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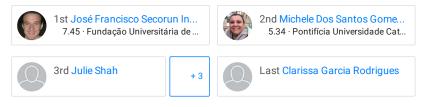


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Monophasic and Biphasic Shock for Transthoracic Conversion of Atrial Fibrillation: Systematic Review and Network Meta-analysis

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Abstract

Objectives: Conduct a systematic review of the literature to compare the efficacy of different biphasic and monophasic shock waveforms technologies for transthoracic cardioversion of Atrial Fibrillation (AF). Methods: We searched PubMed, EMBASE, The Cochrane Library, LILACS and ClinicalTrials.gov databases for randomized clinical trials comparing two or more defibrillation waveforms when performing elective transthoracic cardioversion of AF. The outcomes assessed were 1st shock success, overall success, cumulative energy and number of shocks to restore Normal Sinus Rhythm. Results: Were included 23 trials involving 3046 patients, 5 biphasic and the monophasic waveform. Direct meta-analysis revealed that Biphasic waveforms have higher chance to achieve cardioversion in the 1(st) shock (OR: 3.2; 95% CI 2.2-4.7) and after a sequence of attempts (OR:2.4; 95% CI 1.5-3.9), requiring 296 less Joules (95% CI 356-237) and 0.74 less shocks (95%Cl 1.03-0.44) when compared to Monophasic. Network meta-analysis showed no significant differences between the Biphasic technologies of PhysioControl ADAPTIV, Philips SMART and ZOLL Rectilinear, in any of the four outcomes. Conclusion: The evidences points to a Biphasic waveform superiority over Monophasic to perform AF cardioversion, supporting current guidelines to use less energy when using a Biphasic defibrillator. It is suggested that the Biphasic defibrillators from PhysioControl ADAPTIV, Philips SMART and ZOLL Rectilinear have similar efficacy and the use of any of them may result in similar chances, energy and number of shocks to achieve successful AF cardioversion.

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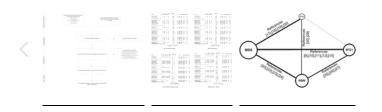
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Review article

Monophasic and biphasic shock for transthoracic conversion of atrial fibrillation: Systematic review and network meta-analysis^{*}



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A R T I C L E I N F O

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A B STR A CT

Objectives: Conduct a systematic reviewof the literature to compare the efficacy of different biphasic a monophasic shock waveforms technologies fortransthoracic cardioversion of Atrial Fibrillation (AF). *Methods*: We searched PubMed, EMBASE,The CochraneLibrary, LILACSand ClinicalTrials.govdatabae for randomized clinical trials comparing two or more defibrillation waveforms whenperforming ele tive transthoracic cardioversion of AF.The outcomes assessed were 1st shock success, overall succe cumulative energy and number shocks to restore Normal Sinus Rhythm.

Results: Were included 23trials involving 3046patients, 5 biphasic and the monophasic waveform. Dir meta-analysis revealed that Biphasicwaveforms have higher chanceto achieve cardioversion in the shock (OR:3.2; 95% CI2.2-4.7) and aftera sequence of attempts(OR:2.4; 95% CI 1.5-3.9), requiring 296 l Joules (95%CI 356-237) and 0.74 lesshocks (95%CI 1.03-0.44) when compared to Monophasic. Network meta-analysis showed no significant differences between the Biphasic technologies of PhysioCont ADAPTIV, Philips SMART and ZOLL Rectilinearin any of the four outcomes.

Conclusion: The evidences points to a Biphasic waveform superiority over Monophasic to perform cardioversion, supporting current guidelines to useless energy when using a Biphasic defibrillator. I suggested that the Biphasic defibrillators from PhysioControl ADAPTIV, Philips SMARTand ZOLLRec linear have similar efficacy and the use of any of them may result in similar chances, energy and und of shock to achieve successful AF cardioversion.

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Introduction

Electrical cardioversion for the treatment of Atrial fibrillation (AF) is classified as a Class I treatment when pursuing rhythmcontrol strategy (LOEB). Its benefits have been demonstrated when a rapid ventricular response to AF does not respond promptly to pharmacological strategies and contributes to other comorbidities (LOE C) and when it is associated with hemodynamic

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instability (LOE C).¹ It is also known that biphasic shock wav forms need lower energy than monophasic shock waveforr for transthoracic cardioversion of AF. Recommendations for i tial energy have been set to 120 J for biphasic waveforms, *e* 200J for monophasic waveforms.² Animal studies suggest t lower energy biphasic shocks decrease the risk of myocard dysfunction.³

Overall, in guidelines and literature reviews, Biphasic wav formshocks are treated as equal, and possible differences betwe Biphasic waveform technologies have not yet been complete clarified. A recent systematic review of nine studies on t treatment of AF compared monophasic and biphasic techno gies demonstrating better performance of the Biphasic, t no distinction of the biphasic technologies were evaluated reported.⁴

[☆] ASpanishtranslated version of the summaryof thisarticle appearsas Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2015.12.009.
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Two major types of biphasic waveforms are known as Rectilinear Biphasic Waveform (RBW) and Biphasic Truncated Exponential (BTE.) Different BTE manufactures can have different peak voltages, positive and negative cycle's durations and tilts. In both types of biphasic waveforms the defibrillator reads the patient's transthoracic impedance during energy delivery, and adjusts its outputs in order to deliver the selected energy to the patient. However they differ in how they adjust their output to compensate for the patient's impedance. Rectilinear Biphasic Waveform (RBW), developed by ZollTM, has a 200 J limitand adjusts its internal impedance to deliver a constant current.One major Biphasic Transthoracic Exponential waveform is ADAPTIVTM developed by $PhysioControl^{TM}$. It has a 360J limit and controls lead-edge voltages and adjustspulse duration. Another major BTE waveform is the Philips SMARTTM Biphasic, it has a 200 limit, constant edge voltages and itcontrols pulse tilts and adjusts pulse duration.^{5–7}A number of randomized controltrials have evaluated the safety and performance of these technologies andothers, yet further investigation is needed to better understand these differences. Thus, the aim of this study was to conduct asystematic reviewand network meta-analysis of randomized controltrials to compare the efficacy of different biphasic waveforms and monophasic shock waveforms, applied through the thorax, for the conversion of Atrial fibrillation. Theoutcomes comparedwereCumulative Energy, Numberof Shocks, First Shock Success Rate and Overall Success Rate to restore normal sinusrhythm(NSR) in patients with AFundergoing elective cardioversion therapy.

Methods

Protocol and registration

This systematic review is reported in accordance with the Preferred Reporting Items for Systematic Reviewand Meta-Analyses (PRISMA) statement ⁸ and is registered in the Prospero database [CRD42014010479].

Eligibility criteria

Participants: Patients diagnosed with AF, persistent or not, undergoing elective cardioversion.

Interventions: Studies where the cardioversion shock therapy delivered through the thorax in attempt restore NSR was evaluated reporting thenumber of shocks delivered, the mean energy delivered and successrate torestore NSR.

Comparison: Group receiving any Biphasic shock technology compared toa groupreceiving Monophasic shock or group receiving one type of Biphasic technology compared to a group receiving other type of Biphasic technology.

*Outcomes:*The outcomes were CumulativeEnergyrepresenting the mean cumulative energy necessary torestore NSR,the number of shocks, representing the mean number of shock necessary to restore NSR, first shock success rate, representing the odds ratio to restore NSR the first shockattempt and overall success rate to restore NSR after all shocks attempt.

Typesof Study: Studies designed as a RandomizedClinical Trial (RCT). No languagelimits were usedStudies with duplicatedpopulation andthose that dichotprovide thetypeofbiphasic technology used were excluded.

Information sources

Asearchedwasperformed usingthe following electronic databases: PubMed, EMBASE, Cochrane Central Registry of Controlled Trials, ClinicalTrials.gov, and Lilacs. The search included references of manually included articles and citation analysis of the inc studies wasperformed using Google Scholar.

Search

The initial search comprised the Mesh terms Atrial fibril electric countershock, clinical trial and their related entry term search date was limited between 1/01/2000 and 6/31/2014 complete search strategy used for the PubMed database is s in Appendix Table 1. The searches were updated on 9/5/20 verify if newer publications were available.

Studyselection

Titles and abstractsof the retrieved articles were independevaluated by 2 reviewers (JFI and MG). Abstracts that diprovideenough information regarding the eligibility criteria kept for full-text evaluation. Reviewers independently evalu full-text articles and determined study eligibility. Disagreen were solved by consensus and when a consensus could r reached athird reviewer (AM) was used.

Risk ofbias

Risk of biaswas evaluated according tothe PRISMA state recommendation.Study quality assessmentincluded: select bias items, such as adequatesequence generation, and alloc concealment; performance of bias items, such asblinding ofpa pantsand personnel, and blinding of outcome assessment; att ofbias evaluated through the assessment of incomplete out data; reportingof bias by the assessment of selective reporting other sources of bias. Two reviewers (JFI and MG) indepent performed quality assessment, and disagreementswere solv consensus or by a third reviewer (AM).

Dataextraction

Two reviewers (JFI and MG) independently conducted the extraction and disagreements were solved by the thirdrevi (AM). Characteristics such ascumulative energy, numberofsh and first shock success to restore normal sinus rhythm retrieved from the included studies. In studies where cros analysiswas conducted, the data was collected before the cros was performed. Cumulative success rate and study ups energy protocol were used to calculate the cumulative energ the numberof shocks in studies that did not report theseoutc directly.

