

Protocol

Open and Thoracoscopic Approaches to Treat Atrial Fibrillation and Atrial Flutter (Maze and Related Procedures)

(70114)

Medical Benefit		Effective Date: 01/01/18	Next Review Date: 09/19
Preauthorization	No	Review Dates: 05/07, 07/08, 09/09, 03/10, 03/11, 03/12, 03/13, 09/13, 09/14, 09/15, 09/16, 09/17, 09/18	

Preauthorization is not required.

The following protocol contains medical necessity criteria that apply for this service. The criteria are also applicable to services provided in the local Medicare Advantage operating area for those members, unless separate Medicare Advantage criteria are indicated. If the criteria are not met, reimbursement will be denied and the patient cannot be billed. Please note that payment for covered services is subject to eligibility and the limitations noted in the patient's contract at the time the services are rendered.

Populations	Interventions	Comparators	Outcomes
Individuals: <ul style="list-style-type: none"> With symptomatic atrial fibrillation or flutter who are undergoing cardiac surgery with bypass 	Interventions of interest are: <ul style="list-style-type: none"> Cox maze or modified maze procedure 	Comparators of interest are: <ul style="list-style-type: none"> Medical management Catheter ablation 	Relevant outcomes include: <ul style="list-style-type: none"> Overall survival Medication use Treatment-related morbidity
Individuals: <ul style="list-style-type: none"> With symptomatic, drug-resistant atrial fibrillation or flutter who are not undergoing cardiac surgery with bypass 	Interventions of interest are: <ul style="list-style-type: none"> Minimally invasive, off-pump thoracoscopic maze procedures 	Comparators of interest are: <ul style="list-style-type: none"> Medical management Catheter ablation 	Relevant outcomes include: <ul style="list-style-type: none"> Overall survival Medication use Treatment-related morbidity
Individuals: <ul style="list-style-type: none"> With symptomatic, drug-resistant atrial fibrillation or flutter who are not undergoing cardiac surgery with bypass 	Interventions of interest are: <ul style="list-style-type: none"> Hybrid thoracoscopic and endocardial ablation procedures 	Comparators of interest are: <ul style="list-style-type: none"> Medical management Catheter ablation 	Relevant outcomes include: <ul style="list-style-type: none"> Overall survival Medication use Treatment-related morbidity

DESCRIPTION

There are various surgical approaches to treat atrial fibrillation (AF) that work by interrupting abnormal electrical activity in the atria. Open surgical procedures, such as the Cox maze procedure were first developed for this purpose and are now generally performed in conjunction with valvular or coronary artery bypass graft surgery. Surgical techniques have evolved to include minimally invasive approaches that use epicardial radiofrequency ablation, a thoracoscopic or mediastinal approach, and hybrid catheter ablations/open procedures.

SUMMARY OF EVIDENCE

For individuals who have symptomatic AF or flutter who are undergoing cardiac surgery with bypass who received a Cox maze or a modified maze procedure, the evidence includes several randomized controlled trials

(RCTs) and nonrandomized comparative studies, along with systematic reviews of these studies. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. Several small RCTs have provided most of the direct evidence confirming the benefit of a modified maze procedure for patients with AF who are undergoing mitral valve surgery. These trials have established that the addition of a modified maze procedure results in a lower incidence of atrial arrhythmias following surgery, with minimal additional risks. Observational studies have supported these RCT findings. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have symptomatic, drug-resistant AF or flutter who are not undergoing cardiac surgery with bypass who receive minimally invasive, off-pump thoracoscopic maze procedures, the evidence includes RCTs and observational studies, some of which identify control groups. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. One RCT has provided most of the direct evidence comparing surgical AF ablation using video-assisted thoracoscopy with percutaneous catheter ablation. This trial reported higher success at maintaining sinus rhythm at one year of follow-up with thoracoscopic ablation but also reported higher adverse event rates compared with catheter ablation. The case series have generally reported high success rates, and a few with matched comparison groups have reported higher success rates with surgical treatment than with catheter ablation. However, this evidence does not permit definitive conclusions whether a specific approach is superior to the other. Factors, such as previous treatment, the probability of maintaining sinus rhythm, the risk of complications, contraindications to anticoagulation, and patient preference, may all affect the risk-benefit ratio for each procedure. At present, it is not possible to define a subgroup of patients who would benefit more from thoracoscopic (or other minimally invasive) surgical ablation compared with percutaneous ablation, so the risks and benefits of surgical ablation compared with catheter ablation are not well-defined. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have symptomatic, drug-resistant AF or flutter who are not undergoing cardiac surgery with bypass who receive hybrid thoracoscopic and endocardial ablation procedures, the evidence includes a nonrandomized comparative study and single-arm case series. Relevant outcomes are overall survival, medication use, and treatment-related morbidity. The studies have suggested that hybrid ablation procedures are associated with high rates of freedom from AF, but direct comparisons with catheter ablation are lacking. Comparative studies are needed to permit direct comparisons of the benefits and harms of hybrid ablation procedures with alternatives. The evidence is insufficient to determine the effects of the technology on health outcomes.

