

Cryoablation of AVNRT

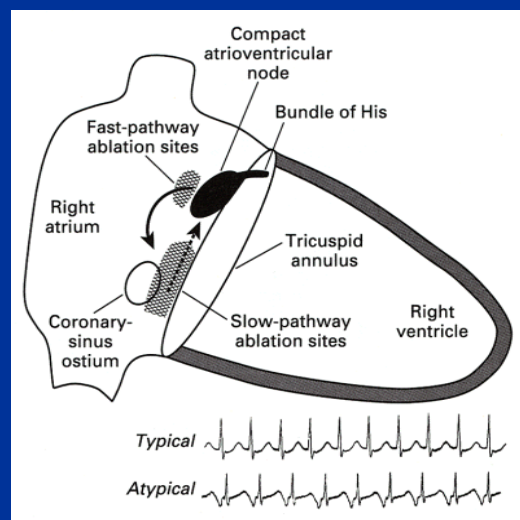
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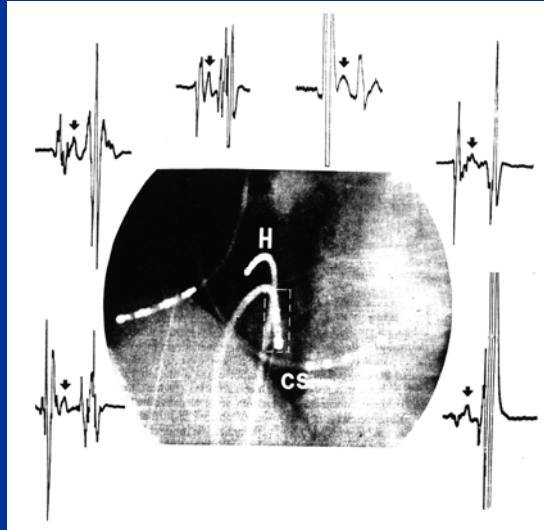
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Conflict of interest: none