Dataanalysis

Considering that the studies have similar designs, same out measures and different upscaling energy protocols, we cond direct meta-analysis pooling the results using a random ϵ with mean differences for continuous outcomes such ascumu energy and number of shocks and odd ratios outcomes such shock success and overall success, and calculated 95% confic intervals and two sided *P* values. The Cochran *Q* test was us assess heterogeneity and a value of *P* less than 0.1 was consistatistically significant. The l^2 testing was also used to measu magnitude of the heterogeneity. The possibility of bias across ies was also evaluated using funnel plot of each of the trials size against the standard error (SE).

A network meta-analysis was also used, allowing for in comparison of two trialsthat haveat least one treatment in mon. The Bayesan Markov-chainMonte Carlo method usir statistical softwareRstudio and JAGSpackage was used. The r

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were expressed with meandifferences for cumulative energy and number of shocks and odd ratios for 1st shock success and overall success with 95% credible intervals (CrI).

Results

Study selection

Basedon thesearch strategy, a total of 2651 citations were dentified and reviewed. After evaluating those against the predefined eligibility criteria, a total of 23 studies were included in this systematic review involving 3046 patients, 5 different bip hasic waveform technologies and 7 types of monophasic waveform. The complete study workflow is shown in Fig. 1.

Studiescharacteristics

Table 1 summarizes the included studies characteristics. The energy protocol is the predefined upscaling energy protocol of attempts to restore normal sinus rhythm and differences among studies were observed, where the majorityhad predefined protocols starting with a lower energy and upscaling the energy until the highest energyavailable was used in the last attempt. In one particularly study the energy dose was defined by the physician individually for each patient and in another study the energy dose was chosen proportionally to the patient weight. Criteria to define successful cardioversion also vary; studies may consider a valid conversion an immediate conversion, a conversion that holds at least a number of consecutive sinus beats or a conversion that sustains at leastone to two minutes of normal sinus rhythm. PhysioControl Biphasic (BTE1) is present in 11studies being applied in 706 patients, PhilipsSMARTBiphasic (BTE2) in 5 studies and 292 patients, WelchAllyn Biphasic(BTE3) in two studies and 93 patients, Nihon-Koden Biphasic (BTE4) in onestudy and 100 patients and the Zoll Rectlinear Biphasic (RBW) in 9 studies and 655 patients. The Monophasic Damped Sine waveform (MDS) was present in 19 studies and 1200 patients, appearing in seven different forms: PhysioControl Lifepak 9 Monophasic (MDS1), PhysioControLifepak 12Monophasic(MDS2), GEResponder 3000Monophasic (MDS3), GECardioServMonophasic (MDS4), HPCodeMaster XL Monophasic(MDS5), Zoll Monophasic (MDS6) and ChiranaBPD 13 Monophasic(MDS7). The use ofseveral pharmacological antiarrhythmic therapies wasidentified acrossstudies where the patientcould be receiving oneor moredrugsprior to the procedures.

Risk of biaswithin studies

In relation to selection bias most trials presented unclear descriptions. Eleven studies did not report the method for allocation concealment and 13 failed to report the method for random sequence generation.

For performance bias, because transthoracic elective cardioversion is performed with the patient under sedation, and blinding of the defibrillator isa challenge, single-blinded studies were considered to be of lowrisk of bias. Only two studies were considered to be of highrisk. In relation to detection bias, 13 studies lacked information regarding the blinding of the outcome assessment, and three were considered high risk.

Attrition biaswas analyzed by evaluating incomplete outcomes data. Most studies presented low risk of bias (16 trials), three trials were considered to have high risk of bias, and in three trials the risk of bias was unclear. Additionally, among the 23 studies included, 17 had low risk of reporting bias (analyzed by the evaluation of selective reporting) and six had ahigh risk of reporting bias. 1 complete risk of bias results is shown in Appendix Table 2.

Qualitativeanalysis-Individual studies

Of the23trials included, 8 compared BTE1 and MDS. Treestud reported BTE1 as superior for 1st shock success, overall succe cumulative energy and number of shocks to restore NSR.^{9–11} O study reported BTE1 as superior toMDS for overall success a cumulative energy but did noate statistical results regarding shock success and number of shocks.¹² One study demonstrat BTE1 assuperior forcumulative energyand number of shocks, a no significant difference for overall success. It did notevaluate shocksuccess since the studydid not followa predefined ener protocol; the energy was set at the discretion of thephysician In addition, one study showedBTE1 as superior for overall succ and cumulative energy, and reported no significant difference the number of shocks and did not evaluate 1st shock success Also onestudy had aBTE1 protocol (50-100-150-175J)using 1 the energyof the MDS protocol(100-200-300-360J) presenting significant difference between BTE1 and MDS for 1st shock succe overall success and number of shocks and BTE 1 assuperior cumulative energy.¹⁵ Finally, one study reported that the grc that received BTE1 at anypointhad a significantly higher over successrate.16

Four studies were reviewed that compared BTE2 to MDS. (study reported BTE2 assuperior to MDS for1st shock succe cumulative energy and number of shocks and found no signific difference for overall success.¹⁷ One study showed no signific difference for 1st shock success, overall success or number shocks, and found BTE2 to be superior for cumulative energy Another study demonstrated BTE2as superior to MDS for 1st sho success, and showed no significant difference **for** overall succe but did notevaluate cumulative energy or number of shocks.¹⁹ (study reported BTE2 as significantly superior to MDS for overall s cess and cumulative energy, but did not evaluate 1st shock succe ornumber of shocks.²⁰

Five studieswere reviewedcomparing RBWtoMDS. Twostud reported no significant difference for 1st shock successand over all success, and reportedRBW as superiorto MDS forcumulati energy.^{21,22} One study found nosignificant difference for 1st she success, overall success, ornumber of shocks and reported RBW superioronly for cumulative energy.²³ One study reported RBW superiorfor overall success and cumulative energy butdid notev uate 1st shock success ornumber of shocks.²⁰ One study report RBW as uperior toMDS for 1st shock successand overall success but did not evaluate cumulative energy or number of shocks.²⁴

Three studies were reviewed comparingBTE1 to RBW.^{25–27} studies reported no significant difference for1st shock success overall success. One study reported no significant difference number of shocks and RBW as superior to BTE1 forcumulati energy using theStudent's t testapproach.²⁷ One study repor no significant difference for number of shocks and BTE1 as sugrior to RBW for cumulative energy using theWilcoxonrank-su testapproach.²⁵

Two studies were reviewed comparing BTE2to RBW. Neitl study showed significant differences for overall success. One stu hadno significant difference for 1st shock success overall succe cumulative energy ornumber of shocks.²⁸ One study reported B1 assuperior to RBW for cumulative energy.²⁰

Two studies evaluated BTE3 versus MDS. One study repor nosignificant difference for 1st shock successor overall succ andreported BTE3as significantly superior toMDS forcumulati energy and number of shocks.²⁹ One study presented cumulati energy and number of shocks results however no statistical differences were calculated between groups.³⁰

9	Summary of characteris	stics of included s	tudies.				
-	First Authorand Year ofpublication	Study arms	No. of patients	Energy protocol (J)	Successful cardioversioncriteria	Mean ag∉ SD (years)	Meanwe or BMI±
-	Deakin 2013 ²⁸	RBW	n = 101	50-100-150-200-200	Converted tosinus rhythm immediately aftershock and remained at fo60 s	65.5 (60.0–70.2) [*]	90.2 (80.0-0
		BTE2	n = 99	50-100-150-200-200	Temaned at 1000 5	68.0 (61.5–72.0) [*]	88.9 (80.2–9
	Stanaitienė 2008 ¹¹	MDS1	<i>n</i> = 112	100–200–300–360	ECG registered sinus rhythm within 30s aftershock	64.9 ±9.28	89.5±1
See all › 31 References	See all > 3 Figures				Share	Download full-text	PDF
	Manegold 2007 ²¹	MDS4	<i>n</i> = 21	200-300-360-360	Notreported	70.0 ±10.0	27±4 k
	Kawabata 2007 ¹⁵	RBW MDS5	n = 23 n = 77	100–150–200–200 100–200–300–360	Restoredsinus rhythm for1 h after the shock	60.1 ± 13.3	26.6+4.8
		BTE1	n = 77	50-100-150-175		55.1 ± 13.5	26.5 +3.
	Ambler 2006 ²⁹	MDS5	<i>n</i> = 68	100-200-300-360-360	Notreported	70 (22–87) ^{*†}	83(42–1 kg ^{*†}
	Skulec 2006 ¹³	BTE3 MDS3	n = 60 n = 70	70–100–150–200–300 At discretionofphysician	Sinusrhythm restorationpersisted >30s after shock	$67.2\pm\!10.9$	27.3 +3.
	Alatawi 2005 ²⁵	BTE1 RBW	n = 71 n = 71	At discretionofphysician 50-75-100-120-150-200	Conversion tosinus rhythm forat least1 minute	$\begin{array}{c} 68.6 \pm 11.7 \\ 67.6 \pm 12.9 \end{array}$	27.6 +3.1 31.8 +6.5
		BTE1	n = 70	50-70-100-125-150-200-300-360		65.3 ± 14.5	30.2 +6.
	Kosior 2005 ¹⁴	MDS4	n = 22	2J/kg-360-360	Sinusrhythm was maintained for >2h	$61.3\pm\!9.1$	Notrepo
	Kim 2004 ²⁶	BTE1 RBW	n = 26 n = 71	2J/kg-360-360 50-100-150-200	afterthe procedure Restorationofsinus rhythm lasting >5s afterdefibrillation	$\begin{array}{c} 62.1 \pm 10.5 \\ 64 \pm 15.2 \end{array}$	84.9±2
		BTE1	n = 74	50-100-150-200-360		65 ±14.8	83.7±1