POLICY

The maze or modified maze procedure, performed on a non-beating heart during cardiopulmonary bypass with concomitant cardiac surgery, is considered **medically necessary** for treatment of symptomatic atrial fibrillation or flutter.

Minimally invasive, off-pump maze procedures (i.e., modified maze procedures), including those done via mini-thoracotomy, are considered **investigational** for treatment of atrial fibrillation or flutter.

The procedures performed on a beating heart would be off-pump and would be **investigational**.

Hybrid ablation (defined as a combined percutaneous and thoracoscopic approach) is considered **investigational** for the treatment of atrial fibrillation or flutter.

The use of an open maze or modified maze procedure performed on a non-beating heart during cardio-pulmonary bypass without concomitant cardiac surgery is considered **not medically necessary** for treatment of atrial fibrillation or flutter.

POLICY GUIDELINES

Given the availability of less-invasive alternative approaches to treat AF (see the Catheter Ablation as Treatment for Atrial Fibrillation Protocol) performing the maze procedure without concomitant cardiac surgery should rarely be needed.

Published studies on the maze procedure have described patients with drug-resistant AF and atrial flutter as having experienced their arrhythmias for an average of seven or more years and having had unsuccessful results with an average of five or more antiarrhythmic medications.

BACKGROUND

ATRIAL FIBRILLATION

AF is a supraventricular tachyarrhythmia characterized by disorganized atrial activation with ineffective atrial ejection. The underlying mechanism of AF involves the interplay between electrical triggering events that initiate AF and the myocardial substrate that permits propagation and maintenance of the aberrant electrical circuit. The most common focal trigger of AF appears to be located within the cardiac muscle that extends into the pulmonary veins. The atria are frequently abnormal in patients with AF and demonstrate enlargement or increased conduction time. Atrial flutter is a variant of AF.

Treatment

The first-line treatment for AF usually includes medications to maintain sinus rhythm and/or control the ventricular rate. Antiarrhythmic medications are only partially effective; therefore, medical treatment is not sufficient for many patients. Percutaneous catheter ablation, using endocardial ablation, is an accepted second-line treatment for patients who are not adequately controlled on medications and may also be used as first-line treatment. Catheter ablation is successful in maintaining sinus rhythm for most patients, but long-term recurrences are common and increase over time. Performed either by open surgical techniques or thoracoscopy, surgical ablation is an alternative approach to percutaneous catheter ablation.

Open Surgical Techniques

The classic Cox maze III procedure is a complex surgical procedure for patients with AF. It involves sequential atriotomy incisions that interrupt the aberrant atrial conduction pathways in the heart. The procedure is also intended to preserve atrial pumping function. It is indicated for patients who do not respond to medical or other surgical antiarrhythmic therapies and is often performed in conjunction with correction of structural cardiac conditions such as valve repair or replacement. This procedure is considered the criterion standard for the surgical treatment of drug-resistant AF, with a success rate of approximately 90%.

The maze procedure entails making incisions in the heart that:

- direct an impulse from the sinoatrial node to the atrioventricular node;
- preserve activation of the entire atrium; and
- block re-entrant impulses responsible for AF or atrial flutter.