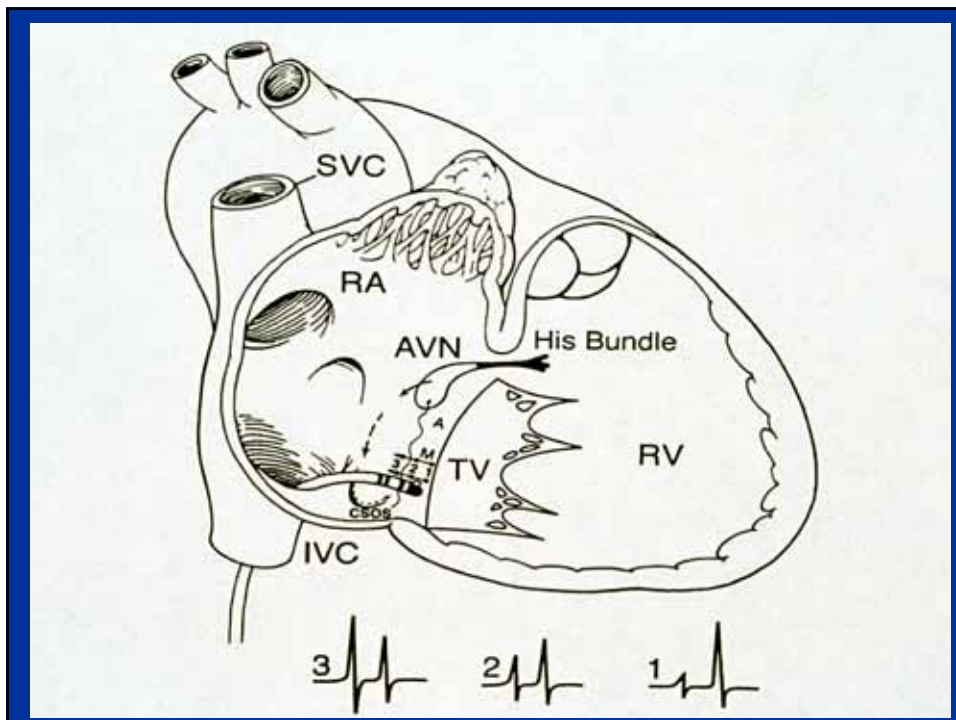
AV Nodal Reentry Tachycardia



Slow Pathway Potential



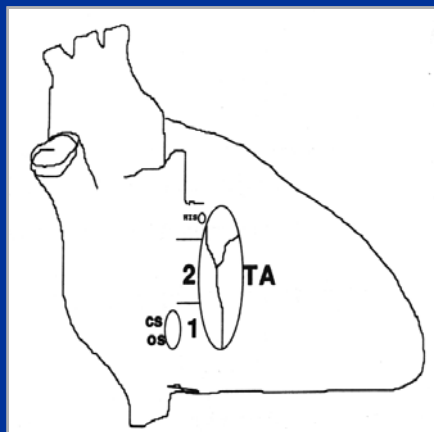
Haïssaguerre et al., Circulation 1992



RF success rate of AVNRT ablation

Acute ~ 99%

**Long term :
~ 5% of recurrence**



Manolis et al., Circulation 1994

Complete AV Block when using RF

Incidence \leq 1% (PM implantation)

Unexpected and immediate in some cases

Calkins H et al., Circulation 1999
Scheinman MM et al. PACE 2000

AVNRT

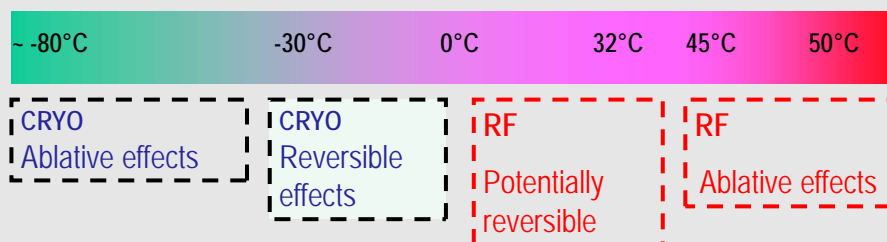
Récemment la Cryo est devenue une alternative à la RF.

Les avantages sont dans la sécurité de cette technologie.

Le cornerstone est le cryomapping qui permet l'évaluation de l'effet de la Cryo avant la lésion définitive.

Ça rend la Cryo particulièrement utile dans le cas d'une cible proche de l'His ou du NAV.

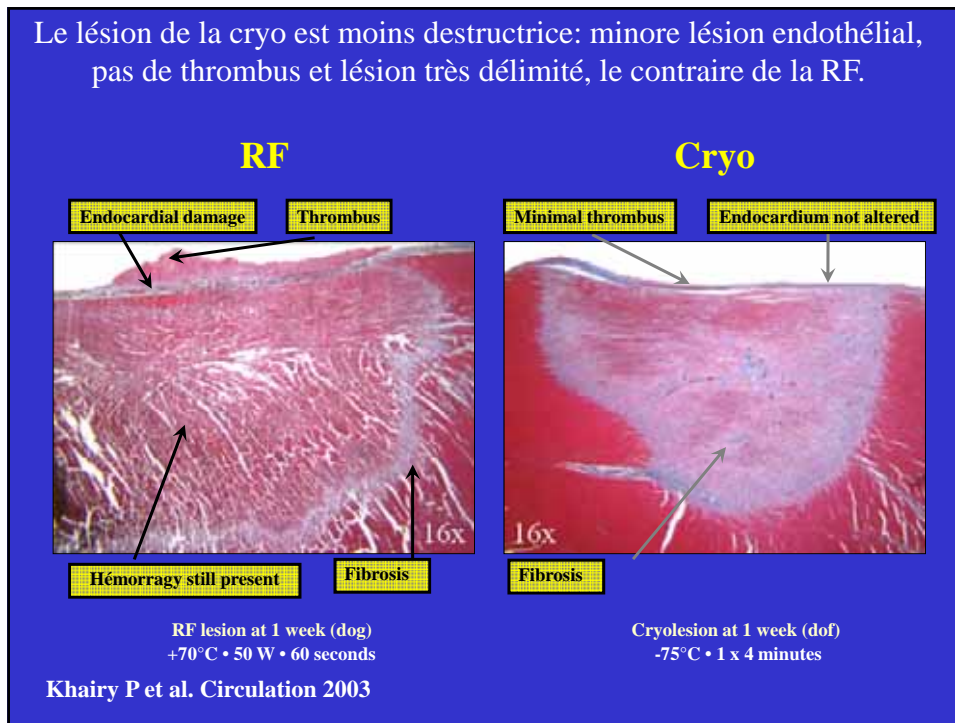
Cryo and RF effects



Les effets de la cryo son réversibles jusqu'à -30 C°, température utilisée pour le cryo-mapping, puis la lésion est réalisée avec température inférieure à -80°C.

