Cardiac rythm device surgery with uninterrupted oral anticoagulation: the new standard?

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- implants in 2009: 1.25 million pacemakers and 410000 defibrillators(1)
- a growing number of Pts with indications to implant a PM/ICD assumes OAT: 14-35%
- ideal strategy: reduction of bleeding complications without increasing the risk of thromboembolism

1) Pacing Clin Electrophysiol2011;34:1013 – 27

bleeding complications

- The most common bleeding complications after implantation is the **pocket hematoma 5%** [1]
  - Pain
  - Discomfort
  - Prolongation of hospitalization and increased costs
  - Increase in outpatient controls
  - Need for reoperation
  - Increased risk of infections
  - "no temporary protection" related to the suspension of anticoagulant drugs

- **intraoperative bleeding**
  - Increased operation time
  - Increased risk of infections

- **Perforation** -> haemopericardium (1,2%)[2]

1)CHEST 2004; Circulation 2007; JACC 2010
2) Heart Rhythm 2005

EUROPEAN SOCIETY OF CARDIOLOGY®

Europace (2011) **13**, 1669–1680
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REVIEW

Anticoagulation and antiplatelet therapy in implantation of electrophysiological devices

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Studies examining the role of anticoagulation therapy on the incidence of bleeding complications in electrophysiological device implantation

Author; year (reference no.)	Study design	Study population and protocol	Reason for antithrombotic therapy	EPD type—procedure type	Vein access	Implantation techniques	Bleeding complications	Other outcomes	Nil	Mortality
Goldstein *et al.*; 1998[17]	Retrospective observational	150 pts, outpatient pacemaker procedures, 37 of 150 pts on warfarin (mean INR 2.5)	N.R.	Pacemaker implantation/ pacemaker generator replacement/lead revision	Cephalic vein cut down (>70%)	Electrocautery, pre-pectoral pocket	No significant pocket haematoma in both groups	No cardiac perforation	F/U visit 7–10 days postoperatively	Nil
Michaud *et al.*; 2000[14]	Prospective randomized trial	192 pts, 77 of 192 pts on chronic anticoagulation, 52% of all pts on aspirin, 49 of 192 pts on i.v. heparin bridging (initiation 6 h postoperatively—26 pts; 24 h postoperatively—23 pts), 28 of 192 continuation of warfarin	Anticoagulation due to chronic AF, MV, and DVT	Pacemaker or ICD first implantation	N.R.	Pre-pectoral pocket	Incidence of pocket haematoma: 23% i.v. heparin – 6 h postoperatively 17% i.v. heparin—24 h postoperatively 4% warfarin continuation 2% no anticoagulation mean time to haematoma formation 5.1 days	Longer hospital stay in heparin groups (3.6 vs. 2.3 days in warfarin group vs. 2.5 days in no anticoagulation)	Until hospital discharge—physician contact thereafter	1 death (no anticoagulation group) due to pulmonary edema
Al-Khadra; 2003[16]	Case series	47 pts on warfarin (mean INR 2.3)	AF, valve disease, MV, DVT, stroke, and MI	Pacemaker or ICD implantation, Generator replacement (7 of 47)	Axillary vein	Pre-pectoral pocket, active fixation leads electrocautery, pressure dressing for 24 h	One case of pocket haematoma	N.R.	6 weeks	Nil
Giudici *et al.*; 2004[17]	Prospective observational	1025 pts, 470 of 1025 pts on OAC (mean INR 2.6), the rest: control group	N.R.	Pacemaker or ICD implantation, lead revisions, generator replacement alone (53 of 1025)	Subclavian vein (89%), Subclavian venogram, Micropuncture technique	Active fixation leads	Nine in-hospital haematomas and three late haematomas in each of the two groups	N.R.	2 weeks	N.R.
Milic *et al.*; 2005[18]	Randomized controlled trial	81 pts, 41 pts control (20 heparin bridging, 21 OAC continuation), 40 pts application of fibrin sealant, all pts were on aspirin	AF, MV, and DVT	First pacemaker implantation	93.8% cephalic vein cut down	Pre-pectoral pocket, application of fibrin sealant before wound closure in the treatment group, pressure dressing for 24 h	10 haematomas in the control group (five in heparin bridging subgroup, five in OAC continuation subgroup), no haematoma in fibrin sealant group, mean time for haematoma formation 4.4 days	Mean time of hospital stay 4.3 days in heparin subgroup vs. 2.6 days in OAC group, mean time of hospital stay in haematoma pts was 5.6 days vs. 2.9 days in non-haematoma pts, one stroke in an OAC patient	1 week and then every 2 months	N.R.
Marquie *et al.*; 2006[18]	Retrospective case–control	76 pts with AF—76 controls, 38 pts with mechanical valve—38 controls, heparin bridging in all MV pts, heparin bridging in 67% of AF pts	AF and MV	Pacemaker implantation / Generator replacement with lead insertion	Cephalic vein / Subclavian vein	Electrocautery, Wound drainage (31/38 pts with mechanical valve; 9/76 AF pts)	MV group: 11 haematomas vs. 1 in controls, AF group: 8 with haemorrhagic complications[a] vs. 1 in controls	Mean hospital stay 14 days in bridging group and 7.3 days in controls, no thrombotic or embolic event	30 days	1 fatal event in a patient with aortic valve prosthesis who had a pocket haematoma (surgery—shock)

Author; year (reference no.)	Study design	Study population and protocol	Reason for antithrombotic therapy	EPD type—procedure type	Vein access	Implantation techniques	Bleeding complications	Other outcomes	Nil	Mortality
Tischenko *et al*.; 2009[28]	Prospective observational	3 groups: 117 pts on warfarin (mean INR 2.2), 117 matched controls, 38 bridging with LMWH	High-risk AF pts/MVpatients/recent DVT	Pacemaker/ICD implantation including CRT devices, replacements/revisions	Subclavian or axillary vein	Pre-pectoral pocket, active fix. leads, electrocautery, pressure dressings for 24 h	Incidence of haematomas: 23.7% bridging group, 7.7% warfarin group, 4.3% control, In warfarin group: number of leads implanted the only independent risk factor	No thromboembolic events, tamponade, haemothorax	1 month	Nil
Robinson *et al*.; 2009[32]	Retrospective observational	148 pts underwent bridging with LMWH, different protocols: pre-/post-operative LMWH administration or not, aspirin not stopped	AF (73%), LV dysfunction (12%), MV (10%), and DVT	Pacemaker/ICD implantation generator replacements, ILR implantations (1%)	Cephalic or subclavian vein	Pre-pectoral pocket, electrocautery	Haematoma rates: pre/post: 22%, no pre/post: 29%, pre/no post: 8%, no pre/no post: 9%, no further risk in pts taking aspirin, independent predictors of haematoma: postoperative LMWH, high INR, male sex	No stroke	4 weeks	Nil
Cheng *et al*.; 2009[49]	Prospective observational	109 pts on anticoagulation, 51 pts: warfarin suspended 3 days before surgery, 58 pts: warfarin continuation	MV with or without AF	First pacemaker implantation	Subclavian vein	Pre-pectoral pocket, pressure dressings for 24 h	Pocket haematoma: 3.4% in warfarin cessation, 5.9% in warfarin continuation, excessive bleeding during operation in warfarin continuation (31.4 vs. 8.6%)	No difference in embolic events, (1 embolic event in warfarin continuation group)	3 months	Nil
Tolosana *et al*.; 2009[22]	Prospective randomized trial	101 high-risk pts on OAC, 51 pts heparin bridging, 50 pts on OAC (mean INR: 2)	High-risk AF, MV, DVT, and intracavitary thrombi	Pacemaker/ICD implantation including CRT devices, generator replacements	Subclavian vein under fluoroscopic guidance	Pre-pectoral pocket, passive fixation leads, pressure dressings for 6 h	Incidence of pocket haematoma: 7.8% heparin group, 8% OAC group	No thromboembolic events, median hospital stay: 5 days in heparin group, 2 days in OAC group	45 days	1 patient from each group had a fatal endocarditis of the prosthetic valve
Ahmed *et al*.; 2010[50]	Retrospective observational	459 pts on chronic OAC, 222 pts continuing OAC (mean INR 2.6), 123 pts heparin bridging, 114 OAC stop without bridging, concomitant aspirin use in 58, 77, and 68 of pts, respectively	AF, MV, DVT, and LV thrombus	Pacemaker/ICD implantation including CRT devices, replacements/revisions	Subclavian vein, venogram and micropuncture technique	Pre-pectoral pocket, pressure dressings	Incidence of pocket haematoma: continued OAC group 0.45%, bridging group 5.7%, OAC withheld group 1.75%, all pts with haematoma were on antiplatelet therapy, no other bleeding complications	Transient ischemic attacks: Continued OAC group 0%, bridging group 0.8%, OAC withheld group 3.5%, mean hospital stay (days): continued OAC group: 1.2, bridging group 2.3, OAC withheld group 1.2	N.R.	N.R.