The classic Cox maze procedure is performed on a nonbeating heart during cardiopulmonary bypass. Simplification of the maze procedure has evolved with the use of different ablation tools such as microwave, cryotherapy, ultrasound, and radiofrequency energy sources to create the atrial lesions instead of employing the incisional technique used in the classic maze procedure. The Cox maze IV procedure involves the use of radiofrequency energy or cryoablation to create transmural lesions analogous to the lesions created by the “cut-and-sew” maze.

Minimally Invasive (Thoracoscopic) Techniques

Less invasive, transthoracic, endoscopic, off-pump procedures to treat drug-resistant AF have been developed. The evolution of these procedures involves both different surgical approaches and different lesion sets. Alternative surgical approaches include mini-thoracotomy and total thoracoscopy with video assistance. Open thoracotomy and mini-thoracotomy employ cardiopulmonary bypass and open-heart surgery, while thoracoscopic approaches are performed on the beating heart. Thoracoscopic approaches do not enter the heart and use epicardial ablation lesion sets, whereas the open approaches use either the classic “cut-and-sew” approach or endocardial ablation.

Lesion sets may vary independent of the surgical approach, with a tendency toward less extensive lesion sets targeted to areas most likely to be triggers of AF. The most limited lesion sets involve pulmonary vein isolation and exclusion of the left atrial appendage. More extensive lesion sets include linear ablations of the left and/or right atrium and ablation of ganglionic plexi. Some surgeons perform left atrial reduction in cases of left atrial enlargement.

The type of energy used for ablation also varies; radiofrequency energy is most commonly applied. Other energy sources such as cryoablation and high-intensity ultrasound have been used. For our purposes, the variations on surgical procedures for AF will be combined under the heading of “modified maze” procedures.

Hybrid Techniques

“Hybrid” ablation refers to the use of both thoracoscopic and percutaneous approaches in the same patient. Ablation is performed on the outer surface of the heart (epicardial) via the thoracoscopic approach, and on the inner surface of the heart (endocardial) via the percutaneous approach. The rationale for a hybrid procedure is that a combination of both techniques may result in a complete ablation. Thoracoscopic epicardial ablation is limited by the inability to perform all possible ablation lines because the posterior portions of the heart are not accessible via thoracoscopy. Percutaneous, endoscopic ablation is limited by incomplete ablation lines that often require repeat procedures. By combining both procedures, a full set of ablation lines can be performed, and incomplete ablation lines can be minimized.

The hybrid approach first involves thoracoscopy with epicardial ablation. Following this procedure, an electrophysiologic study is performed percutaneously followed by endocardial ablation as directed by the results of electrophysiology. Most commonly, the electrophysiology study and endocardial ablation are done immediately after the thoracoscopy as part of a single procedure. However, some hybrid approaches perform the electrophysiology study and endocardial ablation on separate days, as directed by the electrophysiology study.

REGULATORY STATUS

Several radiofrequency ablation systems have been cleared for marketing by the U.S. Food and Drug Administration through the 510(k) process for cardiac tissue ablation. Table 1 provides a select list.

Table 1. Radiofrequency Ablation Approved by the Food and Drug Administration

Device	Manufacturer	510(k) Date
Medtronic Cardioblate® System	Medtronic	Jan 2002
Cardima Ablation System	Cardima	Jan 2003
Epicor™ Medical Ablation System	Epicor Medical	Feb 2004
Isolator™ Transpolar™ Pen	AtriCure	Jun 2005
Estech COBRA® Cardiac Electrosurgical Unit	Endoscopic Technologies	Dec 2005
Coolrail™ Linear Pen	AtriCure	Mar 2008
Numeris® Guided Coagulation System with VisiTrax®	nContact Surgical	Feb 2009
EPI-Sense® Guided Coagulation System with VisiTrax®	nContact Surgical	Nov 2012

A number of cryoablation systems, which may be used during cardiac ablation procedures, have also been cleared for marketing, including those in Table 2.