Khairy P et al. Circulation 2003

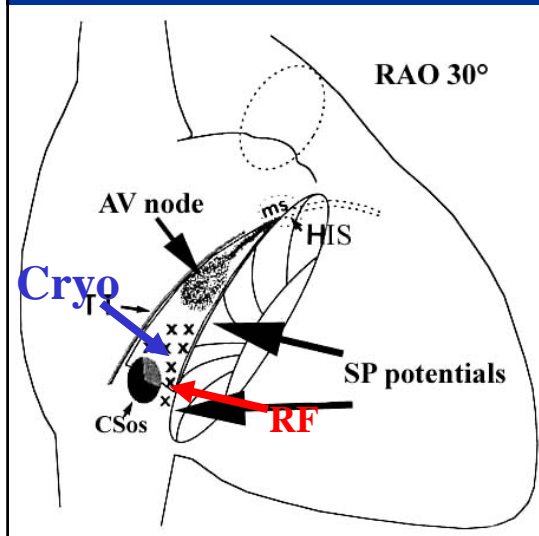
Le lésion de la cryo est moins destructrice: minore lésion endothélial, pas de thrombus et lésion très délimité, le contraire de la RF.



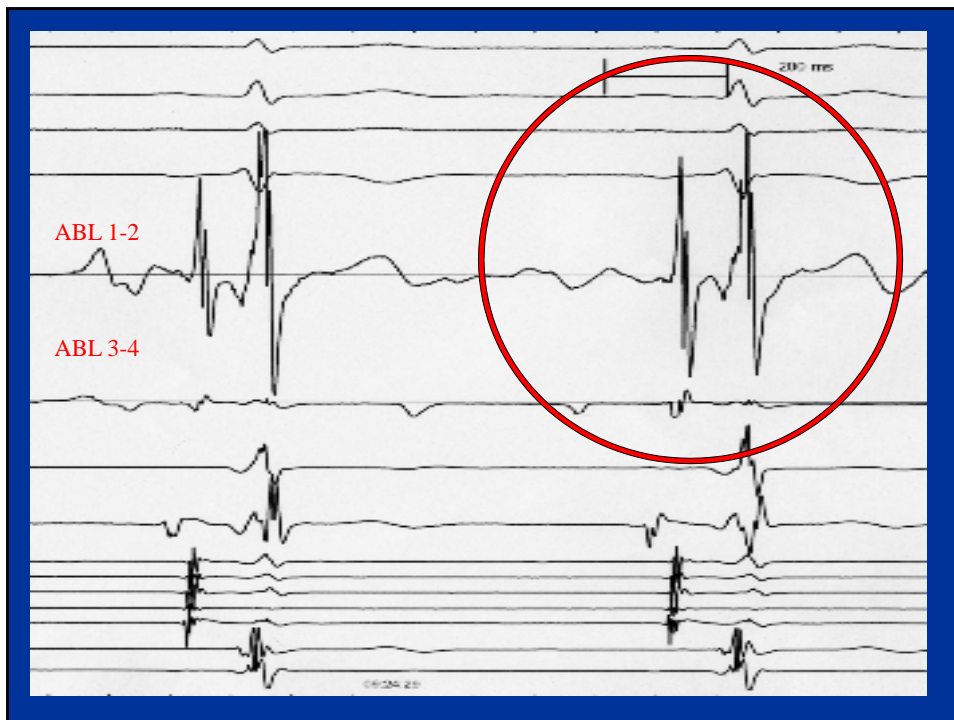
Advantages	Clinical implications
Reversible effects of cryomapping	No risk of definitive AV block
Adhesion to the myocardium	Best prediction of the results of the ablation before the application
Homogenous lesions	Catheter stability
Less risk of thrombus formation	Non arrhythmogenic effects
Painless	Less risk of embolisation
Connective tissue and endocardium is free of lesions	Cooperation of the patient and less sedation
Precision of ablative effect	Less risk of perforation
	Less risk of damage of the adjacent structures

Amara W et al., Arch Cardiol Mex. 2010

RF or Cryo for AVNRT Ablation Site



- Ablation site were different:
- RF site is lower and more anterior
- Cryo site is upper and more posterior



Most common Protocol

7 Fr 6-mm-tip cryocatheter

Cryomapping -30°C for 30 sec
Successful cryomapping defined as
slow pathway abolition or
AVNRT noninducibility

Cryoablation -80°C for 4 minutes if no AV-block

Acute success defined as AVNRT noninducibility
or complete slow pathway abolition.