Ghanbari *et al.*; 2010[24]	Retrospective observational	Chronic OAC pts, 49 pts high thromboembolic risk: 20 OAC continuation (mean INR: 2.4), 29 Heparin bridging, 74 pts of low risk—OAC cessation	AF, MV, and DVT	Implantation of CRT-D devices including upgrade procedures	Axillary vein (puncture under fluoroscopy)	Pre-pectoral pocket, pocket prior to lead implantation, electrocautery	Incidence of pocket haematoma: Continued OAC group 5%, bridging group 20.7%, OAC cessation group 4%	Mean hospital stay (days): Continued OAC group: 2.9, bridging group 3.7, OAC cessation group 1.6, longer hospital stay in haematoma pts vs. no haematoma (4.3 vs. 2.1 days)	30 days	N.R.
Chow *et al.*; 2010[29]	Retrospective observational	518 pts, perioperative anticoagulation 15.4% (OAC or bridging), perioperative antiplatelets (23.7%)	N.R.	First pacemaker implantation	Cephalic vein	Implantation by cardiothoracic surgeons	Incidence of haematoma 4.9%, in anticoagulation group all haematomas associated with bridging therapy, no haematomas in warfarin pts, multivariate predictors: peri-operative anticoagulation, acute procedure	Median hospital stay in haematoma pts: 8 days vs. 1 day in no complication pts	6 weeks	N.R.
Cheng *et al.*; 2011[51]	Randomized clinical trial	100 pts on chronic OAC, 83 'moderate' risk pts randomized to OAC continuation or OAC discontinuation without heparin bridging, 17 'high' risk pts randomized to OAC continuation or OAC discontinuation with heparin bridging, mean INR in OAC continuation group 2.2, 43 pts were on either aspirin or clopidogrel	AF, MV, prior stroke, depressed EF, and pre-existing thrombus	Implantation of pacemakers and ICDs, generator changes, lead revisions/upgrades	No cephalic vein cut down, Upper extremity venogram, micropuncture technique	Pre-pectoral pocket, electrocautery	Only 2 cases of pocket haematoma, both in pts of the heparin bridging group	1 transient ischemic attack in a non-heparin patient, 1 patient suffered heparin-induced thrombocytopenia	4–6 weeks	N.R.

Conclusion: continuation of OAC represent promising strategies with an acceptable safety profile.

Europace (2011)13, 1669–1680

- **OAT -> eparin bridging** : incidence of hematoma 20%
- **TAO con INR 1,9-2,6**: incidence of hematoma 0,45% - 8%
- **TAO con INR 1,5 – 2**: no studies
- **TAO + ASA:** It does not seem to increase the risk of hematoma
- **TAO** -> increased intraoperative bleeding (hemostasis)

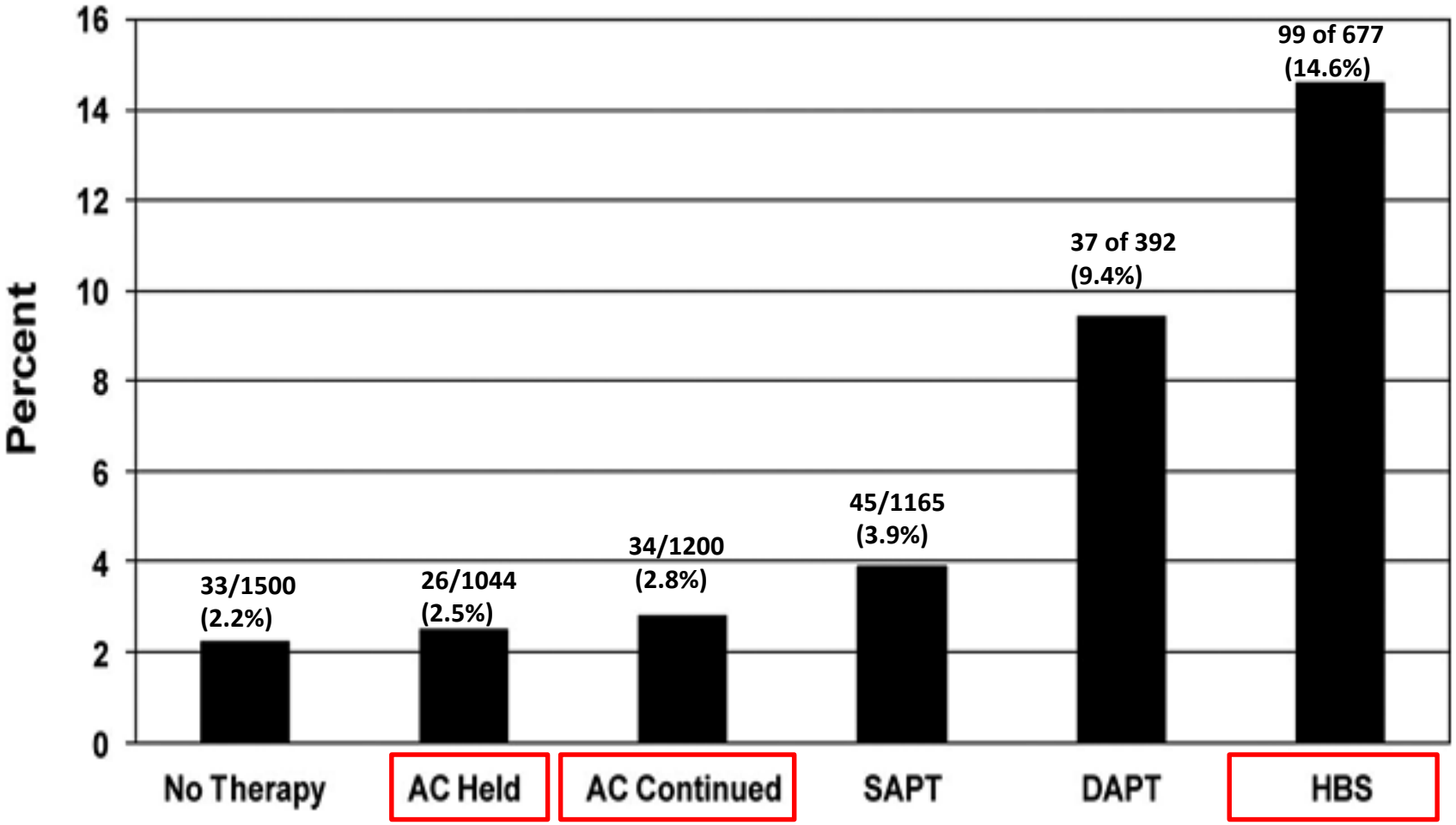
No increased risk of thromboembolism with any strategy

