Transcript Details

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A Landmark Surgery That Saved Three Children With One Heart

ReachMD Announcer:
Welcome to ReachMD. This medical industry feature is titled “A Landmark Surgery that Saved Three Children with One Heart,” featuring Dr. Andrew Goldstone, pediatric cardiac surgeon at NewYork-Presbyterian Morgan Stanley Children’s Hospital. This audio is a production of New York-Presbyterian with world-class doctors from Columbia & Weill Cornell Medicine.

Dr. Goldstone:
I remember I was on call. I had gotten a call for an offer for a heart, a whole heart. It was around two in the morning or something.

Erin Welsh:
This is Doctor Andrew Goldstone - a pediatric and congenital heart surgeon at New York-Presbyterian. And the call he’s talking about took place back in the spring of 2023.

Dr. Goldstone:
After a call like that, it's very hard to go to sleep again. You know, you're sort of awake and you're thinking about the transplant that you're gonna do. And so I was just checking my emails, and I was looking through the case conference schedule for the next day.

Announcer:
An incoming case caught Dr. Goldstone's eye - an infant patient in heart failure who needed a truncal valve repair.

Dr. Goldstone:
I saw this patient who had truncus arteriosis and had already had a truncal valve repair. So, her heart was failing because the truncal valve wasn't working well still. And so, in my mind I was like, you know, I have a similar size patient who's getting a heart transplant.

Erin Welsh:
Dr. Goldstone and the team at New York-Presbyterian were presented with a unique opportunity. They had one patient – an infant that was about to receive a donor heart transplant, and another infant patient who needed a new heart valve.

Dr. Goldstone:
At our case conference we were all talking about how it would be great if we could do this partial heart transplant for that child who needed the truncal valve. And so I said I'm doing a heart transplant later today. The valves work. Maybe we could do it as a domino.

Erin Welsh:
A Domino Partial Heart transplant. The doctors would transplant a new heart into the first patient, and then use the working valves from that patient’s heart to perform a valve transplant for the second patient. Saving two lives in the process.
A domino partial heart transplant had only been done in children at one other institution in the US but it was something that Dr. Goldstone and the rest of the team at NYP were ready to try in order to save the lives of their patients.

Dr. Kalfa:
It really takes a village to make this happen, right?

Erin Welsh:
That’s Dr. David Kalfa – another pediatric cardiac surgeon at New York-Presbyterian.

Dr. Kalfa:
You have to know, coordinate a lot of things. You have to involve a lot of people, you know, surgeons and cardiologist

anesthesiologists, perfusionists…

Dr. Goldstone:
The whole team really rallied together. It was truly a remarkable exhibition of teamwork and determination to get it all together and a little bit of faith too in each other to organize this and innovate like this.

Erin Welsh:
Together with an expansive team of medical professionals, Dr. Goldstone and Dr. Kalfa performed the first domino partial heart transplant ever done at NYP. It was a landmark moment for the hospital and one that profoundly changed the lives of two small children.

Dr. Kalfa:
It was an incredible feeling. To be honest with you. Especially, you know, when you go out of the OR and then you meet with the parents to update them on how the surgery went. That was just an incredible moment.

Dr. Goldstone:
It led to two lives saved in the same day which was incredible. And, you know, that was the first of many we've done now.

Erin Welsh:
I'm Erin Welsh and this is Advances in Care, a podcast about groundbreaking developments in modern medicine.

That first procedure was only the beginning. Since the initial domino they performed in May of 2023 Dr. Goldstone and Dr. Kalfa have continued to find innovative ways to transplant their patients with living valves and improve children's outcomes.

Today, both doctors share the story of their most recent transplant - a split root domino or double domino. Like the first domino transplant, it involves transplanting a new heart into a pediatric patient. But *this* surgery takes the innovation even further. It uses a donor heart and the aortic and pulmonary valves from the explanted heart to save the lives of not just two, but *three* patients.

Dr. Goldstone and Dr. Kalfa will walk us through this ground breaking procedure, and share how these surgeries are changing patients' lives.

Dr. Goldstone didn't set out to become a pediatric cardiac surgeon.