Table 2. Cryoablation Systems Approved by the Food and Drug Administration

Device	Manufacturer	510(k) Date
Cryocare® Cardiac Surgery System	Endocare	Mar 2002
SeedNet™ System	Galil Medical	May 2005
SurgiFrost® XL Surgical CryoAblation System	CryoCath Technologies; now Medtronic	Jul 2006
Isis™ cryosurgical unit	Galil Medical	Mar 2007

RELATED PROTOCOLS

Catheter Ablation as Treatment for Atrial Fibrillation

Catheter Ablation of Cardiac Arrhythmias

Percutaneous Left Atrial Appendage Closure Devices for Stroke Prevention in Atrial Fibrillation

Services that are the subject of a clinical trial do not meet our Technology Assessment Protocol criteria and are considered investigational. *For explanation of experimental and investigational, please refer to the Technology Assessment Protocol.*

It is expected that only appropriate and medically necessary services will be rendered. We reserve the right to conduct prepayment and postpayment reviews to assess the medical appropriateness of the above-referenced procedures. **Some of this protocol may not pertain to the patients you provide care to, as it may relate to products that are not available in your geographic area.**

REFERENCES

We are not responsible for the continuing viability of web site addresses that may be listed in any references below.

1. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Maze procedure for drug-resistant atrial fibrillation or flutter. TEC Assessments. 1994;Volume 9:Tab 19.
2. Khargi K, Hutten BA, Lemke B, et al. Surgical treatment of atrial fibrillation; a systematic review. *Eur J Cardiothorac Surg.* Feb 2005;27(2):258-265. PMID 15691679
3. Topkara VK, Williams MR, Barili F, et al. Radiofrequency and microwave energy sources in surgical ablation of atrial fibrillation: a comparative analysis. *Heart Surg Forum.* 2006;9(3):E614-617. PMID 16687343
4. Lall SC, Melby SJ, Voeller RK, et al. The effect of ablation technology on surgical outcomes after the Cox-maze procedure: a propensity analysis. *J Thorac Cardiovasc Surg.* Feb 2007;133(2):389-396. PMID 17258570
5. Stulak JM, Dearani JA, Sundt TM, 3rd, et al. Superiority of cut-and-sew technique for the Cox maze procedure: comparison with radiofrequency ablation. *J Thorac Cardiovasc Surg.* Apr 2007;133(4):1022-1027. PMID 17382646
6. Stulak JM, Suri RM, Burkhart HM, et al. Surgical ablation for atrial fibrillation for two decades: Are the results of new techniques equivalent to the Cox maze III procedure? *J Thorac Cardiovasc Surg.* May 2014; 147(5):1478-1487. PMID 24560517
7. Huffman MD, Karmali KN, Berendsen MA, et al. Concomitant atrial fibrillation surgery for people undergoing cardiac surgery. *Cochrane Database Syst Rev.* Aug 22 2016(8):CD011814. PMID 27551927