EUROPACE 2011

Meta-Analysis of Bleeding Complications Associated With Cardiac Rhythm Device Implantation

Circ Arrhythm Electrophysiol 2012

Unadjusted, pooled rates of bleeding



Circ Arrhythm Electrophysiol 2012

Minor and major bleeding

	Minor	Major
No therapy	15/961 (1.5%)	1/961 (0.2%)
AC held	22/1044 (2.1%)	2/1044 (0.2%)
AC continued	24/1079 (2.2%)	5/1079 (0.5%)
HBS	50/551 (9.1%)	11/551 (2.0%)
SAPT	15/618 (1.6%)	1/618 (0.2%)
DAPT	8/263 (3.0%)	5/263 (1.9%)

Minor:

-hematoma that does not require any intervention

-bleeding without the need for transfusion or suspension of therapy

Major

- bleeding -> trasfusion
- Reoperation for pocket hematoma
- Pericardial effusion
- Hemothorax
- life threatening bleeding

Circ Arrhythm Electrophysiol 2012

Thromboembolic complications related to the different strategies

Article	AC Held	AC Continued	HBS
Michaud, 2000		1/28	0/49
Guidici, 2004	1/555	0/470	
Tischendo, 2009		0/117	0/38
Tolosana, 2009		0/50	0/51
Ahmed, 2010	3/114	0/222	1/123
Tompkins, 2010	1/258	0/46	1/154
Cheng, 2011	0/50	1/50	
Totals	5/977 (0.5%)	2/983 (0.2%)	2/415 (0.5%)

Complications included transient ischemic attack, cerebrovascular accident, or other systemic thromboembolization.

AC indicates anticoagulant; HBS, heparin-bridging strategy.

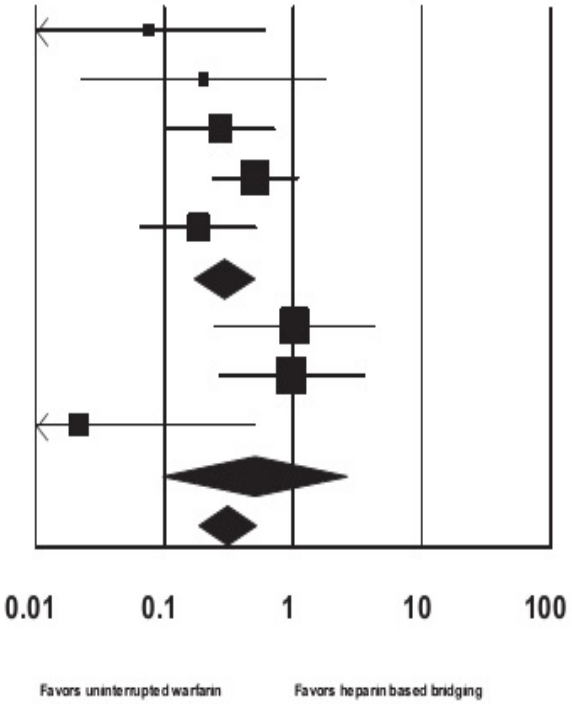
Circ Arrhythm Electrophysiol 2012

Meta-Analysis of Safety and Efficacy of Uninterrupted *Warfarin* Compared to *Heparin*-Based Bridging Therapy During Implantation of Cardiac Rhythm Devices

Hamid Ghanbari, MD, MPH[a,*], Wouter Saint Phard, MD, MD[a], Hazim Al-Ameri, MD[b], Rakesh Latchamsetty, MD[a], Krit Jongnarngsin, MD[a], Thomas Crawford, MD[a], Eric Good, DO[a], Aman Chugh, MD[a], Hakan Oral, MD[a], Frank Bogun, MD[a], Fred Morady, MD[a], and Frank Pelosi, Jr., MD[a]

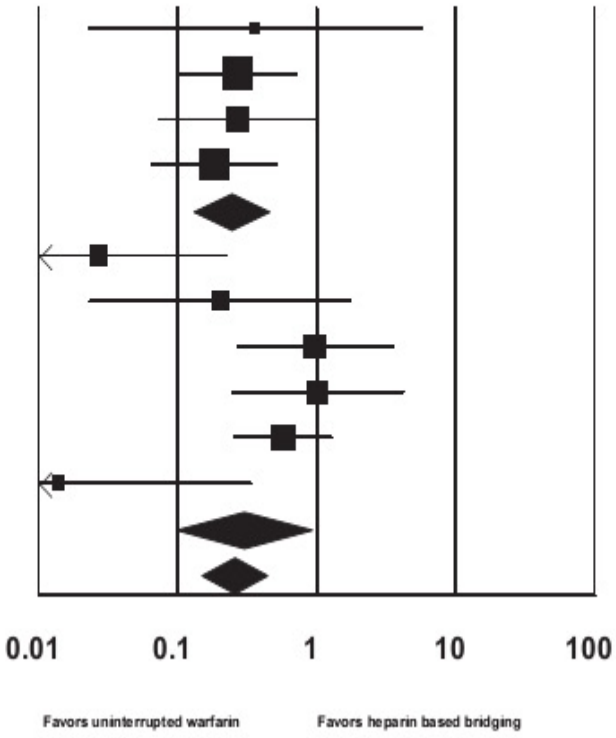
The American Journal of Cardiology 2012

Study name	Study design	Bleeding events / Total: Uninterrupted warfarin	Bleeding events / Total: Heparin based bridging	Statistics for each study: Odds ratio	Lower limit	Upper limit	p-Value	Relative weight
Ahmed[20]	observational	1 / 222	7 / 123	0.07	0.01	0.62	0.02	6.44
Ghanbari[22]	observational	1 / 20	6 / 29	0.20	0.02	1.83	0.15	5.91
Tischenko[7]	observational	9 / 117	9 / 38	0.27	0.10	0.74	0.01	25.56
Li[23]	observational	12 / 324	14 / 199	0.51	0.23	1.12	0.09	38.87
Cano[21]	observational	4 / 129	31 / 208	0.18	0.06	0.53	0.00	23.23
	observational			0.28	0.17	0.49	<0.01	
Tolosana[8]	RCT	4 / 50	4 / 51	1.02	0.24	4.33	0.98	39.76
Milic[19]	RCT	5 / 41	5 / 40	0.97	0.26	3.65	0.97	41.80
Cheng[18]	RCT	0 / 50	2 / 7	0.02	0.00	0.51	0.02	18.44
	RCT			0.49	0.09	2.56	0.40	
	Overall			**0.30**	**0.18**	**0.50**	**<0.01**	