 Table 1

 Summary of characteristics of included studies

First Authorand Year ofpublication	Study arms	No. of patients	Energy protocol (J)	Successful cardioversioncriteria	Mean age± SD (years)	Meanwei or BMI ±S
Siaplaouras 2004 ²³	MDS6	<i>n</i> = 108	200-300-360-360	Termination of AF withat least 2 consecutivesinus beats	65 ±10	
	RBW	n = 108	120-150-200-200		66 ± 10	
Santomauro 2004 ²⁰	MDS6	<i>n</i> = 18	100-200-300-360-360	Sinusrhythm restorationfor at least30 s	55.4±14	
	RBW	n = 22	75-100-150-200-200		55.6 ± 7	
	BTE2	n = 24	70-100-150-200-200		54.8 ± 9.2	
Koster 2004 ⁹	MDS2	n = 37	70–100–200–360	Absenceof AF after delivered shock,even if short-lived	63.2 ± 15.8	δU.3 ± 19
	BTE1	n = 35	70–100–200–360		69.6 ± 10.9	80.4 ± 15
Page 2002 ¹⁷	MDS5	n = 107	100-150-200-360	Twoconsecutive <i>P</i> wavesuninterrupted by AF occurring any timewithin 30 sof the shock	65 ±13	88± 24 k
	BTE2	n = 96	100-150-200-200	the shock	65 ± 14	87±19 k
Marinsek 2003 ¹⁸	MDS5	n = 40	100-200-300-360	AtrialP wave was unmistakably identified>30s after the shock	67 ±8	84 ± 18 k
	BTE2	n =43	70-100-150-200		69 ±6	79±14 k
Neal 2003 ²⁷	RBW	n = 53	50-100-200-200	Presenceof <i>P</i> waves, acaptured atrial paced rhythm, or	63.0 ±16.0	93.9 ± 25
	BTE1	n = 48	50-100-200-200	junction rhythmfor 3 consecutivebeats	$60.0\pm\!16.0$	96.3±28
Scholten 2003 ²²	MDS5	<i>n</i> = 109	200-360	Sinusrhythm restored formore	59.9 ± 14.0	82.5 ± 19
	RBW	n = 118	120-200	thanfive seconds	59.6 ± 12.4	81.9 ± 20

Ricard 2001 ¹⁹	MDS5	n = 27	150–360	Sinusrhythm was restored fora period >5 min	66 ±12	77±17 k
	BTE2	n = 30	150–150	~5 mm	$69 \pm \! 10$	79±14 k
Mittal 2000 ²⁴	MDS6	n = 77	100-200-300-360	Conversion of AF to sinus rhythmfor >30s after theshock	66 ±12	93±24 k
	RBW	n = 88	70–120–150–170		65 ±12	89±21 k
Kmec 2006 ³¹	MDS7	<i>n</i> = 100	200-300-360-360	Conversion of AF to sinus rhythmfor >60s after theshock	62.6 ± 7.7	29.6 +4.8
	BTE4	<i>n</i> = 100	100-120-270-270		63.6 ± 8.5	30.4+5.3
Khaykin 2003 ¹⁶	MDS2	n = 28	360	At least 5consecutive beats of atrial origin withoutevidence of fibrillatoryactivity during diastole	59.7 ± 10.8	96.9±29
Neumann 2004 ¹⁰	BTE1 MDS1	n = 28 n = 57	150–200–360 100–200–360	Conversion of AF to sinus rhythmfor at least30 safter shock delivery	$58.3 \pm 14.6 \\ 63.5 \pm 11$	94.5 ± 27 Notrepor
	BTE1	<i>n</i> = 61	100–200–360		61.5 ± 11	
Deakin 2006 ³⁰	MDS5	n = 25	100-200-300-360-360	Evaluatedthe time between the shock andthe first <i>P</i> wave	71.0 (45–84)*	82.8 (55–139)
	BTE3	n = 33	70-100-150-200-300	and the mist rwave	68.5 (50-86)*	83.0 (83–139)
Kirchhof 2005 ¹²	MDS1	n = 97	50-100-200-300-360	Presenceof sinus rhythm immediately afterthe shock	63 ±1	27.2 +0.4
	BTE 1	n = 104	50-100-200-300-360	attentite shoek	63 ±1	27.3 +0.4

BTE1: PhysioControBiphasic, BTE2:PhilipSMART Biphasic,BTE3:Welch-Allyn Biphasic,BTE4:Nihon-Koden Biphasic, RBW: Zoll Rectilinear Biphasic,MDS1:Physi Monophasic, MDS3:GE Responder 3000 Monophasic, MDS4:GECardioserv Monophasic, MDS5:HPCode Master XLMonophasic, MDS6:Zoll Monophasic, MDS7:C Index. * Variable represented in median (minimum, maximum).

[†] Reporteddata notseparated by study groups.

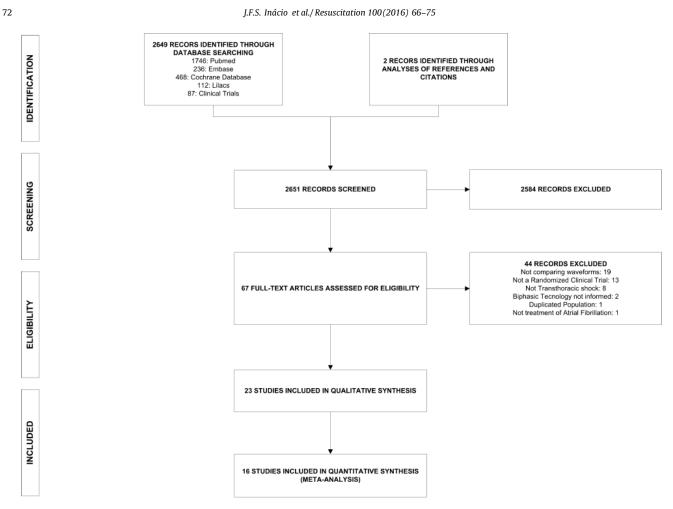


Fig. 1. Studyselection workflow diagram.

One study showed BTE4as significantly superior to MDS for all four outcomes. $^{31}\,$

Synthesis of results-Direct meta-analysis

Meta-analysis of 15 studiescompared MDS to Biphasic, where the Biphasic waveforms were divided into subgroups. Results revealed that Biphasic waveforms have superiority in 1st shock success(OR: 3.2,95% CI 2.2–4.7) (Fig.2a), overall success (OR:2.4; 95% CI 1.5–3.9) (Fig.2b), achieves cardioversion using 296 less Joules(95% CI 356–237) (Fig.2c) and using 0.74 less shocks (95%CI 1.03–0.44) (Fig. 2d) when compared to Monophasic.

When considering the subgroups, the PhysioControl hassuperiority in 1st shocksuccess (OR: 4.1; 95% CI 1.8–9.3) (Fig. 2a) and superiority in overall success (OR:4.6; 95% CI 1.37–15.8) (Fig. 2b) achieves cardioversion using 256 less Joules (95%CI 336–176) (Fig. 2c)and using0.89 less shocks (95%CI 1.38–0.39) (Fig. 2d) when directly compared to Monophasic. Philips SMART hassuperiority in 1st shock success (OR: 4.5; 95% CI 2.8–7.3) (Fig. 2a), achieves cardioversion using 302 less Joules (95%CI 405–198) (Fig. 2c) and using 0.71 less shocks (95%CI 1.35–0.07) (Fig. 2d) when directly compared to Monophasic. ZOLL Rectilinear has superiority in 1st shock success (OR: 2.6; 95%CI 1.05–6.4) (Fig.2a) and achieves cardioversion using 320 less Joules (95% CI 537–104) (Fig. 2c) when directly compared to Monophasic.

Two meta-analyses compared directly Biphasicwaveforms and theresults are presented in Table 2. Meta-analysis of 3 tudies compared the Biphasic waveforms from PhysioControl Biphasic and

Zoll Rectilinear (BTE1xRBW) and meta-analysis of 2studies co paredPhilips SMARTBiphasic versus Zoll Rectilinear (BTE2×RB' andin the pooled results of both meta-analyses no significant c ferencein any of the outcomes were revealed, indicating simil efficacy.

Risk ofbias across studies

Heterogeneity evidence was found amongst studies comp ing Biphasic with Monophasic (Fig.2). Forfirst shock succ the l^2 inconsistency was 66%, for overall success 50%, cumu tive energy84% and numberof shocks90%. When evaluating subgroups homogeneitywas found in studies comparing Phil SMART Biphasic with Monophasic forthe outcomes first shock s cess ($l^2 = 0\%$) and overall success ($l^2 = 0.4\%$).

For studies comparing Biphasic technologies directly, hon geneityis suggested forall four outcomes (Table2).

Synthesis of results-Network meta-analysis

In the network analysis, 581 patients received PhysioConti Biphasicshock, 292 received Philips SMART Biphasic,632 receiv ZOLL Rectilinear Biphasic and 866 received Monophasic Damp Sine shock, summing up to a total of 2371 patients. Fig. 3 sho the network of comparisons. The width of the lines is proportio tothe number of trials comparing eachpair of treatments, andt size of each node is proportional to the number of patients. 1 dashed line represents an indirect comparison.