8. Phan K, Xie A, Tian DH, et al. Systematic review and meta-analysis of surgical ablation for atrial fibrillation during mitral valve surgery. *Ann Cardiothorac Surg.* Jan 2014;3(1):3-14. PMID 24516793
9. Reston JT, Shuhaiber JH. Meta-analysis of clinical outcomes of maze-related surgical procedures for medically refractory atrial fibrillation. *Eur J Cardiothorac Surg.* Nov 2005;28(5):724-730. PMID 16143540
10. Gillinov AM, Gelijns AC, Parides MK, et al. Surgical ablation of atrial fibrillation during mitral-valve surgery. *N Engl J Med.* Apr 9 2015;372(15):1399-1409. PMID 25853744
11. Budera P, Straka Z, Osmanic P, et al. Comparison of cardiac surgery with left atrial surgical ablation vs. cardiac surgery without atrial ablation in patients with coronary and/or valvular heart disease plus atrial fibrillation: final results of the PRAGUE-12 randomized multicentre study. *Eur Heart J.* Nov 2012;33(21):2644-2652. PMID 22930458
12. Van Breugel HN, Nieman FH, Accord RE, et al. A prospective randomized multicenter comparison on health-related quality of life: the value of add-on arrhythmia surgery in patients with paroxysmal, permanent or persistent atrial fibrillation undergoing valvular and/or coronary bypass surgery. *J Cardiovasc Electrophysiol.* May 2010;21(5):511-520. PMID 19925605
13. Saint LL, Damiano RJ, Jr., Cuculich PS, et al. Incremental risk of the Cox-maze IV procedure for patients with atrial fibrillation undergoing mitral valve surgery. *J Thorac Cardiovasc Surg.* Nov 2013;146(5):1072-1077. PMID 23998785
14. Kim KC, Cho KR, Kim YJ, et al. Long-term results of the Cox-Maze III procedure for persistent atrial fibrillation associated with rheumatic mitral valve disease: 10-year experience. *Eur J Cardiothorac Surg.* Feb 2007;31(2):261-266. PMID 17158057
15. Damiano RJ, Jr., Badhwar V, Acker MA, et al. The CURE-AF trial: a prospective, multicenter trial of irrigated radiofrequency ablation for the treatment of persistent atrial fibrillation during concomitant cardiac surgery. *Heart Rhythm.* Jan 2014;11(1):39-45. PMID 24184028
16. Gaita F, Ebrille E, Scaglione M, et al. Very long-term results of surgical and transcatheter ablation of long-standing persistent atrial fibrillation. *Ann Thorac Surg.* Oct 2013;96(4):1273-1278. PMID 23915587
17. Watkins AC, Young CA, Ghoreishi M, et al. Prospective assessment of the CryoMaze procedure with continuous outpatient telemetry in 136 patients. *Ann Thorac Surg.* Apr 2014;97(4):1191-1198; discussion 1198. PMID 24582049
18. van Laar C, Kelder J, van Putte BP. The totally thoracoscopic maze procedure for the treatment of atrial fibrillation. *Interact Cardiovasc Thorac Surg.* Jan 2017;24(1):102-111. PMID 27664426
19. Phan K, Phan S, Thiagalingam A, et al. Thoracoscopic surgical ablation versus catheter ablation for atrial fibrillation. *Eur J Cardiothorac Surg.* Apr 2016;49(4):1044-1051. PMID 26003961
20. La Meir M, Gelsomino S, Luca F, et al. Minimal invasive surgery for atrial fibrillation: an updated review. *Europace.* Feb 2013;15(2):170-182. PMID 22782971
21. Boersma LV, Castella M, van Boven W, et al. Atrial fibrillation catheter ablation versus surgical ablation treatment (FAST): a 2-center randomized clinical trial. *Circulation.* Jan 3 2012;125(1):23-30. PMID 22082673
22. Pokushalov E, Romanov A, Elesin D, et al. Catheter versus surgical ablation of atrial fibrillation after a failed initial pulmonary vein isolation procedure: a randomized controlled trial. *J Cardiovasc Electrophysiol.* Dec 2013;24(12):1338-1343. PMID 24016147
23. Stulak JM, Dearani JA, Sundt TM, 3rd, et al. Ablation of atrial fibrillation: comparison of catheter-based techniques and the Cox-Maze III operation. *Ann Thorac Surg.* Jun 2011;91(6):1882-1888; discussion 1888-1889. PMID 21619987
24. Wang J, Li Y, Shi J, et al. Minimally invasive surgical versus catheter ablation for the long-lasting persistent atrial fibrillation. *PLoS One.* Jul 2011;6(7):e22122. PMID 21765943
25. Lawrance CP, Henn MC, Miller JR, et al. A minimally invasive Cox maze IV procedure is as effective as sternotomy while decreasing major morbidity and hospital stay. *J Thorac Cardiovasc Surg.* Sep 2014;148(3):955-961; discussion 962-952. PMID 25048635