Dr. Goldstone:
I had job offers in adult cardiac surgery, and I was supposed to be an adult cardiac surgeon. And then, I had to make it complicated and toward the end of my training, decided actually I want to do pediatric heart surgery. What really pushed me toward that is that, you know, my own child needed surgery and I saw the gift that you could give to a family. And I'm reminded of that every day I see my own son.

Erin Welsh:
Like Dr. Goldstone, Dr. Kalfa was drawn to the profession by the incredible impact cardiac surgery can have on children throughout their lives.

Dr. Kalfa:
When I first saw the case of a pediatric cardiac surgery in a small child that was for a replacement of one of these cryopreserved homografts.

Erin Welsh:
Cryopreserved homografts are just one of a handful of less than ideal options available to infants and children who require a new heart valve. Since these valves don't grow as the patient grows, a child will have to endure surgery after surgery to keep their heart functioning.

Dr. Kalfa:

That was already the fourth operation that this child had to undergo. And based on this experience, I decided to really focus my whole career on that.

Erin Welsh:
Dr. Kalfa has gone on to focus on finding new options for living value transplant in children. As it stands today, the most common solutions are cryopreserved homografts,tissue valves - which are cow and pig valves, and mechanical valves. But all three of these options lack one very important quality – the ability to grow with patients.

Dr. Kalfa:
All these options, the mechanical valve and the tissue valve, all these options do not have any growth potential.

Erin Welsh:
When heart valves are unable to grow with a patient it means that many more surgeries are required throughout a patient's life which increases morbidity and mortality. That's why Dr. Kalfa and Dr. Goldstone were so keen to embrace a new solution - the domino partial heart transplant. And it's why the double domino is so incredible.

Doctors have known for some time that living valve transplants are possible but they come with their own set of challenges.

Dr. Kalfa:
In the sixties, in the seventies, some surgeons were actually implanting fresh homografts, which mean that they are using this living tissue coming from a person, who passed away or coming from a heart that is explanted at the time of a transplant.

Erin Welsh:
These living valve transplants were not as successful as the ones that doctors have recently performed for a few reasons. First, they weren't using immunosuppression, which makes it much less likely that patients will reject the living valves once they've been transplanted.

Dr. Kalfa:
The other difference was that they didn't necessarily rush to implant this valve, which meant that some of this valve had a long called ischemic time before being reimplanted in the patient.

Erin Welsh:
It turns out that ischemic time is very important to maintaining the health of living valves. It's one of the major reasons that domino partial heart transplants are not being done more frequently.

Dr. Goldstone:
So in general, the heart, we try to get it from the time that we're stopping the blood flow to it in the donor to the time that the recipient is giving their blood to this heart and perfusing it, we try to have that happen within four hours.

Erin Welsh:
And ischemic time also becomes a problem when it comes to getting and using living valves. It can be difficult to locate and move valves from one hospital to another within the necessary time frame to still consider them living. That's one of the major advantages of double domino heart transplants. When they're done at one institution, like New York-Presbyterian, the valves are ready right after they've been explanted from the first patient who is receiving a full heart transplant. It makes it far simpler logistically to ensure that ischemic time is kept to 4 hours or less.

It's also the main reason that Dr. Kalfa and Dr. Goldstone saw such incredible potential for their patients when, in the summer of 2024, they got word that another heart was about to become available. And this time, they may be able to help not two, but three children.

Dr. Goldstone:
Dr. Kalfa was on call. He received the offer for the heart for one of my patients.

Erin Welsh:
Once again Dr. Kalfa and Dr. Goldstone were notified that a heart had become available for one of their patients. But this time the circumstances created a unique opportunity.

Dr. Goldstone:
We had a situation where we had patients that needed separate valves. One needed just an aortic valve and one needed just a pulmonary valve. And so we had a donor who was the right size and had the right size valves for each of these patients. And we said, well, we could potentially set off a cascade where we help three kids with one heart transplant.

Erin Welsh:
This would be the first time that the team at New York-Presbyterian would be able to do a split-root domino partial heart transplant.