Index of all diret model Image: Solution of a large model of all diret model Image: Solution of all diret model	ludy	BIP Events Total Ev	MDS ents Total	1.1	OR 95%-	CI W(fixed)	W(random)	Study	Events Tota		nDS otal	Odds Ratio	OR	96%-C/	W(fixed)	W(random
All and set	IP = BTE3:WelchAllyn															
					2.12 [0.94; 4.7	6 6.1%	7.4%					12	2.14 10	162; 7.33]	6.7%	7.5
		60	65		2.12 [0.94; 4.7	5	7.4%	Random effects model	0	0	65	#	2.14 [0	1.62; 7.33]	0.7%	7.5
The state of the state		le atorby				-			single study							
The state of the state	IP = BTE1:PhysicControlMedtro	nic						BIP = BTE1:PhysioControl/Me	dtronic							
the state of the state	swabata et. al (2007)		42 77	+	1.11 [0.59; 2.1	0.8%		Kawabata et. al (2007)	69 7		77	-	0.73 [0	124; 2.21]	8.3%	8.3
The state of th	inchhof et al. (2005) order et al. (2004)	26 104	8 97	-	3.71 [1.59; 8.0	7] 5.5% 0] 1.6%	7.1%	Kirchhof et al. (2005) Koster et al. (2004)		4 78	97		4.82 [1	.72; 13.49]	9.7%	8.8
The first shows the state of		35 61	9 57							1 42	57	-				2.4
All of the loss of the lose	tanaitienA et al.(2008)	75 112	42 112	+	3.38 [1.95; 5.8	5 13.2%	9.1%	StanaitienA-et al.(2008)	109 11	2 89	112		9.39 [2	173; 32.29]	6.7%	7.5
		389	380	2		2] 35.4%	35.6%		38	9	380	2				30.6
Strong B <td>sterogeneity: i-squared=80.8%, tau-squ</td> <td>vared=0.6711, p=0.0003</td> <td></td> <td></td> <td>acto [riso; sta</td> <td>4</td> <td>00.03</td> <td>Heterogeneity: 3-squared=70.9%, tax</td> <td>-squared=1.268, p=0.00</td> <td>82</td> <td></td> <td></td> <td>e.ee [1</td> <td>ar, releij</td> <td></td> <td>00.0</td>	sterogeneity: i-squared=80.8%, tau-squ	vared=0.6711, p=0.0003			acto [riso; sta	4	00.03	Heterogeneity: 3-squared=70.9%, tax	-squared=1.268, p=0.00	82			e.ee [1	ar, releij		00.0
$\frac{62}{1000} \underbrace{100}{100} \frac{10}{100} \frac{10}{100} \frac{10}{100} \frac{100}{100} \frac{100}{$	D = DTE (Nilhon Kodan							DD = DTC/ Nihos Koden								
All of the state of the		50 100	27 100	-	2.70 [1.50; 4.8	8 11.4%	8.8%		93 10	0 83	100	- 6-	2.72 [1	1.08; 6.89	11.9%	9.5
	xed effect model	100	100	+	2.70 [1.50; 4.8	8] 11.4%		Fixed effect model	10	0	100	2	2.72 [1	1.08: 6.891] 11.9%	9.6
	ndom effects model krooweity: not applicable for a singl	h study		1	2.70 [1.50; 4.8	8]	8.8%	Heterogeneity: not applicable for a	sinalo study			1	2.72 [1	.08; 6.89]		9.5
The set a (20) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																
production production pr		12 43	5 40	-	2.71 10.85: 8.5	61 3.0%	5.4%		38 4	3 36	40		0.84 10	121: 3.40	5.3%	6.
$\frac{1}{12} = \frac{1}{12} $	ge et al. (2002)	58 96	24 107	100	5.28 [2.86; 9.7	3 10.7%	8.7%	Page et al. (2002)	87 9	6 91	107	H	1.70 0	0.71; 4.05]	13.6%	9.5
	card et al. (2001)	26 30	18 27		4.47 [1.21: 18.4				28 3	0 24	27					4.8
$\frac{1}{12} = \frac{1}{12} + \frac{1}{12} $	and effect model	193		*			2.179	Fixed effect model	24 2	3 14		L	1.62 10	76; 303.32] 1.83: 3.16 ²	22.9%	2.0
	indom effects model			0	4.48 [2.76; 7.3		21.0%	Random effects model				4	1.62 [0	1.83; 3.17]	1	23.4
$\frac{1}{12} = \frac{1}{12} $		id=0, p=0.725						neurogenery: seguened=0.4%, ne-	ademac=0.0027, p=0.19			1				
$\frac{1}{1} = \frac{1}{1} = \frac{1}$	r = RBW:Zoll Rectilinear	80.00	50 77		9 17 (4 03 404	7.0**	8.00	BIP = RBW:Zoll Rectilinear			37	1	1.95 14	E1. 10.00	0.22	
$\frac{1}{12} \frac{1}{12} \frac$		2 22	1 18		1.70 [0.14; 20.4	2 0.6%	1.9%	Santomauro et al. (2004)	21 2	2 14	15	-1-	6.00 [0	1.61; 59.44]	1.9%	8.I 3.4
$\frac{1}{1000} \underbrace{1}{1000} \underbrace{1}{1000} \underbrace{1}{1000} \underbrace{1}{10000} \underbrace{1}{100000} \underbrace{1}{1000000} \underbrace{1}{10000000000000000000000000000000000$	cholten et al. (2003)	95 118	77 109		1.72 [0.93; 3.1	7] 10.6%	8.7%	Scholten et al. (2003)	107 11	8 98	109		1.09 [0	0.45; 2.63]	13.2%	9.8
$\frac{1}{1000} \frac{1}{1000} \frac{1}{1000$		82 108	73 108		1.51 [0.83; 2.7	5 11.2%	8.8%		102 10	8 104	108		0.65 [0	0.18; 2.39]	6.1%	7.1
	andom effects model		014	4	2.60 [1.05; 6.4		27.3%	Random effects model			916	4	1.79 [0	1.68; 4.75]		29.0
$\frac{1}{100} \frac{1}{100} \frac{1}$	terogeneity: I-squared=78.9%, tau-squ	sared=0.6667, p=0.0019						Helerogeneity: I-squared=58.7%, tax	r-squared=0.5518, p=0.0	6.3.9		1				
$\frac{1}{12} \frac{1}{12} \frac$	red effect model	1078	1052	4	2.95 [2.42; 3.6	1] 100%	-	Fixed effect model	107	8	052	÷.	2.21 [1	1.61; 3.05)	100%	
<u>2 <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u> <u>1</u></u>		vared=0.3137, p=0.0002		\$	3.23 [2.23; 4.6	8]	100%		-soured=0.424, p=0.01	24		\$	2.41 [1	.48; 3.92]		10
					100											
y Y Total Mun Bot Bot Ford Ford Solution Mode Ford Ford Solution Mode Ford Ford Solution Mode Ford Ford Ford Ford Solution Ford Ford <th></th>																
bit No. Total Max Total Max<		(a)	First shock	success						(b) O	verall s	uccess				
P = 0121 Standardsong Arbbar et al. (2006) 60 2.20 1.24 85 2.28 1.42 -0.68 1.14.6 2.20 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 85 2.28 1.24 3.28 1.24 3.28 1.25 3.58 7.71 3.58 7.71 3.58 7.71 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 3.58 7.75 7.75 7.75		(a)	First shock	success						(b) O	verall s	uccess				
P = 073 304 00 210 4 0 015 0 110 110 110 110 110 110 110 110					e					BIP	MDS		rence	MD	95%-CI W	(fixed) W
and effect model 0 61 -17.5 0.1 (43.5.4; 427.17) 3.6 7.5 and effect model -17.5 0.1 (43.5.4; 427.17) 3.6 7.5 4.5 7.5 and effect model -17.5 0.1 (43.5.4; 427.17) 3.6 7.5	dy	BIP	MDS			95%-CI	W(fixed) W(randow	BIP = BTE3:WelchAllyn	Total Mean	BIP 1 SD Tot	MDS I Mean SD					
odden affekts model manuskrij kragenderijk fare struktur i struktiv fare struktur i struktur i strukt	P = BTE3:WelchAllyn	BIP Total Meen SD	MDS Total Nean SD		MD			m) BIP = BTE3:WelchAllyn Ambler et al. (2006) Fixed effect model	Total Mean	BIP 1 SD Tot	MDS I Mean SD	Nean differ		-0.68 [-1.14	4; -0.22] 4; -0.22]	3.7%
- FTE 1Physicolasticitie/communication of the second state of the second st	= BTE3:WelchAllyn blor et al. (2006)	BIP Total Meen SD 3 60 240.0 216.4	MDS Total Nean SD	Mean difference	MD -376.50 (-49)	5.24; -257.76]	3.5% 7.1	M BIP = BTE3:WelchAllyn Ambler et al. (2005) Fixed effect model Random effects model	Total Mean 60 2.24 80	BIP 1 SD Tot	MDS I Mean SD	Nean differ		-0.68 [-1.14	4; -0.22] 4; -0.22]	3.7%
	= BTE3:WelchAllyn bler et nl. (2006) ed effect model ndom effects model	50 240.0 216.4	MDS Total Nean SD	Mean difference	MD -376.50 [-49: -376.50 [-49:	.24; -257.76] .24: -257.76]	3.5% 7.1	BIP = BTE3:WeichAilyn Ambler et al. (2005) Fixed effect model Kandom effects model Mandom effects model	Total Mean 60 2.24 80	BIP 1 SD Tot	MDS I Mean SD	Nean differ		-0.68 [-1.14	4; -0.22] 4; -0.22]	3.7%
