

# Is one-and-a-half better than two?

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The concept of a one-and-a-half type of repair for complex cardiac anatomy was first described in the 1980s (1) and has predominantly been used to achieve a septated circulation in the setting of borderline or small right ventricular size—typically in pulmonary atresia with intact septum.

More recently, the technique has been advocated in the anatomical repair of congenitally corrected transposition (ccTGA) in order to simplify the atrial switch component of the surgery. Using a bidirectional Glenn means that atrial inversion can then be achieved by performing atrial septectomy and then baffling the IVC flow across to the tricuspid valve using a simple patch (the so-called 'Hemi-Mustard' procedure). In this paper published in the *European Journal of Cardiothoracic Surgery*, Zhang *et al.* from Fuwai Hospital have described the use of this technique as part of anatomical repair in ccTGA with VSD and left outflow tract obstruction (LVOTO) in combination with a Rastelli procedure in 31 patients (2). Their results have been excellent with only one case of baffle obstruction needing reoperation and with good haemodynamic results in the majority of patients over a median follow-up of 3.3 years.

At first impression, the means justify the end given that their outcomes have been good and there is no doubt that this is a safe and valid option in this complex patient group. There are many potential benefits of this technique in this particular setting, not least the fact that it simplifies the surgery with reproducible results that have been demonstrated by several published series (3). This patient group with LVOTO may be severely cyanosed and need augmented pulmonary blood flow prior to definitive repair—the Bidirectional Glenn can provide that palliation and so safely delay repair until the patient is older and more

robust, thus allowing for a larger conduit to be used at time of Rastelli and avoiding volume loading the circulation in the interim with systemic shunts. Furthermore, some patients with this anatomy have a slightly truncated right ventricle and there can be a concern that the Rastelli procedure will 'steal' some of the right ventricular volume in creating the LV-Aortic tunnel and so leave the heart with a restrictive right ventricle. The one-and-a-half may be an ideal solution in these patients in line with its traditional application in the borderline sized RV.

Nevertheless, the one-and-a-half circulation is not without its problems. Raised pulmonary vascular resistance and/or competitive SVC flow in the setting of pulsatile flow from the RV can lead to high SVC pressures and prolonged pleural effusions and chylothorax, as seen in over 20% of the cases in this series. The bidirectional Glenn also denies access to the heart for pacing procedures in a group of patients who have a natural history of developing heart block and with a significant risk of post-operative heart block (10% in this series)—committing them to a series of epicardial pacing procedures. Finally, and probably most importantly, there is concern that the one-and-a-half circulation does not provide the same functional capacity as a true biventricular repair with limited capacity to increase cardiac output during exercise (4). This is not universally proven, but may have contributed to the fact that nearly one-fifth of these patients are in NYHA III/IV at only 3.3 years after this procedure in this series.

The authors explain that they only use the one-and-a-half approach where there is malposition of the ventricular mass (dextro- or meso-cardia) because this is felt to make full atrial inversion technically difficult. The Fuwai group still prefer full biventricular repair in patients with normal

heart position [refer to the first figure in (2)], implying that the benefits of avoiding one-and-a-half are very much part of their decision making. Several large series of anatomical repair of ccTGA have been proponents of the complete Senning in all positional variants of the heart without baffle obstructions being a concern and with cross-clamp and bypass times very similar to those recorded in this series. Modifications such as the Schumacher technique or patch augmentation of the outer layer of the Senning have been successful in avoiding baffle complications in abnormal heart positions (5,6).

There is no doubt that the one-and-a-half approach is a reasonable option in these complex patients in terms of excellent early results, and is particularly attractive as a means to delay Rastelli until an older age and also where there is concern over the size of the right ventricle. However, in all other settings, there is good evidence to strive for full biventricular repair whenever possible as the technical issue of the Senning can usually be overcome with experience and surgical modifications, even in abnormal heart positions. In the setting of two well developed ventricles, a complete biventricular circulation is likely to yield the best functional long-term results and so two would seem better than a one-and-a-half so long as it can technically be achieved. Nevertheless, the fact that the indication for bidirectional Glenn may be different in these patients compared to the traditional 'borderline RV' patients could mean that their functional performance will be better than predicted. Long term follow-up of the one-and-a-half repairs will tell us whether or not these suppositions are true and functional assessment with exercise testing will be invaluable in determining the best durable outcome for this challenging condition.

Congratulations to the group from Fuwai for such outstanding results and for adding to the evidence that encourages us to continue to search for the most suitable surgical techniques.

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## Footnote

*Conflicts of Interest:* The author has no conflicts of interest to declare.

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