Volume - 11 | Issue - 05 | May - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

# DESTINATION THERAPY WITH DRIVE LESS TOTAL ARTIFICIAL HEARTS

Cardiovascular

| | |
|---|---|
| **Dr Pradeep Kumar Radhakrishnan*** | Gitam University India*Corresponding Author |
| **Himabindu A** | Gitam University India. |
| **Gayathri Ananyajyothi Ambat** | Gitam University India. |
| **Sachin Reddy** | Gitam University India. |
| **Sujatha Mohanty** | AIIMS India. |
| **Pulivarthi Nageshwar Rao** | Gitam University India. |
| **Sivakrishna Rao G V** | Gitam University India. |
| **Nagesh Kumar** | Gitam University India. |
| **Bisoi A K** | AIIMS India. |
| **Siva Prasad** | Gitam University India. |
| **Satyanarayana Murthy** | Maritime University India. |
| **Satyanarayana M R S** | Gitam University India. |
| **Ravishankar** | Gitam University India. |
| **Srinivas** | Gitam University India. |
| **Valluvan Jeevanandam** | University of Chicago USA. |
| **Venugopal P** | AIIMS India. |

## ABSTRACT

Around 70% of mechanical circulatory devices find application as bridge to transplantation and 30% as destination devices, but shortage of donor organs forces up to 85% of these to enter the zone of destination devices. There is an urgent need to do away with drive lines as they contribute significantly to morbidity and mortality with device implantation. Hybrid coupled energy transfer system offer advantages of prolonged support and the redundancy of back up emergency support with retro auricular direct back up which is very essential when considering these devices on their role as destination therapy devices. Initial use has given promising results and devices that are emerging in the horizon like Saispandan would pave way for major technological advances in this field. The power of prescribing a total artificial heart as destination therapy would soon be a reality due to explosion of technology in multiple integrated disciplines.

## KEYWORDS

FIVAS – Fully implantable ventricular assist systems, CET – Coplanar energy transfer, TET-Trancutaneous energy transfer, DT- Destination therapy, BTT-Bridge to Transplantation

**Introduction**

In 1885 Nikola Tesla had the vision to state that power transmission is feasible unaided by wires. With mechanical circulatory support devices both ventricular assist devices and total artificial hearts as bridge to transplant and as destination therapy demonstrating results as good as transplantation technology has to be recruited in generation of driveless implants that would eliminate one of the major deterrents of device use on long term basis (1).Survival free of adverse events is of major importance in the success of such devices when applied as destination treatments. Infections due to drivelines peak at around the 9th month with incidence rates of around 30-35% and mortality of close to 55-60%.Morbidity, readmission, health expenditure and mortality remains a major concern with use of drive lines (2).Trancutaneous energy transfer options offer the feasibility of elimination of drive lines. Hybrid coplanar energy transfer techniques, which use resonance energy transfer technique with a coil in coil structure has been tried in 2 patients recently (3).This opens up exiting possibilities especially with a redundancy of retro auricular back up connectors. Newer emerging devices for destination therapy like Saispandan – TAH for destination therapy using 12/14 hybrid BSRM are also being structured on similar lines. Elimination of a holstered mode of operation ensures freedom and better quality of life too.

**Design**

Initial attempts of TETS were done on pulsatile LVADS and Total Artificial Hearts (4, 5).Close coil alignment leads to efficiency loss and operational capability of up to 30 minutes in the initial designs.CET – Coplanar Energy Transfer Systems offer up to 6 hrs of support- seems promising break through on this front (Leviticus Cardio, Ltd., Petach Tikva, Israel). This reported design has an internal integrated controller and battery linked with an internal thoracic coil ring for energy harvesting. External components include a power transmission belt coupled with an external controller, battery, and wearable wrist monitor. This wearable link provides the device malfunction alert.