Model at 10001) rf 1438 8 16 2001 rf 2 22 248 8 rf 2 22 17 7 rf 2 22 17 7 <td>P = BTE3:WelchAllyn bler et al. (2005) ed effect model ndom effects model</td> <td>50 240.0 216.4</td> <td>MDS Total Nean SD</td> <td>Mean difference</td> <td>MD -376.50 [-49: -376.50 [-49:</td> <td>.24; -257.76] .24: -257.76]</td> <td>3.5% 7.1</td> <td>BIP = BTE3:WolchAllyn Ambler of al (2005) Fixed effect model Mi Random effects model Mitregerwin: not applicable for 1 BIP = BTE1:PhysioControlW</td> <td>Total Mean 60 2.21 60 single study edironic</td> <td>BIP SD Tos 0 1.24 6</td> <td>MD5 I Mean SD 3 2.88 1.42</td> <td>Nean differ</td> <td></td> <td>-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14</td> <td>(4; -0.22) 4; -0.22] 4; -0.22]</td> <td>3.7% 3.7%</td>	P = BTE3:WelchAllyn bler et al. (2005) ed effect model ndom effects model	50 240.0 216.4	MDS Total Nean SD	Mean difference	MD -376.50 [-49: -376.50 [-49:	.24; -257.76] .24: -257.76]	3.5% 7.1	BIP = BTE3:WolchAllyn Ambler of al (2005) Fixed effect model Mi Random effects model Mitregerwin: not applicable for 1 BIP = BTE1:PhysioControlW	Total Mean 60 2.21 60 single study edironic	BIP SD Tos 0 1.24 6	MD5 I Mean SD 3 2.88 1.42	Nean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14	(4; -0.22) 4; -0.22] 4; -0.22]	3.7% 3.7%
star of al. (000) 35 440 116 0 27 540 250 0 40000 [4333, 3003] 57 75% mainter al. (000) 120 000 100 120 000 1	BTE3:WelchAllyn blor et al. (2006) ed effect model ndom effects model mopenky: ner applicable for a single i BTE1:PhysioControlWedtroni	Total Meen SD GD 240.0 216.4 60	MDS Total Mean SD 68 616.5 443.3 68	Mean difference	MD -376.50 [-49: -376.50 [-49: -376.00 [-49:	5.24; -257.76] 1.24; -257.76] 1.24; -257.76]	3.5% 7.1 3.5% - 7.1	BIP = BTE3:WetchAllyn Ambler et al. (2006) Fixed effects model Manual Antipology and approximation for a Barlogornaby, not applicable for a BIP = BTE1:PhysiologonatoroUM Konsubata et, al. (2007)	Total Mean 60 2.28 60 single study editronic 77 1.73	BIP 5 1.24 6	MDS I Mean SD 3 2.88 1.42 3 7 1.73 0.97	Nean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 0.02 [-0.30	4; -0.22] 4; -0.22] 4; -0.22]	3.7% 3.7%
a differ model and effect model a differ model a moment heurine data, no equivalent data, equivalent data, no equivalent da	= BTE3:WelchAllyn sier et al. (2006) ad effect model dom effects model ropeoely: norapplicable for a single i = BTE1:PhysioControl/Wedtroni adota et al. (2007)	BiP Total Meen 50 60 240.0 216.4 60 mily 77 144.8 146.4	MDS Total Neen SD 68 616.5 443.3 68 77 278.2 264.6	Mean difference	MD -376.50 [-49: -376.50 [-49: -376.50 [-49:	5.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.84; -65.96]	3.5% 7.1 3.5% - 7.1 11.0% 8.7	BIP = BTE3.1%eichAllyn Ambler a Ll.0006) Fixed effect model Fixed effect model Fixed effect model Fixed effect model BIP = BTE1.1%pysioControlM Kirchhol ef al. (2005) Kirchhol ef al. (2005) Kirchhol ef al. (2005)	Total Meau 60 2.24 60 editronie 77 1.73 104 2.5 35 1.71	BIP 5 SD Tos 0 1.24 6 5 1.05 7 0 1.26 9 0 .90 9	MD5 I Mean SD 3 2.88 1.42 3 1.73 0.97 7 1.73 0.97 7 3.50 0.95 7 3.50 0.95	Mean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-1.44 -1.80 [-2.22	4; -0.22] 4; -0.22] 4; -0.22] 0; 0.34] 5; -0.75] 12; -1.33]	3.7% 3.7% 7.8% 6.6% 4.6%
a differ model and efficit model angeometric regressioned angeometric	BTE3:WelchAllyn de ret at (2006) id effect model dom effects model dom effects model second for a single <i>i</i> = BTE1:PhysioContro/Weldtroni abstat et. al (2007) hhof et al. (2005)	BIP Total Meen 3D 60 2400 216.4 60 mady 10 77 144.8 145.4 104 3120 3000 35 1460 118.0	MDS Total Mean SD 65 65 77 278.2 264.6 97 578.0 341.0 77 640.0 286.0	Mean difference	MD -376.50 [-40; -376.50 [-40; -376.50 [-49; -133.40 [-20; -286.00 [-35; -400.00 [-49;	0.84; -65.96] 0.84; -65.96] 0.84; -65.96] 0.84; -006.36]	3.5% 7.1 3.5% - 7.1 11.0% 8.7 6.3% 8.0 5.7% 7.9	mb BIP = B TED.19961:hAllyn Ambler et al. (2006) Ambler et al. (2006) No Frankom effects model - Astrogeneyity not supervaliable - Bit P = DTET.199946-Control Mit - Frankom effects and et al. (2007) - Reservation et al. (2005) - Koster et al. (2005) - Koster et al. (2004) - Novement et al. (2004)	Total Mean 60 2.21 60 situdy edironic 77 1.7 104 2.5 35 1.7 61 1.7	BIP 5 5D Tos 5 1.05 7 5 1.05 7 5 0.90 3 5 0.90 3	MD5 I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.60 1.25 7 3.50 0.90 7 2.40 0.75	Mean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.02 [-0.3] -1.10 [-1.43 -1.80 [-2.22 -0.90 [-1.13	4; -0.22] 4; -0.22] 4; -0.22] 90; 0.34] 90; 0.34] 95; -0.75] 92; -1.38]	3.7% 3.7% 5.8% 6.6% 4.6% 13.1%
Description Description <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<>	BTE3:WelchAllyn bler et al. (2006) et effect model dom effects model meenwijn ner apaticable for a single n eabata et. al (2007) hofor et al. (2005) ser et al. (2004) mann et al. (2004)	Total Meen SD 7 60 2400 216.4 60 77 1448 14554 104 3120 3400 36 1440 5180 61 202 0141.0	MDS Total Mean 3D 68 616.5 443.3 68 77 278.2 264.6 97 578.0 341.0 37 546.0 285.0 57 4750 0252.0	Mean difference	MD -376.50 [-49; -376.50 [-49; -376.50 [49] -133.40 [-26] -286.00 [-35; -400.00 [49] -274.00 [-49]	0.84; -257.76] 1.24; -257.76] 1.24; -257.76] 0.84; -65.96] 5.05; -176.96] 0.84; -906.28] 0.84; -906.28] 0.83; -206.37]	3.5% 7.1 3.5% - 7.1 11.0% 8.7 6.3% 8.0 5.7% 7.9	BIJP = 8723 minutualityin Arman at a second and	Total Mesu 60 2.21 51rg/s stroty editronic 77 1.72 104 2.57 35 2.57 112 1.58 112 1.54	BIP 5 5D Tos 5 1.05 7 5 1.05 7 5 0.90 3 5 0.90 3	MD5 I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.60 1.25 7 3.50 0.90 7 2.40 0.75	Mean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.02 [-0.3] -1.10 [-1.48 -1.80 [-2.22 -0.90 [-1.11 -0.71 [-0.97	4; -0.22] 4; -0.22] 4; -0.22] 90; 0.34] 15; -0.75] 15; -0.65] 17; -0.45]	3.7% 3.7% 6.6% 4.6% 13.1% 11.5%
# IFERATION Rodem BUP = BTECATION Rodem BUP = BTECATION Rodem BUP = BTECATION Rodem BUP = BTECATION Rodem G COX00 100 560 0.00 560 0.00 560 0.00 100 2.00 100 0.00 100 2.00 100 100 2.00 100 0.00 100 2.00 100 0.00 100 2.00 100 0.00 100 2.00 100 0.00 100 2.00 100 0.00 100 2.00 100 0.00 100 2.00 100 0.00 100 2.00 100 0.00 <td< td=""><td>= BTE3: WelchAllyn sier et al. (2006) d effect model dom effects model moenthe net aus/Ecolor memory or ans/Ecolor memory and a single for a single a abata et al. (2007) hord at al. (2005) ser et al. (2004) raben - et al. (2004) raben - et al. (2004)</td><td>Tetal Mean BIP 50 2640 216.4 50 200 216.4 50 200 216.4 51 210 216.4 51 210 216.4 51 210 216.4 51 210 216.0 51 210 210 210.0 51 210 210 210.0</td><td>MDS Total Mean 3D 68 616.5 443.3 68 77 278.2 264.6 97 578.0 341.0 37 546.0 285.0 57 4750 0252.0</td><td>Mean difference</td><td>MD -376.80 [-40; -376.50 [-40; -376.00 [-45; -450.00 [-45; -450.00 [-45; -450.00 [-45; -276.00 [-45] -276.00 [-45] -2</td><td>3.