

Best evidence topic - Arrhythmia

Should amiodarone or lidocaine be given to patients who arrest after cardiac surgery and fail to cardiovert from ventricular fibrillation?

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Summary

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was whether the administration of amiodarone or lidocaine in patients with refractory VT/VF after cardiac surgery results in successful cardioversion. Altogether more than 434 papers were found using the reported search, from which 23 articles were used to answer the clinical question. No randomized trials have been found in which amiodarone was studied in patients with refractory VF/VT after cardiac surgery. Recommendations on the use of amiodarone in patients with refractory VF/VT in both European and American 2005 Guidelines on Resuscitation are mainly based on expert consensus and are supported by a few randomized trials in patients with out-of-hospital cardiac arrest. We would therefore recommend that amiodarone is the first line drug that should be used in patients with refractory ventricular arrhythmias after cardiac surgery that persist after three failed attempts at cardioversion. Lidocaine should only be used if amiodarone is not available or if its use is contraindicated. Amiodarone should be administered as an intravenous bolus of 300 mg after the third unsuccessful shock.

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Keywords: Amiodarone; Lidocaine; Ventricular fibrillation; Cardiac surgery

1. Introduction

A best evidence topic was constructed according to a structured protocol. This is fully described in the ICVTS [1].

2. Three-part question

In [patients with refractory ventricular fibrillation after cardiac surgery] is the use of [amiodarone or lidocaine] of benefit in achieving [successful cardioversion]?

3. Clinical scenario

A 77-year-old diabetic patient 3 h after five coronary artery bypass grafts suddenly goes into ventricular fibrillation on the intensive care unit. Three shocks are rapidly administered which fail to cardiovert him. External cardiac massage is commenced and you decide that an emergency re-sternotomy should immediately be performed. The anaesthetist, however, feels that you should delay re-sternotomy to try amiodarone and further attempts at cardioversion. The patient successfully cardioverts after the 4th shock and 2 min of massage, but after angiography requires re-operation to re-do the posterior descending artery graft

which unexpectedly occluded to cause the arrest. You wonder if emergency re-sternotomy should always be delayed until amiodarone has been given in this situation?

4. Search strategy

Pubmed: (amiodarone OR lidocaine OR lignocaine) and (cardiac surgery OR Thoracic Surgery OR Cardiac Surgical Procedures OR Thoracic Surgical Procedures OR cabg OR coronary artery bypass OR heart surgery) and (ventricular fibrillation OR ventricular fibrillations OR ventricle fibrillation OR ventricle fibrillations). **EMBASE:**((amiodarone OR lidocaine OR lignocaine).mp OR exp Amiodarone/OR exp Lidocaine/) and (exp thorax surgery/OR (cardiac surgery OR Thoracic Surgery OR cabg OR coronary artery bypass OR heart surgery).mp) and (exp Heart Ventricle Fibrillation/OR (ventricular fibrillation\$ OR ventricle fibrillation\$).mp).

Web of Science: ts=(amiodaron* OR lidocain* OR lignocain*) and ts=(cardiac surg* OR Thoracic Surg* OR cabg OR coronary artery bypass* OR heart surg*) and ts=(ventricular fibrillation* OR ventricle fibrillation*). **Cochrane:** (amiodarone OR lidocaine OR lignocaine) and (cardiac surgery OR Thoracic Surgery OR Cardiac Surgical Procedures OR Thoracic Surgical Procedures OR cabg OR coronary artery bypass OR heart surgery) and (ventricular fibrillation OR ventricular fibrillations OR ventricle fibrillation OR ventricle fibrillations).

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Table 1
Best evidence papers