AVNRT CRYOABLATION GLOBAL RESULTS

Clinical results of cryoablation for AVNRT - Comparison among studies

Author	Year	Patients (n)	Age (years)	Follow-up (months)	Tip Size (mm)	Acute success (%)	Recurrence rate (%)	Transient AV-block (%)
Friedman et al.	2004	101	39±13	6	4	93	6	7
Kimman et al.*	2004	30	52	11.7±7	4	94	10	7
Zrenner et al.*	2004	100	51±18	6.2	4	97	8	17
Jensen-Urstad et al.	2006	75	53±16	9.2	6	99	7	8
Collins et al.*	2006	57	14±4	40±83	4	95	8	11
Papez et al.	2006	52	13.4	8±7	4 and 6	96	11.5	9.4
Gupta et al.*	2006	71	52±16	2.2	4 and 6	85	19.7	-
Khairy et al.	2007	185	49±14	24	4 and 6	92	9	4.3
De Sisti et al.	2008	150	39±14	18±10	6	95	17	22.7
Avari et al.*	2008	38	14	10.8	4 and 6	97	2	24
Chanani et al.	2008	154	13.7	12	4 and 6	95	14	6
Rivard et al.	2008	289	45±16	5	4 and 6	90.7	15	5.2
Sandilands et al.	2008	160	44±15	18	4 and 6	93	11.9	8
Chan et al.*	2009	80	50±12	11.3	6	97.5	9	-
Bastani et al.	2009	312	53	22±10	6	99	5.8	4
LaPage et al.	2010	61	15±2	36±12	4,6, and 8	96	6.5	17
Drago et al.	2010	76	11±2	29.5	4	97.4	6.8	5
Opel et al.*	2010	123	53±14	1-19	6	93	17	-
Deisenhofer et al.*	2010	251	53	6	6	96.8	9.4	-
Silver et al.	2010	77	15±2	12±3	8	91	2.8	6.5
Gist et al.	2011	62	30	12	4 and 6	98	15	42
Schwagten et al.*	2011	150	51±30	52±30	4	97	11	4

A De Sisti, J Tonet, PACE 2011

Pooled data 22 selected published studies

2,654 patients**Acute success**
95% (range 85%–99%),**Recurrence rate**
11% (range 2%–19.7%).

A De Sisti, J Tonet, PACE 2011

Studies comparing CRYO vs RF ablation for AVNRT

Authors	Year	Patients (n)		Initial success (%)			Recurrence (%)			AVB /RF
		Cryo	RF	Cryo	RF	p	Cryo	RF	p	PM (pts)
Kimman et al.*	2004	30	33	94	94	ns	10	9	ns	0
Zrenner et al.*	2004	100	100	97	98	ns	8	1	ns	0
Collins et al.	2006	57	60	95	100	ns	8	2	ns	0
Gupta et al.	2006	71	71	85	97	<0.05	19.8	5.6	=0.01	1
Avari et al.	2008	38	42	97	95	ns	2	2	ns	1
Chan et al.*	2009	80	80	97.5	95	ns	9	1.3	<0.04	0
Opel et al.	2010	123	149	93	95	ns	17	7	=0.02	1
Deisenhofer et al.*	2010	251	258	96.8	98.4	ns	9.4	4.4	<0.03	1
Schwagten et al.	2011	150	124	96.5	96	ns	11	5	ns	2
Total		900	917	94%	96%		10%	4,5%		0.65%

A De Sisti, J Tonet, PACE 2011

Pooled data involving nine studies

	CRYO	RF
PATIENTS	900	917
INITIAL SUCCESS	94%	96%
RECURRENCE	10%	4,5%
PM for AV-block	0%	0.65%

Procedure time was similar between cryoenergy and RF
Significantly longer using cryoablation in some studies

A De Sisti, J Tonet, PACE 2011

**Pooled data of nine studies comparing
Cryo vs. RF**

**There was a global amount of 6/917
(0.65%) patients who had
inadvertent AV-block under RF who
needed a PM**

A De Sisti, J Tonet, PACE 2011

No case of complete AV-block necessitating PM implant has been reported after cryoablation, although this complication could clearly be possible.