The American Journal of Cardiology 2012

Study name	heparin type	Bleeding events / Total: Uninterrupted Warfarin	Bleeding events / Total: Heparin based Bridging	Statistics for each study: Odds ratio	Lower limit	Upper limit	p-Value	Relative weight
Ahmed[20]	LMWH	1 / 222	1 / 81	0.36	0.02	5.86	0.47	5.07
Tischenko[7]	LMWH	9 / 117	9 / 38	0.27	0.10	0.74	0.01	38.47
Li[23]	LMWH	12 / 324	3 / 24	0.27	0.07	1.03	0.05	21.88
Cano[21]	LMWH	4 / 129	31 / 208	0.18	0.06	0.53	0.00	34.58
	LMWH			0.24	0.13	0.45	<0.01	
Ahmed[20]	UFH	1 / 222	6 / 42	0.03	0.00	0.23	0.00	13.94
Ghanbari[22]	UFH	1 / 20	6 / 29	0.20	0.02	1.83	0.15	13.57
Milic[19]	UFH	5 / 41	5 / 40	0.97	0.26	3.65	0.97	20.30
Tolosana[8]	UFH	4 / 50	4 / 51	1.02	0.24	4.33	0.98	19.27
Li[23]	UFH	12 / 324	11 / 175	0.57	0.25	1.33	0.19	24.40
Cheng[18]	UFH	0 / 50	2 / 5	0.01	0.00	0.35	0.01	8.52
	UFH			0.29	0.10	0.91	0.03	
	Overall			**0.25**	**0.15**	**0.43**	**<0.01**	



The American Journal of Cardiology 2012

Hospital length of stay

	Uninterrupted Warfarin	Heparin-Based Bridging	p Value
Ahmed et al[20]*	1.23 ± 0.12	2.27 ± 0.21	<0.0001
Ghanbari et al[22]*	2.9 ± 2.7	3.7 ± 3.2	<0.001
Tischenko et al[7]*	—	—	—
Tolosana et al[8]†	2 (1–4)	5 (4–7)	<0.001
Milic et al[19]*	2.6 ± 1.3	4.3 ± 2.8	—
Li et al[23]†	1 (—)	6 (—)	<0.001
Cheng et al[18]*	—	—	—
Cano et al[21]†	5.3 (—)	1.3 (—)	<0.0001

— = no information.

* Values reported as mean ± SD.

† Values reported as median (25th–75th percentiles).

The American Journal of Cardiology 2012

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Pacemaker or Defibrillator Surgery without Interruption of Anticoagulation

David H. Birnie, M.D., Jeff S. Healey, M.D., George A. Wells, Ph.D., Atul Verma, M.D., Anthony S. Tang, M.D., Andrew D. Krahn, M.D., Christopher S. Simpson, M.D., Felix Ayala-Paredes, M.D., Benoit Coutu, M.D., Tiago L.L. Leiria, M.D., and Vidal Essebag, M.D., Ph.D., for the BRUISE CONTROL Investigators*

N Engl J Med 2013;368:2084-93

patients (n =681)
annual risk of TE of 5% or greater
randomly assigned to continued warfarin or heparin bridging

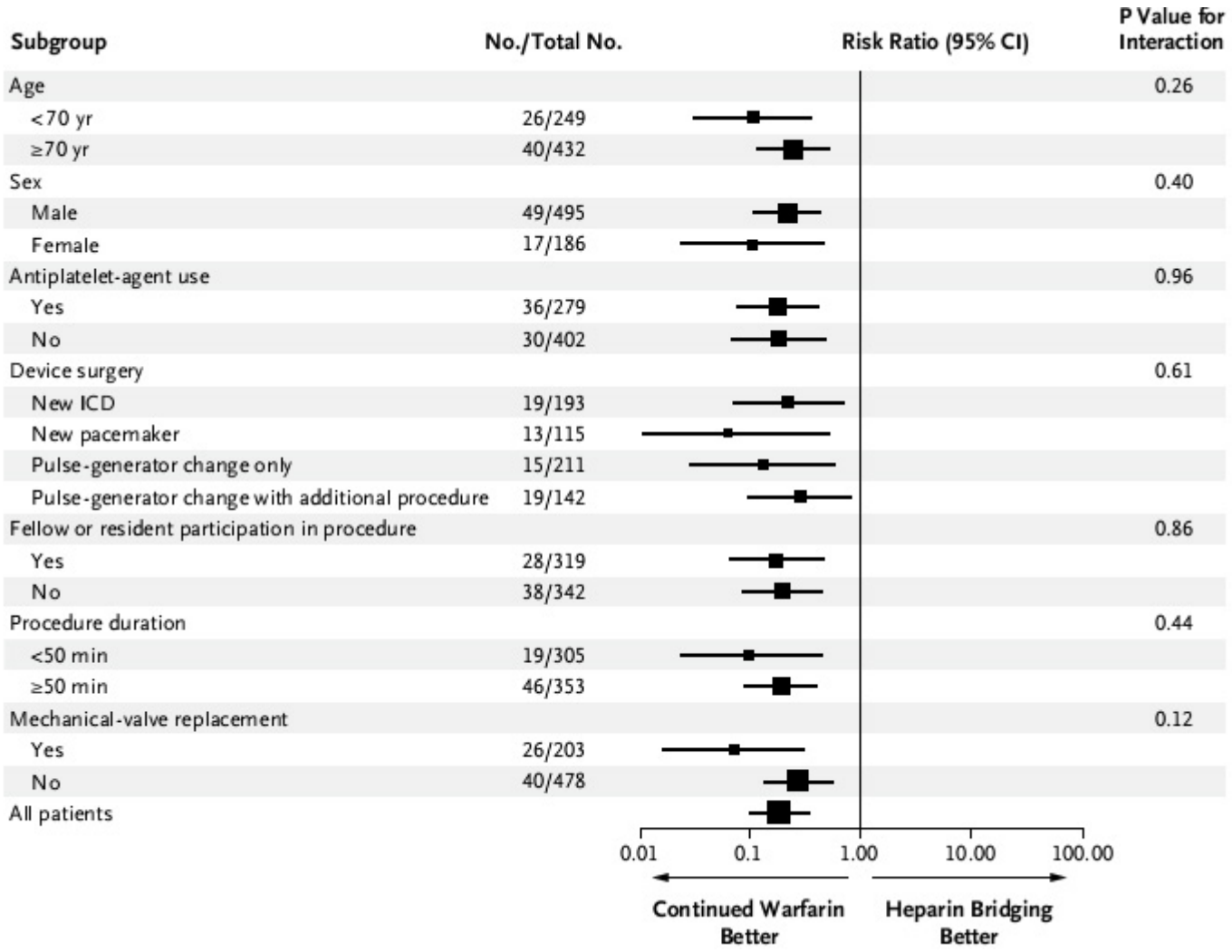
The primary outcome was clinically significant haematoma, which was defined as prolonging hospitalization, necessitating interruption of anticoagulation, or requiring reoperation

Clinically significant haematoma occurred in 12 of 343 (**3.5%**) patients in the **continued-warfarin arm** and 54 of 338 (**16.0%**) patients in the **heparin-bridging arm**

(relative risk, 0.19; 95% CI 0.10 – 0.36;P<0.001)

N Engl J Med 2013;368:2084-93

Subgroup Analyses of Clinically Significant Device-Pocket Hematoma



N Engl J Med 2013;368:2084-93

Pacing Clin Electrophysiol. 2014 Nov;37(11):1573-86. doi: 10.1111/pace.12517. Epub 2014 Sep 19.

Perioperative anticoagulation management in patients on chronic oral anticoagulant therapy undergoing cardiac devices implantation: a meta-analysis.

Du L[1], Zhang Y, Wang W, Hou Y.