26. De Maat GE, Pozzoli A, Scholten MF, et al. Surgical minimally invasive pulmonary vein isolation for lone atrial fibrillation: midterm results of a multicenter study. *Innovations (Phila)*. Nov-Dec 2013;8(6):410-415. PMID 24356430
27. Massimiano PS, Yanagawa B, Henry L, et al. Minimally invasive fibrillating heart surgery: a safe and effective approach for mitral valve and surgical ablation for atrial fibrillation. *Ann Thorac Surg*. Aug 2013;96(2):520-527. PMID 23773732
28. Cui YQ, Li Y, Gao F, et al. Video-assisted minimally invasive surgery for lone atrial fibrillation: a clinical report of 81 cases. *J Thorac Cardiovasc Surg*. Feb 2010;139(2):326-332. PMID 19660413
29. Edgerton JR, Brinkman WT, Weaver T, et al. Pulmonary vein isolation and autonomic denervation for the management of paroxysmal atrial fibrillation by a minimally invasive surgical approach. *J Thorac Cardiovasc Surg*. Oct 2010;140(4):823-828. PMID 20299028
30. Han FT, Kasirajan V, Kowalski M, et al. Results of a minimally invasive surgical pulmonary vein isolation and ganglionic plexi ablation for atrial fibrillation: single-center experience with 12-month follow-up. *Circ Arrhythm Electrophysiol*. Aug 2009;2(4):370-377. PMID 19808492
31. Pruitt JC, Lazzara RR, Ebra G. Minimally invasive surgical ablation of atrial fibrillation: the thoracoscopic box lesion approach. *J Interv Card Electrophysiol*. Dec 2007;20(3):83-87. PMID 18214660
32. Sirak J, Jones D, Sun B, et al. Toward a definitive, totally thoracoscopic procedure for atrial fibrillation. *Ann Thorac Surg*. Dec 2008;86(6):1960-1964. PMID 19022018
33. Speziale G, Bonifazi R, Nasso G, et al. Minimally invasive radiofrequency ablation of lone atrial fibrillation by monolateral right minithoracotomy: operative and early follow-up results. *Ann Thorac Surg*. Jul 2010;90(1):161-167. PMID 20609767
34. Wudel JH, Chaudhuri P, Hiller JJ. Video-assisted epicardial ablation and left atrial appendage exclusion for atrial fibrillation: extended follow-up. *Ann Thorac Surg*. Jan 2008;85(1):34-38. PMID 18154774
35. Yilmaz A, Geuzebroek GS, Van Putte BP, et al. Completely thoracoscopic pulmonary vein isolation with ganglionic plexus ablation and left atrial appendage amputation for treatment of atrial fibrillation. *Eur J Cardiothorac Surg*. Sep 2010;38(3):356-360. PMID 20227287
36. Yilmaz A, Van Putte BP, Van Boven WJ. Completely thoracoscopic bilateral pulmonary vein isolation and left atrial appendage exclusion for atrial fibrillation. *J Thorac Cardiovasc Surg*. Aug 2008;136(2):521-522. PMID 18692667
37. Geuzebroek GS, Bentala M, Molhoek SG, et al. Totally thoracoscopic left atrial Maze: standardized, effective and safe. *Interact Cardiovasc Thorac Surg*. Mar 2016;22(3):259-264. PMID 26705300
38. Ad N, Henry L, Hunt S, et al. The outcome of the Cox Maze procedure in patients with previous percutaneous catheter ablation to treat atrial fibrillation. *Ann Thorac Surg*. May 2011;91(5):1371-1377; discussion 1377. PMID 21457939
39. Castella M, Pereda D, Mestres CA, et al. Thoracoscopic pulmonary vein isolation in patients with atrial fibrillation and failed percutaneous ablation. *J Thorac Cardiovasc Surg*. Sep 2010;140(3):633-638. PMID 20117799
40. Je HG, Shuman DJ, Ad N. A systematic review of minimally invasive surgical treatment for atrial fibrillation: a comparison of the Cox-Maze procedure, beating-heart epicardial ablation, and the hybrid procedure on safety and efficacy. *Eur J Cardiothorac Surg*. Oct 2015;48(4):531-540; discussion 540-531. PMID 25567961
41. La Meir M, Gelsomino S, Luca F, et al. Minimally invasive surgical treatment of lone atrial fibrillation: Early results of hybrid versus standard minimally invasive approach employing radiofrequency sources. *Int J Cardiol*. May 2 2012;167(4):1469-1475. PMID 22560495
42. Bisleri G, Rosati F, Bontempi L, et al. Hybrid approach for the treatment of long-standing persistent atrial fibrillation: electrophysiological findings and clinical results. *Eur J Cardiothorac Surg*. Nov 2013;44(5):919-923. PMID 23475587
43. Gehi AK, Mounsey JP, Pursell I, et al. Hybrid epicardial-endocardial ablation using a pericardioscopic technique for the treatment of atrial fibrillation. *Heart Rhythm*. Jan 2013;10(1):22-28. PMID 23064043