Author, date and country Study type (level of evidence)	Patient group	Outcomes	Key results	Comments
Kron et al., (1984), Ann Thorac Surg, USA [2] Cohort study (level V)	18 patients of a total of 1251 operated patients who experienced unexpected ventricular tachyarrhythmias after cardiac surgery in the first 6 weeks after operation. The primary arrhythmia was VF in 6 patients and VT in 12 patients. Prior to the primary event, 3 patients in the VF group and 7 patients in the VT group used lidocaine due to ventricular ectopy	Alive and well Early death (i.e. during initial hospitalization) Late death (i.e. during follow-up)	With lidocaine VF: 0 patients VT: 2 patients Without lidocaine: VF: 2 patients VT: 4 patients With lidocaine: VF: 2 patients VT: 4 patients Without lidocaine: VF: 1 patient VT: 1 patient With lidocaine: VF: 1 patient VT: 1 patient Without lidocaine: VF: 0 patients VT: 0 patients	Retrospective descriptive single center experience. Ventricular tachyarrhythmia occurrence in the postoperative period is an infrequent but catastrophic event. Lidocaine may prevent premature ventricular complexes but does not prevent ventricular tachyarrhythmia
Bogers et al., (1987), Thorac Cardiovasc Surg, The Netherlands [3] Case report (level V)	1 neonate after corrective surgery for simple transposition of the great arteries with recurrent ventricular fibrillation despite multiple countershocks	Conversion to sinus rhythm	Lidocaine no effect Amiodarone successful conversion	Case report
Kudenchuk et al., (1999), N Engl J Med, USA [15] Randomized controlled trial (level I)	Patients with out-of-hospital cardiac arrest with ventricular fibrillation or pulseless ventricular tachycardia who had not been resuscitated after three or more electric shocks. Patients were randomized to receive a single bolus of intravenous amiodarone (300 mg) ($n=246$) or placebo ($n=258$)	Rate of survival to hospital admission with spontaneously perfusing rhythm	Amiodarone: 44% Placebo: 34% $P=0.03$	Significantly more hypotension and bradycardia after administration of amiodarone Study is underpowered to detect differences in survival to hospital discharge
Dorian et al., (2002), N Engl J Med, Canada [16] Randomized controlled trial (level I)	Patients with out-of-hospital cardiac arrest based on refractory or recurrent ventricular fibrillation. Patients were randomized to receive intravenous lidocaine plus amiodarone placebo ($n=167$) or intravenous amiodarone plus lidocaine placebo ($n=180$)	Proportion of patients who survived to hospital admission	Lidocaine: 12.0% Amiodarone: 22.8% $P=0.009$	Increased survival to hospital admission if time to drug administration is shorter
Somberg et al., (2002), Am J Cardiol, USA [20] Randomized controlled trial (level I)	Double blinded parallel study design in which 29 patients with shock resistant ventricular tachycardia were randomized for treatment with lidocaine (2×100 mg bolus) (11 patients) or amiodarone (2×150 mg bolus) (18 patients) followed by a 24 h infusion	Direct termination of ventricular tachycardia	Lidocaine group: 3 patients (27%) Amiodarone group: 14 patients (78%) $P<0.05$	24-h survival 39% for amiodarone and 9% for lidocaine ($P<0.01$)
Anastasiou-Nana et al., (1994), J Am Coll Cardiol, Greece [22] Experimental study (level VI)	15 dogs with spontaneous ventricular fibrillation after experimental coronary artery ligation who were refractory to basic treatment with lidocaine, epinephrine and 5 electric countershocks were randomized	Conversion from ventricular fibrillation	Group I (lidocaine and epinephrine): 1 out of 8 successful cardioversions Group II (amiodarone):	Animal study

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Table 1 (Continued)

Author, date and country Study type (level of evidence)	Patient group	Outcomes	Key results	Comments
	into two groups: 8 dogs received continued basic treatment whereas 7 dogs were treated with a bolus of amiodarone (10 mg/kg) and shocks		6 out of 7 successful cardioversions	
Atkins, (2005), Circulation, USA [23]	ILCOR worksheet titled 'Amiodarone for pediatric shock resistant VF/VT'	Level of evidence	Class IIb – Acceptable and Useful; fair evidence	
Haukoos and Paradis (2005), Circulation, USA [24]	ILCOR worksheet titled 'What is the optimal drug therapy for VF'	Level of evidence	Class IIa – Acceptable and Useful; good evidence	

In addition, ILCOR worksheets as well as the European and American Guidelines on Resuscitation were searched, including all references.

5. Search outcome

In total, 434 papers were found using the reported search of which 105 in Pubmed, 235 in Embase (194 unique), 164 in the Web of Sciences database (130 unique) and finally 36 in the Cochrane controlled trial register (5 unique). From these papers, 23 papers were used to answer the clinical question. All relevant papers are presented in Table 1.