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.84; -65.96] 5.05; -176.963] 1.63; -206.37] 5.41; -156.59] 1.64; -209.361</td><td>3.5% 7.1 3.5% 7.3 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.9% 8.7 10.4% 8.7 44.3%</td><td>BIP = BTE3:Intel-billyn Ambler at [2006] Ambler at [2006] Finandom effects model Ambler at [2006] Finandom effects model Finandom effects model Finandom effects model Korebiels et al (2005) Konter et al (2006) Konter et al (2</td><td>Total Mean 60 2.24 60 a single study edironic 77 1.75 104 2.59 104 2.59 104 1.59 112 1.50 389</td><td>BHP 5 1.05 7 5 1.05 1 2 1.26 9 5 0.080 1 1 3</td><td>MD5 I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.60 1.25 7 3.50 0.90 7 2.40 0.75</td><td>Mean differ</td><td></td><td>-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-1.48 -1.80 [-2.22 -0.90 [-1.18 -0.71 [-0.93</td><td>4; -0.22] 4; -0.22] 4; -0.22] 90; 0.34] 95; -0.75] 92; -1.38] 15; -0.65] 77; -0.45] 8; -0.61]</td><td>3.7% 3.7% 6.6% 4.6% 13.1% 11.5%</td></td<>	= BTE3: WelchAllyn sier et al. (2006) d effect model dom effects model moenthe net aus/Ecolor memory or ans/Ecolor memory and a single for a single a abata et al. (2007) hord at al. (2005) ser et al. (2004) raben - et al. (2004) raben - et al. (2004)	Tetal Mean BIP 50 2640 216.4 50 200 216.4 50 200 216.4 51 210 216.4 51 210 216.4 51 210 216.4 51 210 216.0 51 210 210 210.0 51 210 210 210.0	MDS Total Mean 3D 68 616.5 443.3 68 77 278.2 264.6 97 578.0 341.0 37 546.0 285.0 57 4750 0252.0	Mean difference	MD -376.80 [-40; -376.50 [-40; -376.00 [-45; -450.00 [-45; -450.00 [-45; -450.00 [-45; -276.00 [-45] -276.00 [-45] -2	3.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.84; -65.96] 5.05; -176.963] 1.63; -206.37] 5.41; -156.59] 1.64; -209.361	3.5% 7.1 3.5% 7.3 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.9% 8.7 10.4% 8.7 44.3%	BIP = BTE3:Intel-billyn Ambler at [2006] Ambler at [2006] Finandom effects model Ambler at [2006] Finandom effects model Finandom effects model Finandom effects model Korebiels et al (2005) Konter et al (2006) Konter et al (2	Total Mean 60 2.24 60 a single study edironic 77 1.75 104 2.59 104 2.59 104 1.59 112 1.50 389	BHP 5 1.05 7 5 1.05 1 2 1.26 9 5 0.080 1 1 3	MD5 I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.60 1.25 7 3.50 0.90 7 2.40 0.75	Mean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-1.48 -1.80 [-2.22 -0.90 [-1.18 -0.71 [-0.93	4; -0.22] 4; -0.22] 4; -0.22] 90; 0.34] 95; -0.75] 92; -1.38] 15; -0.65] 77; -0.45] 8; -0.61]	3.7% 3.7% 6.6% 4.6% 13.1% 11.5%
CC Q000 100 266 2280 100 080 3700	= BTE3: WelchAllyn bler et al. (2006) d efficiet model dom officiets model mobile at al. (2007) mablas at al. (2007) mann et al. (2004) restin/a-re at al. (2004) dom officiets model dom officiets model	Total Meen BiP 60 2400 216.4 501 77 1448 145.4 104 3120 300.0 36 1460 116.0 61 2202 316.0 121 1600 166.0	MDS Total Mean 3D 68 616.5 443.3 68 77 278.2 264.6 97 578.0 341.0 37 546.0 285.0 57 4750 0252.0	Mean difference	MD -376.80 [-40; -376.50 [-40; -376.00 [-45; -450.00 [-45; -450.00 [-45; -450.00 [-45; -276.00 [-45] -276.00 [-45] -2	3.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.84; -65.96] 5.05; -176.963] 1.63; -206.37] 5.41; -156.59] 1.64; -209.361	3.5% 7.1 3.5% 7.3 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.9% 8.7 10.4% 8.7 44.3%	BIP = BTE3:Intel-billyn Ambler at [2006] Ambler at [2006] Finandom effects model Ambler at [2006] Finandom effects model Finandom effects model Finandom effects model Korebiels et al (2005) Konter et al (2006) Konter et al (2	Total Mean 60 2.24 60 a single study edironic 77 1.75 104 2.59 104 2.59 104 1.59 112 1.50 389	BHP 5 1.05 7 5 1.05 1 2 1.26 9 5 0.080 1 1 3	MD5 I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.60 1.25 7 3.50 0.90 7 2.40 0.75	Mean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-1.48 -1.80 [-2.22 -0.90 [-1.18 -0.71 [-0.93	4; -0.22] 4; -0.22] 4; -0.22] 90; 0.34] 95; -0.75] 92; -1.38] 15; -0.65] 77; -0.45] 8; -0.61]	3.7% 3.7% 6.6% 4.6% 13.1% 11.5%
Direct direct model Direct direct model <thdirect direct="" model<="" th=""> Direct direct model</thdirect>	BTE3: WelchAllyn ber et al (2006) ion ethicks model reserves of the scale of the reserves of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the scale of the	Total Meen BiP 60 2400 216.4 501 77 1448 145.4 104 3120 300.0 36 1460 116.0 61 2202 316.0 121 1600 166.0	MDS Total Mean 3D 68 616.5 443.3 68 77 278.2 264.6 97 578.0 341.0 37 546.0 285.0 57 4750 0252.0	Mean difference	MD -376.80 [-40; -376.50 [-40; -376.00 [-45; -450.00 [-45; -450.00 [-45; -450.00 [-45; -276.00 [-45] -276.00 [-45] -2	3.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.84; -65.96] 5.05; -176.963] 1.63; -206.37] 5.41; -156.59] 1.64; -209.361	3.5% 7.1 3.5% 7.3 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.9% 8.7 10.4% 8.7 44.3%	BIP = BTE3:Intel-billyn Antaler a I, (2006) Antaler a I, (2006) Antaler a I, (2006) Antaler a I, (2006) Antaler a I, (2007) Antaler and I, (2007) Konter at I, (2007) Konter at I, (2005) Konter at I, (2005)	Total Mass 60 2.3 51 strabs shoty editronic 77 1.7 104 2.9 35 104 2.9 35 112 1.5 112 1.5 112 1.5 329 329	BHP 5 5 1.05 7 5 1.05 7 5 1.05 7 5 1.06 5 0 .90 3 0 .90 3 0 .90 3 0 .90 3 0 .90 5 0 .90 3 0 .90 5 0	MDS I Mean SD 3 2.88 1.42 1 7 1.73 0.97 7 3.60 1.25 7 2.40 0.15 2 2.40 1.75 2 2.40 1.75 2 2.21 1.17	Mean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.00 [-2.42 -0.90 [-1.14 -0.71 [-0.91 -0.89 [-1.31	4; -0.22] 4; -0.22] 4; -0.22] 30; 0.34] 5; -0.75] 2; -1.33] 5; -0.65] 7; -0.45] 8; -0.39]	3.7% 3.7% 6.6% 4.6% 13.1% 11.5% 43.5%
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Bit 2 philings SMART Bit 2 philings SMART Bit 2 philings SMART Bit 2 philings SMART Instance of all (2004) 24 240 122 0 177 480 0266	ETE3.VHothAllym For et al. (2006) diffect model diffect model ensurement	Total Meen 50 60 2400 216.4 60 maty 10 77 144.8 145.4 104 3120 340,0 51 2020 216.9 51 2020 216.0 112 1890 166.0 339 encert, pr.0.0002	MDS Total Mean BD 68<616.5	Maan difference	MD -376.50 [40] -376.50 [40] -376.50 [40] -413.40 [20] -26600 [43] -26600 [44] -2600 [44] -2600 [44] -2600 [44] -266.27 [430] -39000 [46]	5.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.54; -65.96] 1.53; -176.958] 1.63; -206.37] 3.41; -156.59] 1.53; -176.00] 3.29; -296.71]	3.5% 7.1 3.5% - 7.3 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.9% 8.7 10.9% 8.7 44.3% - 42.0 7.2% 8.2 7.2%	BIP = B TES 14941-BAIlyn All Star (DOG) All Star (DOG)	Total Mean 60 2.3 single sheaty edironia 77 1.7 104 2.5 30 104 2.5 30 30 104 2.5 30 30 104 2.5 30 30 104 2.5 30 30 104 1.7 100 1.70	BHP 5 SD Tots 5 1.05 7 5 0.90 3 5 0.90 1 5 0.90 10 5 0.90 10	MDS I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.56 2.90 7 2.40 0.75 2 2.21 1.17 0 2.39 1.10	Nean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-2.22 -0.90 [-1.13 -0.71 [-0.91 -0.89 [-1.31 -0.89 [-1.31 -0.89 [-1.31	4; -0.22] 4; -0.22] 4; -0.22] 00; 0.34] 4; -0.75] 2; -1.33] 5; -0.65] 7; -0.45] 8; -0.39] 8; -0.32] 8; -0.32]	3.7% 3.7% 6.6% 4.6% 13.1% 11.5% 43.5%