⊕ Author information

Abstract

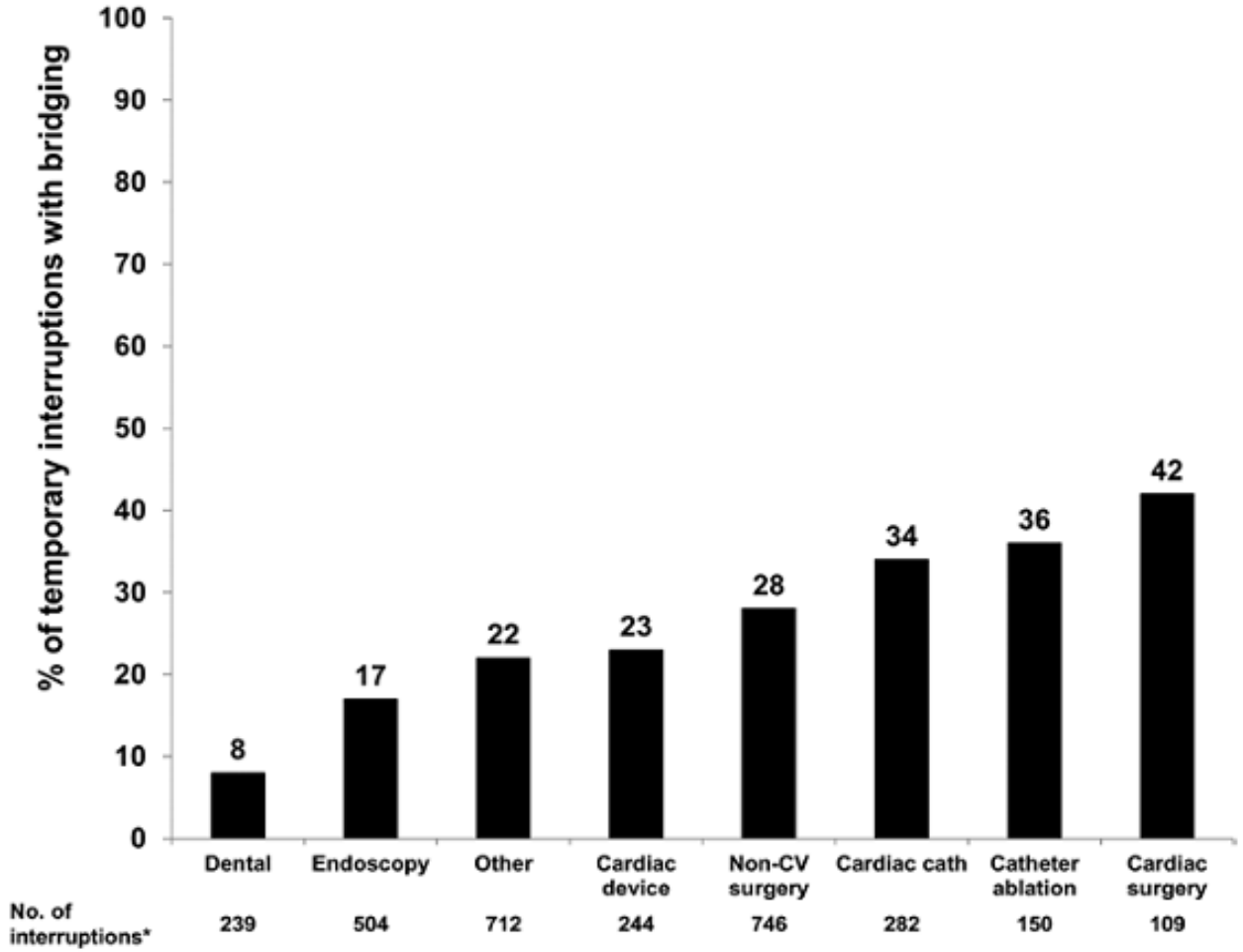
The perioperative anticoagulation strategy during cardiac implantable electronic devices (CIEDs) implantation is highly variable without consensus among implanting physicians. A systematic literature search was performed in MEDLINE, EMBASE, and the Cochrane Library to identify clinical trials in patients on chronic oral anticoagulant (OAC) therapy undergoing CIEDs implantation. Bleeding and thromboembolic events were compared among heparin bridging, continued OAC, and interrupted OAC groups. Data were expressed as relative risks (RRs) and 95% confidence intervals (CIs) using random effects model. According to the inclusion criteria, totally 14 studies involving 3,744 patients were identified and included in the study. The heparin bridging group showed a significantly higher risk of bleeding events (relative risk [RR] 3.10, 95% confidence interval [CI], 2.02-4.76, P < 0.00001), especially pocket hematoma (RR 3.58, 95% CI, 2.17-5.91, P < 0.00001), but no significantly lower incidence of thromboembolism (RR 1.16, 95% CI, 0.36-3.67, P = 0.81) compared with OAC continuation group. Meanwhile, both unfractionated heparin-bridged and low-molecular-weight heparin-bridged subgroup exhibited a higher risk of bleeding. There was no significant difference between OAC continuation and OAC interruption group in bleeding (RR 0.90, 95% CI, 0.65-1.24, P = 0.52) and thromboembolic (RR 0.57, 95% CI, 0.16-2.01, P = 0.38) complications. The OAC interruption group had an obviously lower incidence of bleeding in comparison with the heparin bridging group and no statistical significance was observed in thrombus occurrence. Implantation of CIEDs with continuous OAC therapy may offer the best option by combining the lower risk of bleeding with rare thromboembolism compared with heparin bridging and OAC interruption therapy.

Use and Outcomes Associated With Bridging During Anticoagulation Interruptions in Patients With Atrial Fibrillation

Findings From the Outcomes Registry for Better Informed Treatment of Atrial Fibrillation (ORBIT-AF)

Benjamin A. Steinberg, MD, MHS; Eric D. Peterson, MD, MPH; Sunghee Kim, PhD; Laine Thomas, PhD; Bernard J. Gersh, MBChB, DPhil; Gregg C. Fonarow, MD; Peter R. Kowey, MD; Kenneth W. Mahaffey, MD; Matthew W. Sherwood, MD, MHS; Paul Chang, MD; Jonathan P. Piccini, MD, MHS; Jack Ansell, MD; on behalf of the Outcomes Registry for Better Informed Treatment of Atrial Fibrillation (ORBIT-AF) Investigators and Patients*

Circulation. 2015;131:488-494



Proportion of interruptions involving anticoagulant bridging by procedure. Endoscopy includes gastrointestinal, genitourinary, or bronchoscopic.

Background—Temporary interruption of oral anticoagulation for procedures is often required, and some propose using bridging anticoagulation. However, the use and outcomes of bridging during oral anticoagulation interruptions in clinical practice are unknown.

Methods and Results—The Outcomes Registry for Better Informed Treatment of Atrial Fibrillation (ORBIT-AF) registry is a prospective, observational registry study of US outpatients with atrial fibrillation. We recorded incident temporary interruptions of oral anticoagulation for a procedure, including the use and type of bridging therapy. Outcomes included multivariable-adjusted rates of myocardial infarction, stroke or systemic embolism, major bleeding, cause-specific hospitalization, and death within 30 days. Of 7372 patients treated with oral anticoagulation, 2803 overall interruption events occurred in 2200 patients (30%) at a median follow-up of 2 years. Bridging anticoagulants were used in 24% (n=665), predominantly low-molecular-weight heparin (73%, n=487) and unfractionated heparin (15%, n=97). Bridged patients were more likely to have had prior cerebrovascular events (22% versus 15%; P=0.0003) and mechanical valve replacements (9.6% versus 2.4%; P<0.0001); however, there was no difference in CHA_2DS_2-VASc scores (scores ≥2 in 94% versus 95%; P=0.5). Bleeding events were more common in bridged than nonbridged patients (5.0% versus 1.3%; adjusted odds ratio, 3.84; P<0.0001). The incidence of myocardial infarction, stroke or systemic embolism, major bleeding, hospitalization, or death within 30 days was also significantly higher in patients receiving bridging (13% versus 6.3%; adjusted odds ratio, 1.94; P=0.0001).