Nevertheless, inadvertent transient AV-block, preceded by preliminary successful and uncomplicated cryomapping, ranges between **4% and 23%**, when also including unwanted fast pathway lesion with PR prolongation

VARIABLES AND OUTCOME

CRYO-CATHETER SIZE

RESIDUAL JUMP

ISOLATED RESIDUAL ECHO

AV NODAL ERP PROLONGATION

FREEZING-THAWING-FREEZING CYCLE

AV-BLOCK AT LAST SPOT

VARIABLES AND OUTCOME

CRYO-CATHETER SIZE

Studies comparing 4-mm vs 6-mm tip cryocatheter for AVNRT cryoablation

Authors	Year	Patients (n)		Initial success (%)			Recurrence (%)		
		4-mm	6-mm	4-mm	6-mm	p	4-mm	6-mm	p
Khairy et al.	2007	146	39	92	95	ns	5.6	2.8	ns
Chanani et al.	2008	98	56	93	98	ns	18	9	ns
Rivard et al.	2008	152	137	91.4	89.8	ns	23	11.5	<0.05
Sandilands et al.	2008	59	101	91.5	94	ns	17	7	=0.01
Total		445	333				19.5%	8 %	

De Sisti, J Tonet, PACE 2011

Four studies comparing 4-mm vs 6-mm tip cryocatheter

	4-mm	6-mm
PATIENTS	445	333
INITIAL SUCCESS	92.5%	95.6%
RECURRENCE	19,5%	8%

De Sisti, J Tonet, PACE 2011

VARIABLES AND OUTCOME

RESIDUAL SLOW PATHWAY

ISOLATED RESIDUAL ECHO

(After successful cryoablation: no AVNRT induction)

**In RF ablation for AVNRT,
a residual jump and a single echo do not
seem to modify long-term results,
in cryoablation their effects are under
evaluation.**

Stern JD et al. PACE 2011

De Sisti A, Tonet J, Amara W, et al. EUROPACE 2011

Sandilands et al. found that suppression of slow pathway was associated with long-term success. Recurrence was significantly more likely to occur without complete slow pathway block.

Sandilands A et al. EUROPACE 2008

	Recurrence	No-recurrence	P
Patients (n)	19	130	
Residual slow pathway	8 (42%)	12 (9.2%)	<0.001
Residual echo	7 (36.8%)	12 (9.2%)	<0.001