Dr. Kalfa:
We already had some discussion with the parents of patient A to know whether or not they would be interested in potentially donating the valves from their baby to help other babies. And so we knew that once the heart of patient A would be explanted at the time of the heart transplant, we could use the aortic valve to replant the aortic valve of patient B. And the pulmonary valve to help patient C who needed a pulmonary valve. So that's the concept of a double domino, right? Or a split root heart valve transplant.

Erin Welsh:
In a split-root domino, or double domino, the first patient receives a new heart. Their heart is then explanted, and the aortic and

pulmonary valves are taken from that explanted heart and split, giving each to a patient in need of a valve transplant.

Dr. Kalfa:
So you split the roots so that you can know, implant them in two different patients.

Erin Welsh:
Thanks to the team's previous experience with the original Domino heart transplant, they were ready to begin prepping for a split-root domino as soon as the call came in.

Dr. Goldstone:
Usually from the time that you get the call, you have anywhere from like eight to 24 hours that you're sending your team out to go procure the donor heart, organ.

Erin Welsh:
Once their procurement team was in motion, they needed to reach out to the families of each of the three patients.

Dr. Goldstone:
If we're planning to do the domino, we need to then start setting the teams in motion to start talking to the families about it. A lot of these patients that are living with valve disease are not hospitalized, so they need to come in and sometimes they don't live that close, so we need to let them know so they can mobilize.

Erin Welsh:
It takes a large and well-coordinated team to make sure that Dr. Kalfa and Dr. Goldstone are able to transplant the valves from one patient to another in such a tight timeframe.

Dr. Goldstone:
To get a child through heart surgery requires a tremendous number of people. And they all have to work together well, for this shared common goal of doing what's right by the patient. And so even in the operating room, there may be 10 people in the operating room making that function, you know, including the anesthesiologist. The perfusionists who run the heart and lung machine, the surgical assistants, the nurse, the scrub nurse who's handing the instruments, applying the instruments, a circulating nurse, trainees. So there's a lot of people in there to make this work.

Erin Welsh:
Once the team was mobilized and the patients were ready, Dr. Kalfa scrubbed in to begin the first heart transplantation.

Dr. Kalfa:
I first performed, heart the transplant on patient A. So we brought patient A in the operating room knowing that I would explant this heart and then I would harvest, you know, first the pulmonary valve and this pulmonary valve would be implanted in patient B.

Erin Welsh:
While Dr. Kalfa was in the operating room performing the heart transplant, Dr. Goldstone entered a different operating room next door. He began opening his patient's chest.

Dr. Goldstone:
I was doing the first valve transplant simultaneously as Dr. Kalfa was doing the heart transplant.

Erin Welsh:
Dr. Kalfa had to work quickly, so that he could transfer the first valve to Dr. Goldstone with as little ischemic time as possible. Once Dr. Kalfa finished removing the first heart and splitting off the pulmonary valve for Dr. Goldstone's patient, he put that heart with the remaining aortic valve in a device which helped maintain temperature.

Dr. Kalfa's heart transplant took about eight hours and Dr. Goldstone's valve replacement took about six. After his first transplant was over, Dr. Kalfa took the briefest moment to refuel.

Dr. Kalfa:
Thank God I have a few bananas in my office.

Erin Welsh:
But Dr. Kalfa does not rest long. Soon it's time for him to transplant the aortic valve in the final patient. He begins but soon runs into a complication.

Dr. Kalfa:

So, at the time of the implantation of the aortic valve patient, we actually figured out that the donor of the aortic valve has a congenital malformation of the coronary arteries. These coronary arteries are these small arteries, coming from the aorta to bring some blood and some oxygenation to the myocardium.Sometimes you can have an abnormal origin of the coronary artery, right? So this is something that we treat, you know, by doing a surgery that we call a coronary unroof and unroofing of the coronary artery.At the time of the implantation of the aortic valve, I actually was surprised to see that, you know, patient A had donated an aortic valve with an abnormal coronary artery to patient C. So I also had to do this unroofing and deal with this little surprise.

Erin Welsh:
But thanks to years of experience in the operating room, this didn't throw Dr. Kalfa off.