	TES Verschaftigen TES Verschaftigen Service State State Service Sta	Total Meen 50 60 2400 216.4 60 maty 10 77 144.8 145.4 104 3120 340,0 51 2020 216.9 51 2020 216.0 112 1890 166.0 339 encert, pr.0.0002	MDS Total Mean BD 68<616.5	Nean difference	MD -376.50 [40] -376.50 [40] -376.50 [40] -413.40 [20] -26600 [43] -26600 [44] -2600 [44] -2600 [44] -2600 [44] -266.27 [430] -39000 [46]	5.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.54; -65.96] 1.53; -176.958] 1.63; -206.37] 3.41; -156.59] 1.53; -176.00] 3.29; -296.71]	3.5% 7.1 3.5% - 7.3 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.9% 8.7 10.9% 8.7 44.3% - 42.0 7.2% 8.2 7.2%	BIP = B TES 14941-BAIlyn All Star (DOG) All Star (DOG)	Total Mean 60 2.3 single sheaty edironia 77 1.7 104 2.5 30 104 2.5 30 30 104 2.5 30 30 104 2.5 30 30 104 2.5 30 30 104 1.7 100 1.70	BHP 5 SD Tots 5 1.05 7 5 0.90 3 5 0.90 1 5 0.90 10 5 0.90 10	MDS I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.56 2.90 7 2.40 0.75 2 2.21 1.17 0 2.39 1.10	Nean differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-2.22 -0.90 [-1.13 -0.71 [-0.91 -0.89 [-1.31 -0.89 [-1.31 -0.89 [-1.31	4; -0.22] 4; -0.22] 4; -0.22] 00; 0.34] 4; -0.75] 2; -1.33] 5; -0.65] 7; -0.45] 8; -0.39] 8; -0.32] 8; -0.32]	3.7% 3.7% 6.6% 4.6% 13.1% 11.5% 43.5%
Prove et al. (DOD) 43 240 144.0 40 48 0 271.0	BTE3.WelchAllyn BTE3.WelchAllyn Bar et al. (2006) Born ar staftstaft for a single- Born area at al. (2005) Bo	Total Meen 50 60 2400 216.4 60 midy 10 77 144.8 145.4 104 3120 340,0 51 2020 216.9 51 2020 216.0 112 1890 166.0 339 encert, pr.0.0002	MDS Total Mean BD 68<616.5	Nean difference	MD -376.50 [40] -376.50 [40] -376.50 [40] -413.40 [20] -26600 [43] -26600 [44] -2600 [44] -2600 [44] -2600 [44] -266.27 [430] -39000 [46]	5.24; -257.76] 1.24; -257.76] 1.24; -257.76] 0.54; -65.96] 1.53; -176.958] 1.63; -206.37] 3.41; -156.59] 1.53; -176.00] 3.29; -296.71]	3.5% 7.1 3.5% - 7.3 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.9% 8.7 10.9% 8.7 44.3% - 42.0 7.2% 8.2 7.2%	BIP = B TES York-Daliyon First affect model First affectate model First First affectate model First First affectate model First First	Total Mass 60 2.3 single study 2.4 90 2.4 100 7.7 12 1.5 30 7.7 12 1.5 30 1.7 120 3.6 120 1.6 100 1.7 100 1.7 100 1.7 100 1.7	BHP SD Tos 5 1.05 7 5 1.05 7 5 1.06 5 5 0.90 15 0 0.90 10 10 0 0.90 10	MOS MOS 2.88 1.42 7 1.73 0.97 7 3.60 1.97 7 3.60 1.27 2.40 0.75 2.40 0.75 2.40 1.75 2.40 1.10 0 2.30 1.10	Neandiffer + + + + + + + + + + + + + + + + + + +		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-1.44 -1.10 [-2.22 -0.90 [-1.14 -0.71 [-0.91 -0.81 [-0.91 -0.81 [-0.91 -0.80 [-0.81 -0.60 [-0.81 -0.60 [-0.81	4; -0.22] 4; -0.22] 4; -0.22] 4; -0.22] 4; -0.22] 5; -0.65] 5; -0.65] 5; -0.65] 5; -0.65] 5; -0.65] 6; -0.65] 8; -0.32] 8; -0.32]	3.7% 3.7% 6.6% 4.0% 13.1% 11.5% 43.5% 10.2%
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d effect model and michts model and micht and and and and and and and and and and and and and and and and and	PTTE Official addyn effect and 2000 d effect model d effect model d effect model d effect model m	Tetal Masen BPP 50 C 2400 2164 60 77 144.8 145.4 104 3120 306.0 61 2202 141.0 105 146.0 140.0 100 266.0 209.0 100 266.0 200.0 100 266.0 200.000000000000000000000000000	MDS S Total Neem 80 68 6165 5433 88 77 778 2 364 6 97 576 0 341 6 97 776 0 341 6 97 744 0 265 0 97 751 0 350 0 100 151 0 350 0 100 456 0 370.0 100 40 458 0 277 0 490 450 0 277 0	Near difference $+$ + + + + + + + 0 + + 0	MD -376.50 [448 -376.50 [449 -376.50 [449 -376.50 [449 -376.50 [449 -376.50 [449 -376.50 [446 -376.50 [446 -380.00 [446 -380.00 [446 -380.00 [446 -380.00 [446 -380.00 [446 -380.00 [446] -380.00 [456] -380.00 [456]	3.34: -257.76[1.24: -257.76] 0.84: -65.96[0.84: -65.96] 0.84: -65.96[0.84: -65.96] 0.84: -508.26] 0.84: -508.26] 0.84: -508.26] 0.82: -108.571 0.82: -146.15[0.85: -146.15]	3.5% 7.1 3.5% 7.1 11.0% 8.7 6.3% 8.0 5.7% 7.9 10.4% 8.7 44.3% 42.0 7.2% 8.2 7.2% 8.2 7.2% 8.2 5.1% 7.7	BIP = B TES: Intel-Indigyn Antiber ei al (2006) Antiber ei al (2006) Antiber ei al (2006) Antiber ei al (2006) Birlendom effette model Astengenety: not agelcable intel Karubate et al (2005) Karubate et al (2006) Fixed effect model Batengenety: Ingurante EZU, 8 Bateng	Total Mean 60 2.3 60 2.4 2.4 2.4 100 2.7 1.7 1.7 1.6 1.6 101 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.2 1.0 1.7 1.00 1.00 1.7 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	BHP SD Tos 51.05 7 51.05 7 51.06 7 51.06 5 50.90 11 50.90 10 10 0.90 10 10 0.90 10 10 10 10 10 10 10 10 10 10	MDS 1 Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.60 0.75 7 2.40 0.75 2 2.21 1.17 0 2.30 1.10 0 2.55 0.90 7 2.80 1.00	Nan differ		-0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -0.68 [-1.14 -1.10 [-1.44 -1.80 [-2.22 -0.90 [-1.11 -0.71 [-0.91 -0.81 [-0.28 -0.60 [-0.88 -0.60 [-0.88 -0.60 [-0.88 -0.60 [-0.88 -0.60 [-0.88 -0.60 [-0.81 -0.60 [-0.81 -0.61 [-0.61 -0.61 [-0.61 [-0.61 -0.61 [-0.61 [-0.61 -0.61 [-0.61 [-0.61 [-0.61 -0.61 [-0	4; -0.22] 4; -0.22] 4; -0.22] 0; 0.34] 5; -0.75] 2; -1.33] 5; -0.65] 8; -0.32] 8; -0.32] 8; -0.32] 8; -0.32] 5; 0.33] 0; -0.80]	3.7% 3.7% 6.6% 4.8% 13.1% 43.5% 43.5% 43.5% 43.5% 43.5%
Public Description Page 2018	HTTS Alverhalling HTTS Alverhalling de allest toxods de allest toxods de allest toxods de allest de de allest de	Bir Solution Bir Solution 00 2400 216.4 90 00 2400 216.4 90 01 2120 310.0 3120 310.0 104 3120 310.0 328 101 3120 310.0 328 102 20 141.0 318 100 2660 2660 100 100 100 2660 2660 107.0 94.070 43 243.0 147.0 94.270 0177.0 24 270 0177.0 94.270 0177.0	MDS Total Heam 9D 68 616.5 443.2 17 72/52 254.6 17 72/60 2220 17 7460 2220 170 100 100 100 100 100 100 100 100 10	Near difference $+$ + + + + + + + 0 + + 0	NG -376.59 [40] -376.59 [40] -376.59 [40] -376.50 [40] -405.00 [44] -405.00 [44] -256.00 [44] -256.00 [44] -360.00 [45] -360.00 [45]	3.24; -257,76] 1.24; -257,76] 1.24; -257,76] 0.84; -65,96] 0.84; -65,96] 1.32; -257,76] 1.34; -265,96] 1.32; -206,371] 3.29; -296,71] 3.29; -296,71]	3.5% 7.1 3.5% 7.1 11.0% 8.7 6.3% 8.0 5.7% 7.5 5.7% 7.2% 8.2 7.2% 7.2% 7.2% 7.2% 7.2% 7.2% 7.2% 7.2%	BIP = B TES: WeizhAilyn Ambier ei J. (2006) Ambier ei J. (2006) Ambier ei J. (2006) BIP = B TES: WeizhAilyn BIP = B TES: WeizhCanber (J. 1997) Bir (1997)	Total Maan 60 2.3 61 2.3 61 2.3 61 5.5 7 5	BHP 51.05 7 51.05 7 51.05 7 51.05 7 50.90 5 50.90 5 50.90 10 11 00.90 10 11 00.90 10 11 00.90 10 11 00.90 10	MDS I Mean SD 3 2.88 1.42 7 1.73 0.97 7 3.69 1.55 2 2.90 1.90 2 2.90 1.10 0 2.55 0.90 7 2.50 0.90 7 2.50 0.90 7 2.50 0.90 3 .44 1.30	Naadifier		0.68 [-1.14 0.68 [-1.14 0.68 [-1.14 0.68 [-1.14 0.02 [-0.3] 1.10 [-1.44 1.10 [-22 0.90 [-1.11 0.71 [-0.9] 0.81 [-0.3] 0.88 [-1.31 0.60 [-0.88 0.60 [-0.88 0.60 [-0.84 0.65 [-0.61 -1.10 [-1.44 0.86 [-1.44	4; -0.22] 4; -0.22] 4; -0.22] 4; -0.22] 5; -0.65] 5; -0.65] 5; -0.65] 6; -0.32] 8; -0.32] 8; -0.32] 5; -0.80] 8; -0.33] 10; -0.80] 8; -0.13]	37% 3.7% 66% 48% 11.5% 10.2% 10.2% 10.2% 10.2%
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Fig. 2. Comparisonbetween Biphasic and Monophasic, sub-grouped by Biphasic type—(a) Firstshock success rate. (b) Overall success rate. (c) Cumulative Energy i to achieve success.(d) Number of shocks to achieve success.