De Sisti A, Tonet J, Amara W, et al. EUROPACE 2011

Pitié-Salpêtrière Hospital, Paris

Clinique de l'Europe, Amiens

Le Raincy-Montfermeil Hospital, Montfermeil

Inclusion criteria

Slow-fast AVNRT

Acute successful cryoablation

6-mm tip cryocatheter

Baseline jump

AVNRT inducibility

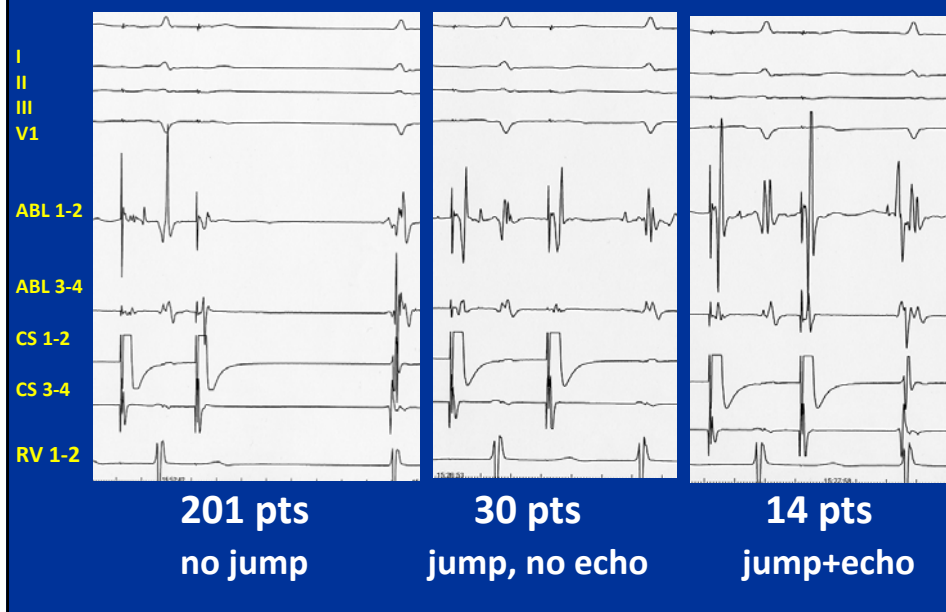
No previous ablation attempts

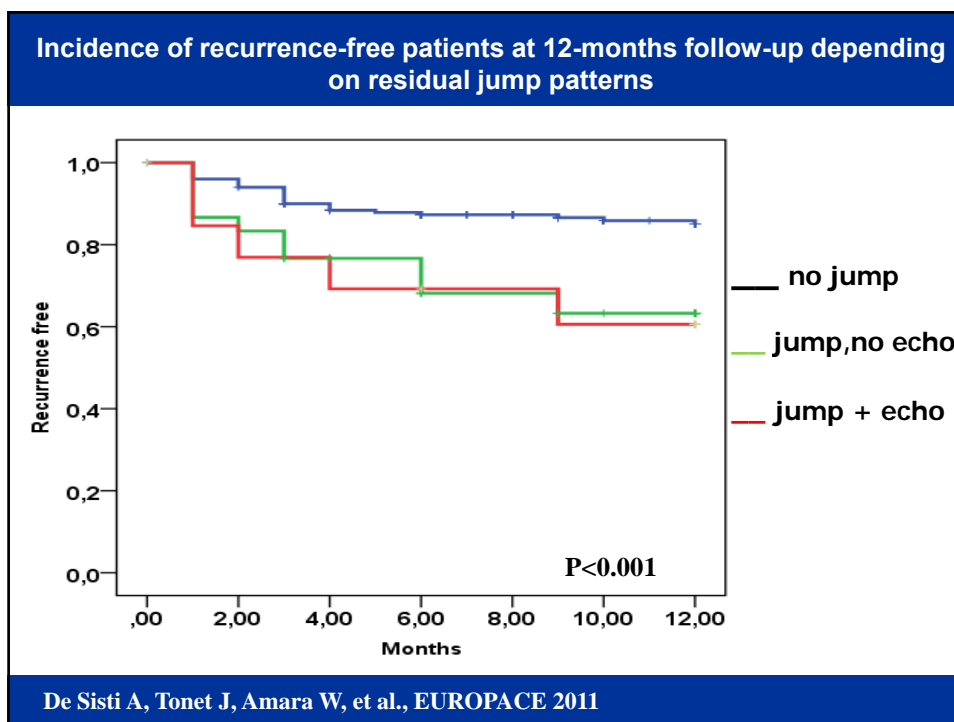
RESULTS

Among 332 patients who had undergone cryoablation from May 2002 to March 2010 in our institutions, 245 of them fulfilled the entry criteria.

De Sisti A, Tonet J, Amara W, et al. EUROPACE 2011

EP characteristics at the end of the procedure





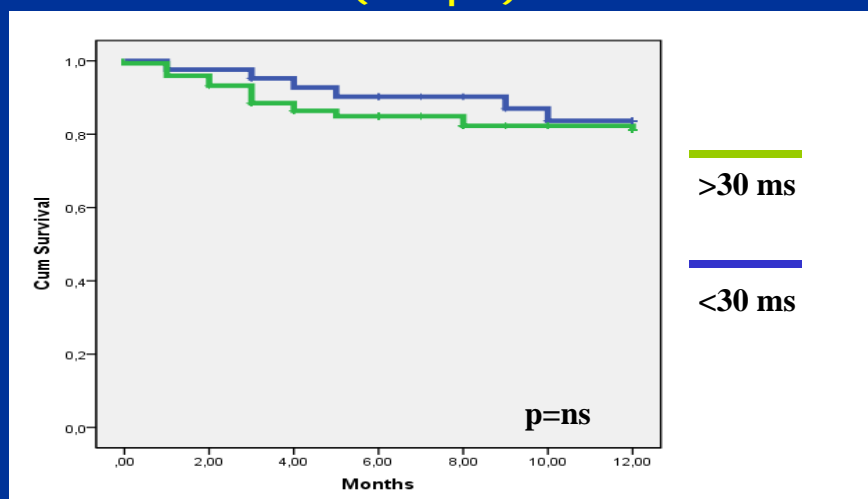
**Comparison among patients without jump, jump and no echo, and jump + echo.
Clinical and electrophysiological data.**