44. Gersak B, Pernat A, Robic B, et al. Low rate of atrial fibrillation recurrence verified by implantable loop recorder monitoring following a convergent epicardial and endocardial ablation of atrial fibrillation. *J Cardiovasc Electrophysiol*. Oct 2012;23(10):1059-1066. PMID 22587585
45. La Meir M, Gelsomino S, Lorusso R, et al. The hybrid approach for the surgical treatment of lone atrial fibrillation: one-year results employing a monopolar radiofrequency source. *J Cardiothorac Surg*. Jul 19 2012;7:71. PMID 22812613
46. Muneretto C, Bisleri G, Bontempi L, et al. Successful treatment of lone persistent atrial fibrillation by means of a hybrid thoracoscopic-transcatheter approach. *Innovations (Phila)*. Jul-Aug 2012;7(4):254-258. PMID 23123991
47. Muneretto C, Bisleri G, Bontempi L, et al. Durable staged hybrid ablation with thoracoscopic and percutaneous approach for treatment of long-standing atrial fibrillation: a 30-month assessment with continuous monitoring. *J Thorac Cardiovasc Surg*. Dec 2012;144(6):1460-1465; discussion 1465. PMID 23062968
48. Pison L, La Meir M, van Opstal J, et al. Hybrid thoracoscopic surgical and transvenous catheter ablation of atrial fibrillation. *J Am Coll Cardiol*. Jul 3 2012;60(1):54-61. PMID 22742400
49. Zembala M, Filipiak K, Kowalski O, et al. Minimally invasive hybrid ablation procedure for the treatment of persistent atrial fibrillation: one year results. *Kardiol Pol*. Aug 2012;70(8):819-828. PMID 22933215
50. Gersak B, Zembala MO, Muller D, et al. European experience of the convergent atrial fibrillation procedure: multicenter outcomes in consecutive patients. *J Thorac Cardiovasc Surg*. Apr 2014;147(4):1411-1416. PMID 23988287
51. Civello KC, Smith CA, Boedefeld W. Combined endocardial and epicardial ablation for symptomatic atrial fibrillation: single center experience in 100+ consecutive patients. *J Innovations Cardiac Rhythm Manage*. 2013;August.
52. Badhwar V, Rankin JS, Damiano RJ, Jr., et al. The Society of Thoracic Surgeons 2017 Clinical practice guidelines for the surgical treatment of atrial fibrillation. *Ann Thorac Surg*. Jan 2017;103(1):329-341. PMID 28007240
53. January CT, Wann LS, Alpert JS, et al. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol*. Dec 2 2014;64(21):e1-76. PMID 24685669
54. Calkins H, Kuck KH, Cappato R, et al. 2012 HRS/EHRA/ECAS Expert Consensus Statement on Catheter and Surgical Ablation of Atrial Fibrillation: recommendations for patient selection, procedural techniques, patient management and follow-up, definitions, endpoints, and research trial design. *Europace*. Apr 2012; 14(4):528-606. PMID 22389422
55. Pagé P, CCS Atrial Fibrillation Guidelines Committee. Canadian Cardiovascular Society atrial fibrillation guidelines 2010: surgical therapy. *Can J Cardiol*. Jan-Feb 2011;27(1):67-73. PMID 21329864
56. Skanes AC, Healey JS, Cairns JA, et al. Focused 2012 update of the Canadian Cardiovascular Society atrial fibrillation guidelines: recommendations for stroke prevention and rate/rhythm control. *Can J Cardiol*. Mar-Apr 2012;28(2):125-136. PMID 22433576.