Conclusions—Bridging anticoagulation is used in one quarter of anticoagulation interruptions and is associated with higher risk for bleeding and adverse events. These data do not support the use of routine bridging, and additional data are needed to identify best practices concerning anticoagulation interruptions.

Circulation. 2015;131:488-494

The NEW ENGLAND JOURNAL of MEDICINE

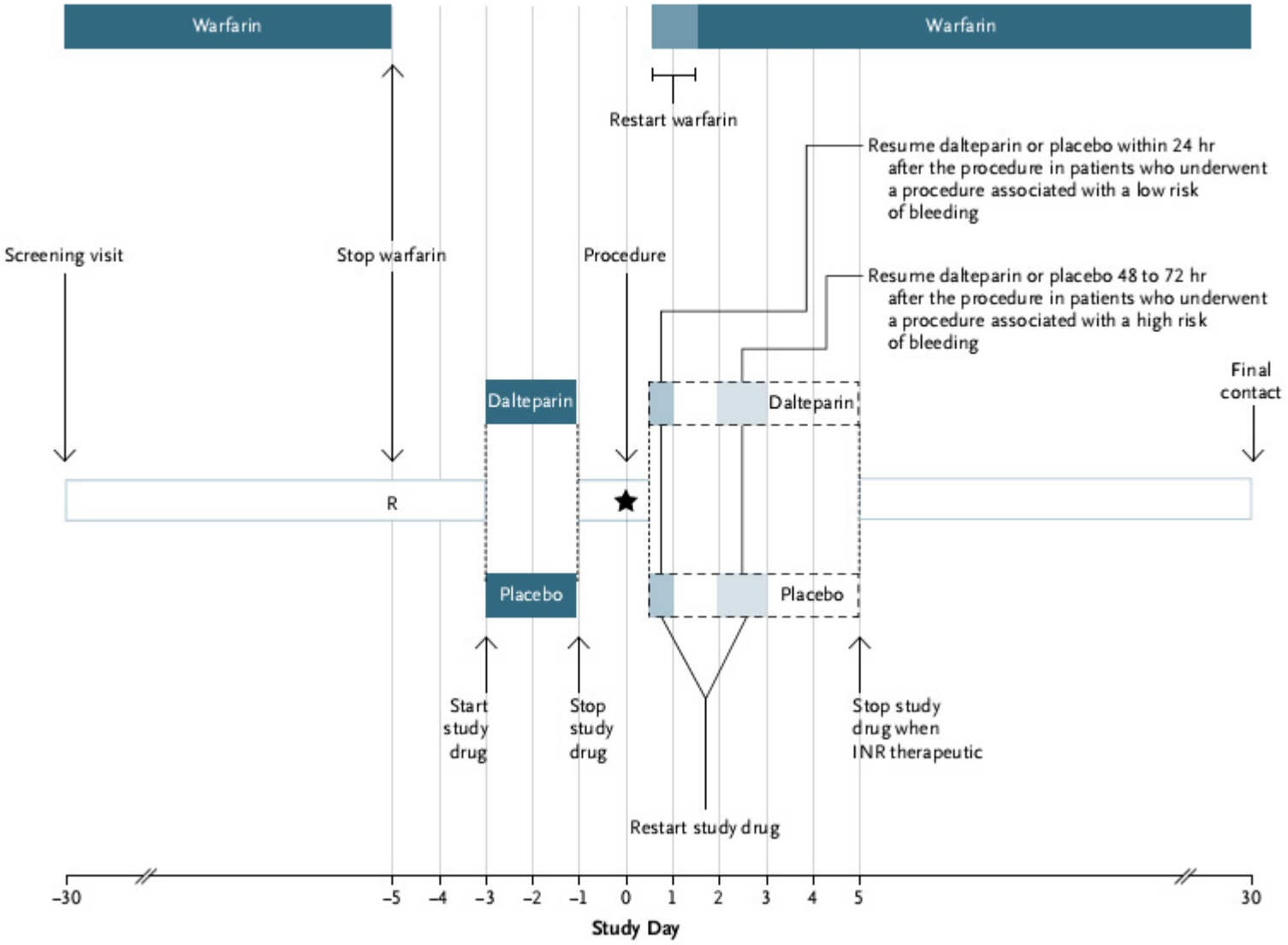
ORIGINAL ARTICLE

Perioperative Bridging Anticoagulation in Patients with Atrial Fibrillation

James D. Douketis, M.D., Alex C. Spyropoulos, M.D., Scott Kaatz, D.O., Richard C. Becker, M.D., Joseph A. Caprini, M.D., Andrew S. Dunn, M.D., David A. Garcia, M.D., Alan Jacobson, M.D., Amir K. Jaffer, M.D., M.B.A., David F. Kong, M.D., Sam Schulman, M.D., Ph.D., Alexander G.G. Turpie, M.B., Vic Hasselblad, Ph.D., and Thomas L. Ortel, M.D., Ph.D., for the BRIDGE Investigators*

N Engl J Med 2015;373:823-33

BRIDGE Study Design



Supplementary Appendix Table S1. Classification of Type of Surgery or Procedure*

Minor or low-bleeding-risk surgery/procedure
▪ gastrointestinal endoscopy (with or without biopsy)
▪ cardiac catheterization (with or without percutaneous coronary intervention)
▪ dental surgery or other dental procedure
▪ dermatologic surgery or other dermatologic procedure
▪ cataract removal or other ophthalmologic procedure
▪ any other surgery or procedure lasting <1 hour
Major or high-bleeding-risk surgery/procedure
▪ intra-abdominal surgery (e.g., bowel or visceral organ resection)
▪ intra-thoracic surgery (e.g., lung resection)
▪ major orthopedic surgery (e.g., hip or knee replacement)
▪ peripheral arterial revascularization (e.g., abdominal aortic aneurysm repair, vascular bypass)
▪ urologic surgery (e.g., prostatectomy, bladder tumor resection)
▪ permanent pacemaker or internal defibrillator insertion
▪ major procedure (e.g., colonic polyp resection, biopsy of kidney or prostate)
▪ any other surgery or procedure lasting ≥1 hour

*Patients who satisfied the trial eligibility criteria were classified according to this suggested classification, although the final designation as minor/low bleeding risk or major/high bleeding risk was left to the discretion of the site investigator.

Supplementary Appendix Table S2. Surgeries and Procedures by Category and Type*

Surgery/procedure type	Placebo	Dalteparin
Minor	**(N=781)**	**(N=758)**
Orthopedic	54 (6.9%)	47 (6.2%)
Cardiothoracic	139 (17.8%)	151 (19.9%)
Interventional radiology	27 (3.5%)	19 (2.5%)
Urologic	41 (5.3%)	45 (5.9%)
Gastrointestinal	391 (50.1%)	357 (47.1%)
Dental	17 (2.2%)	25 (2.3%)
General surgery	38 (4.9%)	27 (3.6%)
Ophthalmologic	13 (1.7%)	33 (4.4%)
Gynecological	3 (0.4%)	5 (0.7%)
ENT (ear, nose, and throat)	13 (1.7%)	9 (1.2%)
Dermatological	36 (4.6%)	35 (4.6%)
Vascular surgery	7 (0.9%)	5 (0.7%)
Other	2 (0.3%)	0
Major	**(N=94)**	**(N=89)**
Orthopedic	29 (30.9%)	29 (32.6%)
Cardiothoracic	3 (3.2%)	3 (3.4%)
Urologic	26 (27.7%)	20 (22.5%)
Gastrointestinal	4 (4.3%)	6 (6.7%)
General surgery	16 (17.0%)	14 (15.7%)
Gynecological	3 (3.2%)	5 (5.6%)
ENT (ear, nose, and throat)	9 (9.6%)	7 (7.9%)
Vascular surgery	4 (4.3%)	4 (4.5%)
Other	0 (0%)	1 (1.1%)