Table 2

Direct meta-analysis between biphasic waveforms:BTE1× RBW and BTE2× RBW.

Comparison	Number of studies		1st Shocksuccess odds ratio	Overallsuccess oddsratio	Cumulative energy mean difference	Number c mean diffe
BTE1 × RBW	3 25-27	Effectsize[95% CI] Heterogeneity <i>P</i> , <i>J</i> ²	0.90 [0.52;1.57] 0.19,40%	1.39 [0.42;4.56] 0.48,0%	23.5[-4.88;51.88]J 0.40,0%	0.15 [-0.0 0.40, 0%
$BTE2 \times RBW$	2 20,28	Effectsize[95% CI] Heterogeneity <i>P</i> , <i>J</i> ²	0.88[0.45;1.76] 0.34,0%	0.70 [0.18;2.69] 0.28,13%	15.2[-77.7; 108.2]J 0.11,61%	0.10 [-0.4 0.11,60%

BTE1: PhysioControl Biphasic, BTE2: Philips SMARTBiphasic, RBW: Zoll Rectilinear Biphasic.

Table3 shows the results of the Network Meta-analysis. Through the network meta-analysis it was possible to indirectly compare PhysioControl Biphasic with Philips SMART Biphasic. Similar to the direct meta-analysis results, PhysioControl Biphasic was significantly superior to Monophasic in the 4outcomes. Both Philips SMART Biphasic and Zoll Rectilinear Biphasic were superior to Monophasic in 3 outcomes (1stshock success, cumulative energy and number of shocks). There were no significant differences in anyof the 4 outcomes in comparisonsbetween any of the Bir waveforms.

Discussion

The evidence regarding the efficacy of Biphasic waveful to convert AF to normal sinus rhythm, is sufficiently to id superiority compared to Monophasic waveforms and, alth

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Networkmeta-analysis comparing BTE1,BTE2, RBW and MDS: 1stshock success, overall success, cumulative energy and number of hocks.

Waveform	1st Shocksuccess, odds ratio [95% Cr1]						
	MDS	BTE1	BTE2				
BTE1	3.7[1.9;7.4]						
BTE2	3.9[1.7;9.2]	1.1 [0.38;3.0]					
RBW	3.4[1.7;6.7]	0.9 [0.42;1.9]	0.85 [0.34;2.1]				
	Overall success, odds ratio [95% CrI]						
BTE1	4.8[1.7;16]						
BTE2	1.9[0.57;8.1]	0.4[0.07;2.5]					
RBW	2.4[0.85,7.9]	0.5[0.14;2.0]	1.3 [0.27;5.5]				
	Cumulativeenergy,mean difference [9	5% CrI], (J)					
BTE1	-258.1 [-340.1; -179.4]						
BTE2	-282.9 [-399.9; -177.1]	-24.4 [-150.6;97.5]					
RBW	-286.4 [-376.5; -201.9]	-28.2[-116.8;59.6]	-3.5 [-114.6;112.2]				
	Number of shocks, meandifference [9	5%CrI]					
BTE1	-0.79 [-1.26;-0.32]	-					
BTE2	-0.67 [-1.29;-0.04]	0.11 [-0.60;0.86]					
RBW	-0.74 [-1.27;-0.23]	0.04 [-0.50;0.57]	-0.07[-0.77;0.61]				

BTE1:PhysioControlBiphasic, BTE2:Philips SMART Biphasic, RBW: ZollRectilinearBiphasic, MDS:MonophasicDamped Sine, CrI: CredibleInterval.

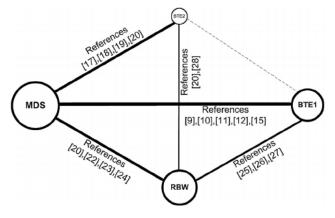


Fig.3. Networkof Clinical Trials comparing defibrillation waveforms for Atrial fibrillation cardioversion—Solid lines represent direct comparison trials and dashed lines represent indirect comparisons. BTE1:PhysioControl Biphasic, BTE2: Philips SMART Biphasic, RBW: ZollRectilinear Biphasic, MDS: Monophasic DampedSine.

this was previously addressed recently⁴ the analysis was limited to pool Odds Ratio from the first shock success rate and the Biphasic waveforms were not discriminated. Our review identified similar evidence and it was able to extend the analysis for additional outcomes such as overall success, cumulative energy and number of shocks to restore sinus rhythm. Were identified 15 clinical trials comparing Biphasic with Monophasic, with a total of 2130 patients, and all studies reported significant Biphasic superiority in at least one of the four outcomes. These studies were of variable quality and methodological heterogeneous, specially regarding the energy sequence protocol, where the protocols could be the same for Biphasic and Monophasic groups, or the Biphasic group protocol could be slightly lower than the Monophasic group or even the Biphasic group protocolcould be half the Monophasic group.

The pooled results provided evidence that the Biphasic waveform is significantly superior than Monophasic in the four outcomes, and therefore is suggested that Biphasic has superior efficacy over Monophasic. Considering that in all studies, the first shock energy of the Biphasic groups werealways equal or slightly lower than the Monophasic, it is possible to assume that Biphasic have a higher chance to convert an AFwith thesame, or slightly lower, energy.Also the Biphasic, considering a sequence of shocks attempts to convertAF, needs lower cumulative energy and number of shocks to achieve success.Finally, for the overall success it wouldn'tbe expected significantly different chances, assuming that Monophasic can achieve success at some point, given more attempts and elevated energy, but the pooled results suggests that the use of Monophasic will lower the chances to achieve AF c dioversions after all shocks attempts are tried.

When assessing efficacy between Biphasic, it was identif three clinical trialscomparing PhysioControl Biphasicagainst ZC Rectilinear Biphasic and two trials comparing Philips SMA Biphasic against ZOLL Rectilinear Biphasic. The energy proto sequenceshowed homogeneityin thesetrials, possiblebecauset Biphasic groupsbetween studies, had the same energy sequei protocolat least in the four initial steps. Through anetwork m analysis it was possible to aggregate these trials strictly co paring Biphasic waveforms with the trials comparing Bipha with Monophasic, allowing to generate an indirectly compa sonbetween PhysioControl Biphasic and PhilipSMART Bipha and resulting in sufficiently evidence to establish the relative $\boldsymbol{\varepsilon}$ cacy of these three technologies. In the network results there v nosignificant difference in any of the four outcomes, indicati that whether using PhysioControl, Philips SMART or ZOLL Re tilinear there would be equal chances to convert AF in the f attempt, equivalent chances to convertafter all attempts andt same cumulative energy and number of shockswould be need to achieve successful cardioversion and thussuggesting simil efficacy.

Biphasic defibrillators in general have the capacity to readt patient's transthoracic impedance and with this information, th can adjust its outputs according to the patient, increasing t efficacy to achieve cardioversion. Although PhysioControl, Phil SMART and ZOLL Rectilinear use different circuit topologies a control methods in order to generate its waveforms output, the individual particularities did not result in differential efficacy in t review.

Limitations

Although the Monophasicdefibrillators share the commoncha acteristic of using the same passive circuit topology, with adjustment regarding the patient transthoracic impedance dur the shock therapydelivery, the components values used, especia the high voltage capacitor capacitance and the currents hapi inductor inductance and resistance, vary from one Monopha manufacturer oother. This will result Monophasic wavefor that are underdamped, critically dampedor overdamped fordiffe ent patient's transthoracic impedance. In this review, the possil efficacy differences between the Monophasic due to these diffe ences were not considered.

Also, the dependence of the four outcomes was not evaluat itis possible that the number of shocks and cumulative energy.

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have an opposite relationship and that actudy protocol designed to start with a higher initial energymay tendto have a higher first shock success rate but also a higher cumulative energy result.

Additionally, skew was identified in theoutcomes cumulative energy and number of shocks in some studies, specifically studies where the energy protocol had a low number of shocks. Even though the predefined statistical methods required the variables to be as close to a normal distribution, for these cases we accepted a level of skewness to apply the statistical evaluation.

Nopossible heterogeneity between studies: sociated with differences in the patients characteristics, such as age, body mass index, weight or AF duration, were evaluated.

Conclusion

Evidences points to a Biphasic waveform superiority over Monophasic to perform AF cardioversion, supporting current guidelines recommendations to use less energy when using a Biphasic defibrillator, that is, startwith 12Q when using Biphasic and start with200 Jwhen using Monophasic.²

The energy output adjustment method by monitoring the patient's transthoracic impedance, inherent to the Biphasic waveforms, is relevant when performing cardioversion of Atrial fibrillation, but the threemethods from different manufacturers evaluated (PhysioControl, Philips SMART and ZOLIRectilinear) suggests similar efficacy and the use of any of them may result in similar chances and umber of shocks to achieve successful AF cardioversion.

Conflict of intereststatement

Noconflicts of interest to declare.

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