Dr. Kalfa:
You deal with this type of situation in cardiac surgery, that's a specialty where you really encounter some surprise, right and so you have to adapt and change your plan or do other additional procedures. So that's not something which is very infrequent to adapt your surgical plan in the operation.

Erin Welsh:
In the early hours of the morning, Dr. Kalfa was able to complete the final valve transplantation.

Dr. Kalfa:
So that was a pretty long day. That was a very, very long day actually. You know, it was almost like a 24 hour adventure.

Erin Welsh:
As with any surgery, Dr. Kalfa went to see his patient's parents after he finished to let them know it was a success.

Dr. Kalfa:
And actually I become kind of a little bit of emotional after talking to the parents of patient C because it had been a long day. And everything went as smoothly as possible. And also I had operated on patients C in the past. So as a surgeon, you know, especially a pediatric cardiac surgeon where you know that you may have to re-operate right in the same patient, you kind of create a relationship with the parents and so I already had this relationship with these parents who are incredible fantastic parents. And so adding that to the whole story makes it a very particular for me.

Erin Welsh:
And it wasn't just patient C who came through the transplant healthy and thriving.

Dr. Goldstone:
The patients all did outstanding. You know they did really well. The heart transplant went very well. The heart worked well. The pulmonary valve recipient has done great and the aortic valve recipient did fantastic as well.

Erin Welsh:
In the wake of the success of the split-root domino heart transplant other institutions have been reaching out to the team to figure out how they can start doing living valve transplants.

Dr. Goldstone:
We as a field are trying to work together to make sure that we understand the outcomes as a group, right? Because not everyone has done that many valves. And so individual center experience is important, but it's gonna be more important as a group experience to understand this new approach to valve replacement.

Erin Welsh:
But there are significant challenges to procuring living valves outside of domino partial heart transplants.

Dr. Goldstone:
There's issues like at the regulatory standpoint, because it's not regulated as a valve, is not declared an organ, right? It's considered tissue at the FDA level. And so the organ procurement organizations are not, technically, it's not under their jurisdiction, so they're not obligated to call for valves in unused hearts. And so it's not so easy to get those calls. We don't get that many calls despite, you know, reaching out a lot.

Erin Welsh:
This has not deterred the team at New York-Presbyterian from looking for solutions. Or from creating the solutions themselves.

Dr. Kalfa:

We are in the process of setting up this heart valve registry in collaboration with the CHSS, who is the Congenital Heart Surgeon Society, and we are moving along with this project pretty well. So that's very, very exciting.

Erin Welsh:
And for his part, Dr. Kalfa has been hard at work finding innovative solutions for storing living valves.

Dr. Kalfa:
We are working in my lab here at NYP Columbia, to set up a system, bioreactor system that helps us, storing, preserving, and then even potentially rehabilitating some valves. In vitro for an extended period of time. So now we are able to store them and to keep them alive for almost two months, which is already a huge game changer.

Erin Welsh:
The future of living valve transplants looks very promising thanks to the dedicated teamwork of the members of the valve transplant program.

Dr. Goldstone:
It comes down to a culture of determination, a culture of innovation and a culture of teamwork, right? And everyone here is dedicated to our patients and trying to do what we feel is best for them and what is best for the families working with them and what their goals of care are. And that is for me, what has made NYP and Columbia such a special place to work, and why I think this endeavor so far has been successful.

Erin Welsh:
The family of patient B, who received the pulmonary valve, recently shared a very important and very furry life update with Dr. Goldstone.

Dr. Goldstone:
They appreciated the procedure so much. They actually, they got a dog and they named their dog Domino, which is incredible. And to see their kid growing up and running around now after this procedure is awesome.

Dr. Kalfa:
When we did this double domino valve transplant, you know, there is absolutely nothing that can be more rewarding than helping three patients at once by doing a heart transplant on one patient and doing two valve transplants on two other patients. Having such an impact on the life of children is magical to me.

Erin Welsh:
Thanks to Dr. Goldstone and Dr. Kalfa for taking the time to share their story about the split-root Domino Heart transplant they performed. Their work has forever changed the lives of many pediatric patients and will continue to revolutionize how the medical community approaches living valve transplants in children.

I'm Erin Welsh.

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