Characteristic	No Bridging (N=950)	Bridging (N=934)
$CHADS_2$ score‡		
Mean	2.3±1.03	2.4±1.07
Distribution — no. (%)		
0	1 (0.1)	1 (0.1)
1	216 (22.7)	212 (22.7)
2	382 (40.2)	351 (37.6)
3	229 (24.1)	232 (24.8)
4	96 (10.1)	106 (11.3)
5	23 (2.4)	27 (2.9)
6	3 (0.3)	5 (0.5)

Study Outcomes

Outcome	No Bridging (N=918)	Bridging (N=895)	P Value
	number of patients (percent)		
Primary			
Arterial thromboembolism	4 (0.4)	3 (0.3)	0.01*, 0.73†
Stroke	2 (0.2)	3 (0.3)	
Transient ischemic attack	2 (0.2)	0	
Systemic embolism	0	0	
Major bleeding	12 (1.3)	29 (3.2)	0.005†
Secondary			
Death	5 (0.5)	4 (0.4)	0.88†
Myocardial infarction	7 (0.8)	14 (1.6)	0.10†
Deep-vein thrombosis	0	1 (0.1)	0.25†
Pulmonary embolism	0	1 (0.1)	0.25†
Minor bleeding	110 (12.0)	187 (20.9)	<0.001†

* P value for noninferiority.

† P value for superiority

N Engl J Med 2015;373:823-33

CONCLUSIONS

In patients with atrial fibrillation who had warfarin treatment interrupted for an elective operation or other elective invasive procedure, forgoing bridging antico-agulation was noninferior to perioperative bridging with low-molecular-weight heparin for the prevention of arterial thromboembolism and decreased the risk of major bleeding

N Engl J Med 2015;373:823-33

which strategy?

thromboembolic risk

- **low risk (≤ 5% per year)**
  - aortic valve prostheses
  - AF with low CHA_2DS_2VASc (<2)

- **hight risk (≥ 5% per year)**
  - AF with $CHA_2DS_2VASc \geq 3$
  - mechanical prosthetic mitral valve
  - Recent deep vein thrombosis and / or pulmonary embolism
  - Ventricular thrombosis

Europace (2015) **17**, 1197–1214
doi:10.1093/europace/euv190

EHRA POSITION PAPER

Antithrombotic management in patients undergoing electrophysiological procedures: a European Heart Rhythm Association (EHRA) position document endorsed by the ESC Working Group Thrombosis, Heart Rhythm Society (HRS), and Asia Pacific Heart Rhythm Society (APHRS)

Christian Sticherling (Chair; Switzerland), Francisco Marin (Co-chair; Spain), David Birnie (Canada), Giuseppe Boriani (Italy), Hugh Calkins (USA), Gheorghe-Andrei Dan (Romania), Michele Gulizia (Italy), Sigrun Halvorsen (Norway), Gerhard Hindricks (Germany), Karl-Heinz Kuck (Germany), Angel Moya (Spain), Tatjana Potpara (Serbia), Vanessa Roldan (Spain), Roland Tilz (Germany), and Gregory Y.H. Lip (UK)

Device implantation in patients receiving vitamin K antagonists: consensus recommendation

In the following patient groups with AF, it is recommended to perform device surgery without interruption of VKA.

- Patients with non-valvular AF and a CHA2DS2-VASc score of≥3.
- Patients with a CHA2DS2-VASc score of 2 due to stroke or TIA within 3 months.
- Patients with AF planned for cardioversion or defibrillation testing at device implantation.
- Patients with AF and rheumatic valvular heart disease.

In the following patient groups with prosthetic heart valves, it is recommended to perform device surgery without interruption of VKA.

- Prosthetic mitral valve.
- Caged ball or tilting disc aortic valve.
- Bileaflet aortic valve prosthesis and AF and a CHA2DS2-VASc score of≥2

Device implantation in patients receiving vitamin K antagonists: consensus recommendation

In patients with severe thrombophilia, it is recommended to perform device surgery without interruption of VKA.

In patients with recent venous thromboembolism (within 3 months), it is recommended to perform device surgery without interruption of VKA.

The INR on the day of surgery should be under the upper limit of the prescribed therapeutic range for the patient (usually≤3;≤3.5 for some valve patients)

In patients with an annual risk of TE events <5% either perform surgery without interruption of VKA or interrupt VKA 3 – 4 days before surgery, no heparin bridging is recommended

Interruption of VKA and bridging with an unfractionated heparin or LMWH should be avoided

… And NOAC?

Missing data on novel anticoagulants

These drugs may have fewer complications and therefore offer new treatment options

Safety of Continuous Anticoagulation With Dabigatran During Implantation of Cardiac Rhythm Devices.

Rowley CP, Bernard ML, Brabham WW, Netzler PC, Sidney DS, Cuoco F, Sturdivant JL, Leman RB, Wharton JM, Gold MR.

Methods: This was a prospective, observational study. **Twenty-five** consecutive patients undergoing implantation of an initial pacemaker, implantable cardioverter-defibrillator (ICD), cardiac resynchronization device, or pulse generator replacement and receiving anticoagulation with dabigatran within 48 hours of the procedure were included. Study endpoints included major bleeding, minor bleeding, and thrombotic complications during the index hospitalization and at 30 days of follow-up.

Results: **The last dose of dabigatran was given 16 ± 15 hours before implantation, and the first dose of the anticoagulant was given 17 ± 16 hours after the procedure. In 11 patients (44%), dabigatran was administered uninterrupted** with no missed doses. During the index hospitalization, no thromboembolic or bleeding complications developed. No major bleeding complications occurred within 30 days of surgery. One minor bleeding event (pocket hematoma that did not require additional intervention or discontinuation of dabigatran) occurred in one patient within 30 days of implantation; this patient was also receiving dual antiplatelet therapy.

Conclusions: The authors concluded that continuous anticoagulation with dabigatran during implantation of CIEDs may be safe, and is not associated with appreciable risk for bleeding and/or thromboembolic complications.

Am J Cardio 2013

Cardiovascular Implantable Electronic Device Implantation with Uninterrupted Dabigatran

Background

While continuation of oral anticoagulation (OAC) with warfarin may be preferable to interruption and bridging with heparin for patients undergoing cardiovascular implantable electronic device (CIED) implantation, it is uncertain whether the same strategy can be safely used with dabigatran.

Objective and Methods

To determine the risk of bleeding and thromboembolic complications associated with uninterrupted OAC during CIED implantation, replacement, or revision, the outcomes of patients receiving uninterrupted dabigatran (D) were compared to those receiving warfarin (W).

Results

D was administered the day of CIED implant in 48 patients (age 66 ± 12.4 years, 13 F and 35 M, 21 ICDs and 27 PMs), including new implant in 25 patients, replacement in 14 patients, and replacement plus lead revision in 9 patients. D was held the morning of the procedure in 14 patients (age 70 ± 11 years, 4 F and 10 M, 5 ICDs and 9 PMs). W was continued in 195 patients (age 60 ± 14.4 years, 54 F and 141 M), including new implant in 122 patients, replacement in 33 patients, and replacement plus lead revision or upgrade in 40 patients. Bleeding complications occurred in 1 of 48 patients (2.1%) with uninterrupted dabigatran (a late pericardial effusion), 0 of 14 with interrupted D, and 9 of 195 patients (4.6%) on W (9 pocket hematomas), P = 0.69. Fifty percent of bleeding complications were associated with concomitant antiplatelet medications.