VARIABLES	No jump	Jump no echo	Jump echo	X2 ANOVA
Patients (n)	201	30	14	
Age (years)	42±16	39±13	40±19	ns
Previous AA drugs (n)	1.2±1.0	1.3±1.2	1.8±1.5	ns
Δ AVN ERP (ms)	64±35	51±53	42±29	ns
Total cryoablation time (sec)	926±774	1315±947	1281±645	<0.05
Recurrence (pts)	28 (14%)	10 (33%)	5 (36%)	<0.01

VARIABLES AND OUTCOME

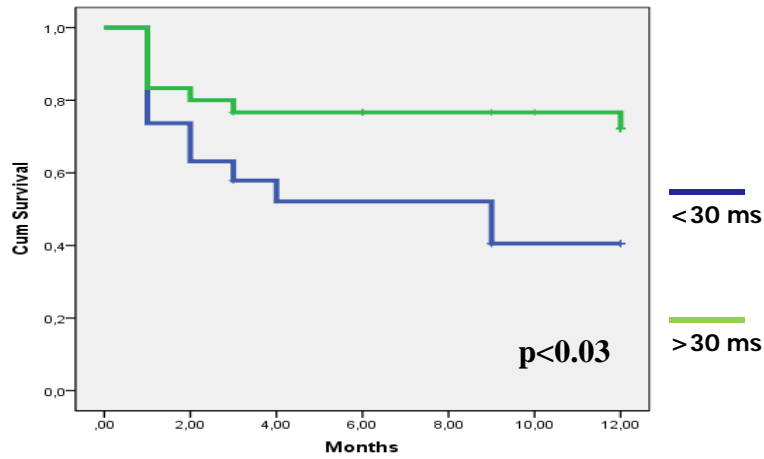
AV NODAL ERP PROLONGATION

Nodal AV ERP after cryoablation in patients without residual jump (245 pts)



De Sisti A, Tonet J, Amara W, et al., Unpublished data 2011

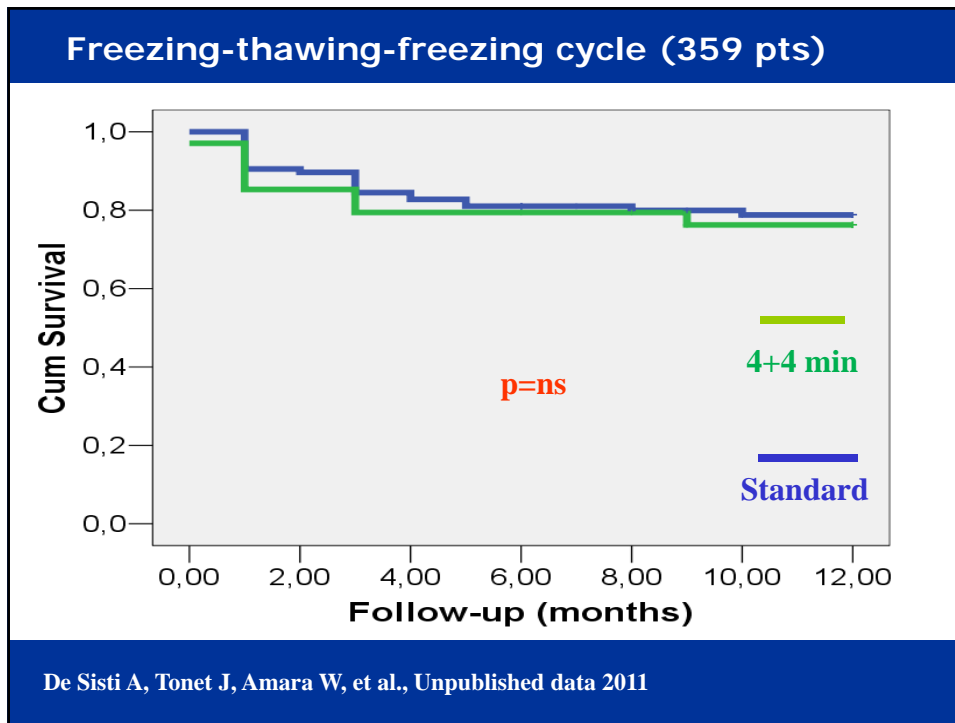
Nodal AV ERP prolongation after cryoablation in patients with residual jump (60 pts)



De Sisti A, Tonet J, Amara W, et al., Unpublished data 2011

VARIABLES AND OUTCOME

FREEZING-THAWING-FREEZING CYCLE



VARIABLES AND OUTCOME

AV-BLOCK AT LAST SPOT

CRYOABLATION OF AV NODE FOR AF

AV-block resulted in only 1/15 patients referred for AV nodal junction ablation with a 6-mm-tip cryo-catheter.

