scale and minimize the number of otherwise acceptable organs that are ultimately discarded."

Researchers suggested that one day transplant teams may be able to use the 3D process to perform virtual transplants before an actual procedure to rapidly measure a donated heart to ensure a better fit and to reduce the risk of mismatching in pediatric transplants.

The 3D process was a collaborative effort developed at the Arizona State University, along with researchers at Phoenix Children's Hospital and St. Joseph's Hospital and Medical Center, also in Phoenix. The team was overseen by Steven D. Zangwill, M.D., medical director of Heart Transplant and Heart Failure at Phoenix Children's Hospital.

Although not yet to the point of replacing size matching for transplants, the investigators are encouraged by what they have found and have already implemented the techniques to supplement standard of care at Phoenix Children's Hospital, Plasencia said.

The big question is how long it will take to further test the technique and move it into actual use. "We are hoping that over the course of the next year, we will have a better sense of its validity in a prospective study," Plasencia said.

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