Conclusions

The incidence of bleeding complications is similar during CIED implantation with uninterrupted D or W. The risks are higher when OAC is combined with antiplatelet drugs.

J Cardiovasc Electrophysiol 2013;24:1125 – 9.

Managing novel oral anticoagulants in patients with atrial fibrillation undergoing device surgery: Canadian survey.

Nascimento T[1], Birnie DH[2], Healey JS[3], Verma A[4], Joza J[1], Bernier ML[1], Essebag V[5].

⊕ Author information

Abstract

BACKGROUND: Approximately 10% of patients who undergo surgical procedures require chronic oral anticoagulation. Physicians must balance the thromboembolic and bleeding risks to make informed decisions on whether to continue anticoagulant medication. Evidence is lacking regarding the perioperative management of novel oral anticoagulant (NOAC) agents. This survey aims to describe the management of perioperative NOAC use during device implantation by Canadian centres.

METHODS: A Web-based tool was used to survey all Canadian adult pacemaker/defibrillator implant centres. The survey collected data regarding the perioperative management of NOACs in atrial fibrillation patients at high risk for thromboembolism who undergo device implantation.

RESULTS: Twenty-two centres performed approximately 14,971 device implants; 1150 (8%) of these implants were in patients who were prescribed a NOAC. In 82% of centres, the NOAC is discontinued in anticipation of device implantation; 73% of these centres do not bridge with heparin. In patients with normal renal function at high risk of thromboembolic events (Congestive Heart Failure, Hypertension, Age, Diabetes, Stroke/Transient Ischemic Attack; CHADS2 ≥ 2), 72% of the centres restart the NOAC within 48 hours of the procedure. For patients with abnormal renal function (glomerular filtration rate < 80 mL/min), the timing of NOAC discontinuation is variable. Hematoma rates vary from 0 to 30%.

CONCLUSIONS: Most Canadian centres perform device implantation with NOAC interruption without the use of bridging. The timing of stopping and restarting anticoagulation and incidence of bleeding complications is variable. These findings emphasize the need for randomized controlled studies to guide the optimal approach to management of NOACs during device implantation.

Europace. 2016 May;18(5):778-84. doi: 10.1093/europace/euw127.

Perioperative management of antithrombotic treatment during implantation or revision of cardiac implantable electronic devices: the European Snapshot Survey on Procedural Routines for Electronic Device Implantation (ESS-PREDI).

Deharo JC[1], Sciaraffia E[2], Leclercq C[3], Amara W[4], Doering M[5], Bongiorni MG[6], Chen J[7], Dagres N[5], Estner H[8], Larsen TB[9], Johansen JB[10], Potpara TS[11], Proclemer A[12], Pison L[13], Brunet C[14], Blomström-Lundqvist C[2]; Coordinated by the Scientific Initiatives Committee of the European Heart Rhythm Association.

⊕ Collaborators (14)

⊕ Author information

Abstract

The European Snapshot Survey on Procedural Routines for Electronic Device Implantation (ESS-PREDI) was a prospective European survey of consecutive adults who had undergone implantation/surgical revision of a cardiac implantable electronic device (CIED) on chronic antithrombotic therapy (enrolment March-June 2015). The aim of the survey was to investigate perioperative treatment with oral anticoagulants and antiplatelets in CIED implantation or surgical revision and to determine the incidence of complications, including clinically significant pocket haematomas. Information on antithrombotic therapy before and after surgery and bleeding and thromboembolic complications occurring after the intervention was collected at first follow-up. The study population comprised 723 patients (66.7% men, 76.9% aged ≥66 years). Antithrombotic treatment was continued during surgery in 489 (67.6%) patients; 6 (0.8%) had their treatment definitively stopped; 46 (6.4%) were switched to another antithrombotic therapy. Heparin bridging was used in 55 out of 154 (35.8%) patients when interrupting vitamin K antagonist (VKA) treatment. Non-vitamin K oral anticoagulant (NOAC) treatment was interrupted in 88.7% of patients, with heparin bridging in 25.6%, but accounted for only 25.3% of the oral anticoagulants used. A total of 108 complications were observed in 98 patients. No intracranial haemorrhage or embolic events were observed. Chronic NOAC treatment before surgery was associated with lower rates of minor pocket haematoma (1.4%; P= 0.042) vs. dual antiplatelet therapy (13.0%), VKA (11.4%), VKA + antiplatelet (9.2%), or NOAC + antiplatelet (7.7%). Similar results were observed for bleeding complications (P= 0.028). Perioperative management of patients undergoing CIED implantation/surgical revision while on chronic antithrombotic therapy varies, with evidence of a disparity between guideline recommendations and practice patterns in Europe. Haemorrhagic complications were significantly less frequent in patients treated with NOACs. Despite this, the incidence of severe pocket haematomas was low.

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doi:10.1093/europace/eut423

Treatment with novel oral anticoagulants in a real-world cohort of patients undergoing cardiac rhythm device implantations

Jedrzej Kosiuk*, Emmanuel Koutalas, Michael Doering, Philipp Sommer, Sascha Rolf, Ole-A. Breithardt, Sotirios Nedios, Borislav Dinov, Gerhard Hindricks, Sergio Richter, and Andreas Bollmann

The interruption of NOAC prior procedure was protocolized as follows: the last pre-intervention dose of NOAC was omitted meaning that patients with dabigatran received it 24 h and patients with rivaroxaban 36 h prior procedure (12 h NOAC-free interval in case of dabigatran and 24 h in case of rivaroxaban). The scheduled time of first postinterventional anticoagulant administration was left to the discretion of the implanting physician.

- 93 patients treated with dabigatran and 83 patients with rivaroxaban, respectively
- Post-operative bleeding complications and thromboembolic events occurring within 30 days were compared
- 69 patients (74%) were on dabigatran on admission, 54 patients (65%) were already on rivaroxaban on admission; in both the groups no bridging with heparin was performed.
- dabigatran group, two (2%) bleeding complications; four (5%, three pocket haematomas and one pericardial effusion) in the rivaroxaban group (P= 0.330)

Conclusion

Bleeding and thromboembolic complications in patients treated with dabigatran or rivaroxaban are rare. Further and larger studies are warranted to define the optimal anticoagulation management in patients with a need for oral anticoagulation and CRD interventions.

Strategy of Continued Versus Interrupted Novel Oral Anti-coagulant at Time of Device Surgery in Patients With Moderate to High Risk of Arterial Thromboembolic Events (BRUISECONTROL2)

This study is currently recruiting participants. (see Contacts and Locations)

Verified July 2016 by Ottawa Heart Institute Research Corporation

Sponsor:
Ottawa Heart Institute Research Corporation

Collaborators:
Boehringer Ingelheim
Heart and Stroke Foundation of Canada

Information provided by (Responsible Party):
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ClinicalTrials.gov Identifier:
NCT01675076

First received: August 27, 2012
Last updated: July 14, 2016
Last verified: July 2016
History of Changes

Conclusion

The increasing number of implants and the increase of antithrombotic therapies in cardiovascular care emphasize the importance of an effective strategy for the prevention of periprocedural bleeding complications

Conclusion

- Current evidence suggests that the bridging with heparin in patients on chronic therapy with oral anticoagulants is associated with increased risk of pocket hematoma

- The continuation of the OAT is a strategy with an acceptable safety profile