(Perez-Castellano M et al. Heart Rhythm 2006)

AV-block occurred in 10/12 patients referred for AV nodal junction ablation with a 4-mm-tip cryo-catheter. After 6 months follow-up, 8/10 patients remained in complete AV-block.

(Dubuc M et al., PACE 1999)

In an animal model the minimal application of Cryo for obtaining complete nodal AV-block was 10 sec in duration.

(Wadhwa MK et al., J Interv Card Electrophysiol 2000)

These data stress the need for very careful attention also when ablating with Cryo instead of RF.

De Sisti A, J Tonet et al. EUROPACE 2008

**Inadvertent transient AV-block
at last spot - 24 patients**

No block - 115 patients

Prolonged PR - 13 patients

2nd-3rd AV-block - 11 patients

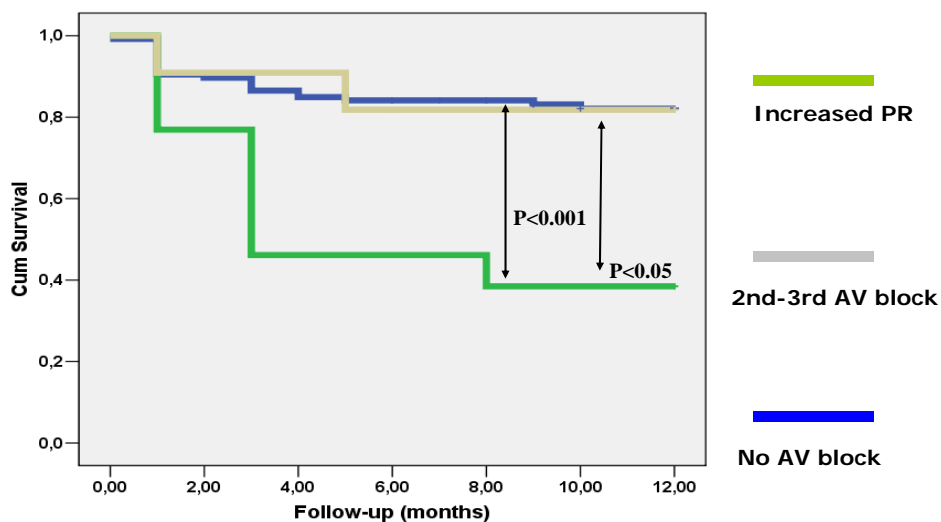
All AV blocks occurring during cryoablation were transient.

2nd-3rd AV-block generally lasted a few seconds, while 1st-degree AV-block sometimes persisted, but AV conduction recovered after hours or some days in these patients (up to 4 days).

The propensity for inadvertent AV-block in cryoablation could be explained by a more anterior approach taken with cryoablation than with RF

De Sisti A, J Tonet et al. EUROPACE 2008

Actuarial graphs of AVNRT recurrence-free status depending on AV-block degree at the last effective spot



De Sisti A, J Tonet et al. EUROPACE 2008

CONCLUSIONS (1)

Current experiences accumulated during the last decade indicate that cryoablation for AVNRT is effective and safe.

However, its widespread use seems to be limited by a slightly lower long-term clinical efficacy when compared to radiofrequency ablation.

CONCLUSIONS (2)

Suppression of the slow pathway conduction is the optimal end-point for AVNRT cryoablation.

Slow pathway persistence can be tolerated if nodal ERP post-cryo is prolonged > 30 ms.

CONCLUSIONS (3)

Fast pathway lesion appears to be associated with a higher recurrence rate in the follow-up

CONCLUSIONS (4)

Additional benefit may potentially be expected from cryocatheters leading to larger and deeper freeze.

AVNRT

In the recent past, cryo-energy has been available as an alternative to RF for catheter ablation procedures.

The advantages of cryoablation are the safety of this technology.

Cryomapping makes possible the assessment of functional effects of a particular site before permanent ablation lesion.

This makes cryoablation particularly useful in high-risk cases, for example, next to the His bundle or the compact AV node.