6. Results

Only two articles were found in cardiothoracic patients. A non-randomized retrospective report described that lidocaine was unable to prevent ventricular tachyarrhythmias in patients after cardiac surgery [2] and the second article describes a case report in a neonate after corrective cardiac surgery in which the use of amiodarone, in addition to cardioversion, resulted in successful treatment of recurrent ventricular fibrillation [3]. Further evidence supporting the use of amiodarone in patients after cardiac surgery is not available. This may in part be explained by the fact that, based on data from retrospective studies, sustained ventricular arrhythmias after cardiac surgery are rather uncommon and have reported incidences ranging from 0.4%–1.4% [4–6]. Anthi reported an incidence of 0.7% in the first 24 h after surgery [7] and Wahba reported an incidence of 1.4% within the first 8 days after surgery [8].

In a prospective study of 4748 patients with no prior history of ventricular arrhythmias, the incidence of sustained postoperative ventricular tachycardia ranged from 0.7%–2.6% depending on the type of surgery, with an overall incidence of 0.9% [9]. Hospital mortality rates are high and reach values from 20%–50% [4–10]. For those patients after internal cardiac massage, overall survival to hospital discharge has been reported as 17%–25% [11, 12].

According to both European and American 2005 resuscitation guidelines [13, 14], no evidence is available that any antiarrhythmic drug given routinely during human cardiac arrest increases survival to hospital discharge. In contrast, two large randomised trials, referred to as the ARREST [15] and ALIVE [16] trials, have shown in patients with out-of-

hospital cardiac arrest that short-term survival to hospital admission is improved by the use of amiodarone as compared to placebo or lidocaine. In the former study by Kudenchuk, beneficial effects of amiodarone in patients with out-of-hospital cardiac arrest as compared to placebo have been reported which resulted in a significant 10% more successful hospital admissions (44% vs. 34%, respectively) [15]. In the ALIVE trial, the effect of intravenous lidocaine with amiodarone in patients with out-of-hospital cardiac arrest were compared [16]. It was found that survival to hospital admission was significantly increased if patients were treated with amiodarone as compared to lidocaine (22.8% vs. 12.0%, $P=0.009$). In addition, it was found that the proportion of patients that developed asystole after defibrillation and administration of study medication was significantly higher in the lidocaine treated group as compared to the amiodarone treated group (29% vs. 18%, $P=0.04$).

Additional studies have also shown a consistent improvement in defibrillation response when amiodarone was given to humans or animals with VF or hemodynamically unstable VT [17–21].

The findings of all above-mentioned studies have led to the expert consensus that 'amiodarone should be considered as the first line antiarrhythmic drug that should be given to patients with VF/pulseless VT that persists after 2–3 shocks plus adequate CPR and use of a vasopressor' [13, 14]. It should be given as a bolus injection of 300 mg. A further dose of 150 mg may be given for recurrent or refractory VF/VT followed by an infusion of 900 mg over 24 h. Lidocaine, 1 mg/kg, may be used as an alternative but only if amiodarone is not available.

Somberg and colleagues showed in a double-blinded study that amiodarone is more effective than lidocaine in the treatment of shock-resistant VT (immediate VT termination in 78% vs. 27%, respectively, $P<0.05$) and that drug-related hypotension was less frequent than with lidocaine [20]. Anastasiou-Nana induced ventricular fibrillation in dogs by acute coronary artery ligation and studied the defibrillation response after administration of amiodarone and lidocaine [22]. They found that amiodarone had a significantly better effect on defibrillation as compared to lidocaine.

Finally, according to two worksheets of the International Liaison Committee On Resuscitation (ILCOR), amiodarone can be safely and effectively used in both paediatric and

adult patients with refractory ventricular fibrillation (class IIb and IIa recommendations, respectively) [23, 24].

7. Clinical bottom line

No randomised trials have been found in which amiodarone was studied in patients with refractory VF/VT after cardiac surgery. Recommendations on the use of amiodarone in patients with refractory VF/VT in both European and American 2005 Guidelines on Resuscitation are mainly based on expert consensus and are supported by a few randomised trials in patients with out-of-hospital cardiac arrest. We would therefore recommend that a 300-mg intravenous bolus of amiodarone is the first line drug that should be used in patients with refractory ventricular arrhythmias after cardiac surgery that persist after three failed attempts at cardioversion. Lidocaine should only be used if amiodarone is not available or if its use is contraindicated.

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