Back up is the ancillary internal vibration alarm embedded within the controller. This is triggered in situations of low internal battery power. Automated data collection, reporting, and configuration systems utilize the standard MedRadio 402 405-MHz communication protocol linked to wearable wrist device. The first trial was using LVAD (Jarvik 2000 LVAS (Jarvik Heart, Inc., New York, NY)(7).

## Techniques

The retro auricular connector is first tunneled and fixed to skull base. Coil is placed in pleural cavity horizontally after sizing. This is further strapped for stability. Between serratus and latissimus dorsi pocket for the integrated controller-battery is fashioned. V shaped power lines are connected following mechanical device implant. Pump activation is then done in a wireless fashion. Sizing and alignment of external belt are also important functional considerations. Alarms are set up in such a fashion that at least 1 hour of pump operation exists after alerting the user. This is particularly important is situations where it is applied with destination therapy devices. The lung field especially right side is quite suitable in cadaveric evaluation and upsizing of coil could be done without external compression or reactive effects on the lung, though exact dimensions needs to be optimized by further evaluation. Shortage of organ donation has led to major surge of interest in TAH as destination therapy (6). Newer technology helps patients on implantable driveless devices to even swim and exercise (8).Emerging models like Saispandan which is based on 12/14 ultra miniaturized bearing less switched reluctance twin motors are fully implantable devices which are driveless with Trancutaneous energy transfer methods as they are primarily intended for use as destination therapy devices (9).

## Conclusion

Validation of safety and efficacy techniques enabling driveless fully implantable models in long term would be the real goal of total artificial heart leading the way to destination therapy as hemato computability issues are more or less within acceptable limits in the newer models. The best evolved technology should be scaled up to meet the demands of mechanical circulatory devices which would continue to emerge and evolve in the decades that ensue, ensuring better quality of life to patients on these devices.

## References

1. Mehra MR, Goldstein DJ, Uriel N, et al. Two-Year Outcomes with a Magnetically Levitated Cardiac Pump in Heart Failure. N Engl J Med 2018; 378:1386-95. 10.1056/NEJMoa1800866
2. Gustafsson F, Netuka I. Interplay of pump design elements and bleeding predilection-Mechanisms for a forward momentum. J Heart Lung Transplant 2019; 38:817-9. 10.1016/j.healun.2019.06.002
3. Yuryi Pya, MD, Jiri Maly, MD, PhD, Mahabbat Bekbossynova, MD, Roman Salov, MBA, et al. First human use of a wireless coplanar energy transfer coupled with a continuous-flow left ventricular assist device 2019;38:339−343/J Heart Lung Transplant Mehta SM, Pae Jr WE, Rosenberg G, et al. The LionHeart LVD-
4. 2000: a completely implanted left ventricular assist device for chronic circulatory support. Ann Thorac Surg 2001; 71(suppl): S156-61.
5. Dowling RD, Gray Jr LA, Etoch SW, et al. Initial experience with theAbioCor implantable replacement heart system. J Thorac Cardiovasc Surg 2004; 127:131-41.
6. Pya Y, Bekbossynova M, Jetybayeva S, et al. Initial 3-year outcomes with left ventricular assist devices in a country with a nascent heart transplantation program. ESC Heart Fail 2016; 3:26-34. 10.1002/ehf2.12066
7. Pya Y, Maly J, Bekbossynova M, et al. First human use of a wireless coplanar energy transfer coupled with a continuous-flow left ventricular assist device. J Heart Lung Transplant 2019; 38:339-43. 10.1016/j.healun.2019.01.1316
8. Gizitdinov N. Heart Pump with Wireless Charging Implanted by Kazakh Doctors. 2019. Available online: https://www.bloomberg.com/news/articles/2019-02-06/wireless-device-for-heart-pumps-implanted-in-kazakhstan-center
9. Pradeep Kumar Radhakrishnan, Himabindu, Venugopal P et al Novel Operative Technique for fully implantable total artificial hearts in those with normal cardiac anatomy Vol XI, Issue II,Feb 2022 IJSR | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr