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Age-related location of manifest accessory pathway and clinical consequences

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ABSTRACT

Background: Accessory pathway (AP) ablation is not always easy. Our purpose was to assess the age-related prevalence of AP location, electrophysiological and prognostic data according to this location.

Methods: Electrophysiologic study (EPS) was performed in 994 patients for a pre-excitation syndrome. AP location was determined on a 12 lead ECG during atrial pacing at maximal preexcitation and confirmed at intracardiac EPS in 494 patients.

Results: AP location was classified as anteroseptal (AS)(96), right lateral (RL)(54), posteroseptal (PS)(459), left lateral (LL)(363), nodoventricular (NV)(22).

Patients with ASAP or RLAP were younger than patients with another AP location. Poorly-tolerated arrhythmias were more frequent in patients with LLAP than in other patients (0.009 for ASAP, 0.0037 for RLAP, <0.0001 for PSAP).

Maximal rate conducted over AP was significantly slower in patients with ASAP and RLAP than in other patients. Malignant forms at EPS were more frequent in patients with LLAP than in patients with ASAP (0.002) or PSAP (0.001).

Similar data were noted when AP location was confirmed at intracardiac EPS. Among untreated patients, poorly-tolerated arrhythmia occurred in patients with LLAP (3) or PSAP (6). Failures of ablation were more frequent for AS or RL AP than for LL or PS AP.

Conclusions: AS and RLAP location in pre-excitation syndrome was more frequent in young patients. Maximal rate conducted over AP was lower than in other locations. Absence of poorly-tolerated arrhythmias during follow-up and higher risk of ablation failure should be taken into account for indications of AP ablation in children with few symptoms.

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Introduction

Radiofrequency ablation of the accessory pathway (AP) is the usual treatment of symptomatic ventricular pre-excitation syndrome (Wolff–Parkinson–White syndrome) and of asymptomatic pre-excitation syndrome with signs of malignancy at electrophysiological study [1,2]. Therefore electrophysiological study (EPS) is recommended to evaluate the pre-excitation syndrome-related risk [3–6]. It is well-known that ventricular fibrillation may be the first event of the pre-excitation syndrome. Ventricular fibrillation was the first manifestation in 8 of 15 patients (53%) in the study of Timmermans et al. [7], but aborted sudden death was rare and seen in 2.2% of this population of 690 patients referred for a Wolff–Parkinson–White syndrome [7]. The risk was reported as lower in a personal study [8]; 6 of 645 patients (0.9%) were resuscitated from a ventricular fibrillation. Fitzsimmons et al. [9] reported a sudden cardiac death risk of 0.02% per patient per year. Male gender, young age, sport, septal accessory pathway (AP), short AP refractory period, atrial fibrillation (AF) were reported as risk factors of sudden death in pre-excitation syndrome [2]. Other indications for AP ablation were the occurrence of spontaneous AV re-entrant tachycardia [10]. But, ablation of atrioventricular AP is not always simple either associated with a risk of failure mainly in the case of right lateral location or associated with complications as the risk of complete AV block in the case of anteroseptal (AS) or parahisian location [11,12].

The purpose of the study was to evaluate the prevalence of AP location according to the age of patient with a pre-excitation syndrome, the clinical data and the prognosis of these patients.

Material and methods

Population of study

The population included 994 consecutive patients referred to our center between 1990 and august 2015 for overt pre-excitation and indication for electrophysiological study (EPS).

Patients underwent examination for various reasons: a) 414 patients (41.6%) had a known history of paroxysmal reciprocal tachycardia; b) 31 patients (3.1%) presented with a well-tolerated AF; c) 359 patients (36%) in whom asymptomatic pre-excitation was discovered during a systematic assessment prior to anesthesia, before obtaining a sporting license, prior to employment in certain at-risk occupations, or during an ECG in the preventive medicine department or in presence of congenital heart disease; d) 114 patients (11.5%) presented with unexplained syncope without documentation of any arrhythmia event; e) 76 patients (7.6%) presented a poorly-tolerated tachycardia, defined as a documented life-threatening hemodynamically non-tolerated arrhythmia, with collapsus or syncope and requiring emergency treatment (ventricular fibrillation in 7 patients, rapid and poorly-tolerated AF conducted over the accessory pathway in 68 patients rapid and poorly-tolerated reentrant tachycardia in one patient).

The retrospective study of patients' files was approved by the Commission Nationale Informatique et Libertés (CNIL), in keeping with French law for single-center usual care observational studies. Prior to EPS and ablation, informed consent was obtained for clinical purposes from all patients and in the case of children, from children and their parents.

Protocol

The protocol included systematic non-invasive (24 h Holter monitoring and exercise testing) and invasive studies.

EPS was performed systematically generally by transesophageal route in asymptomatic patients or patients with undocumented tachycardia, or by conventional intracardiac method. Fig. 1 reports the number of patients studied only by esophageal route (the most frequent), only intracardiac route or by both routes. Patients were not sedated. Details of the EPS protocol have been previously described [5,8].

Briefly, incremental atrial pacing was performed until the highest rate conducted 1/1 through the AP and/or atrioventricular node. Programmed atrial stimulation at a basic cycle length of 600 and 400 ms with the respective introduction of one and two extra-stimuli was performed. For the measurement of the AP effective refractory period (AP ERP), one atrial extra-stimulus was delivered after 7 paced atrial stimuli at a cycle length of 400 ms from 390 ms until the AP refractory pathway or the atrial effective refractory period with 10-msec decrements. The disappearance of the pre-excitation pattern was indicated upon reaching the AP ERP. When a fast AF conducted over AP was induced with this method, the protocol was halted; in the absence of induction of tachycardia conducted over AP at a rate higher than 240 bpm, isoproterenol (0.02–1 $\mu g\ min^{-1}$) was infused to increase sinus rate to at least 130 bpm after which the pacing protocol was repeated.

Pre-excitation was characterized by the following data:

AP location was determined with the 12-lead ECG recorded in maximal pre-excitation according to classical data [13–24]. The location was performed by only one Electrophysiologist. The location is easy and reliable for left AP and right or left posteroseptal location. It is more difficult to differentiate with certainty a right lateral or a parahisian AP (errors in 25% of cases). Nodo-ventricular AP is diagnosed by the absence of modification of preexcited QRS and a progressive increase of AV interval when premature extrastimuli are used.

The exact location of AP was determined by intracardiac route by the determination of the site where atrioventricular conduction was the shortest in bipolar and unipolar recording in 494 patients. Other mapping criteria used for the location were the earliest ventricular activation, the recording of AP potential, and the successful ablation site when decision of ablation was made. The presence of a His bundle potential near this site in a patient without criteria of malignancy were contraindications of ablation for our group in the past (before 2010).

Sustained AF or reciprocating tachycardia was defined as a tachycardia lasting longer than 1 min.

Conduction over the AP was evaluated by the maximal rate conducted over AP either in tachycardia or during atrial pacing.

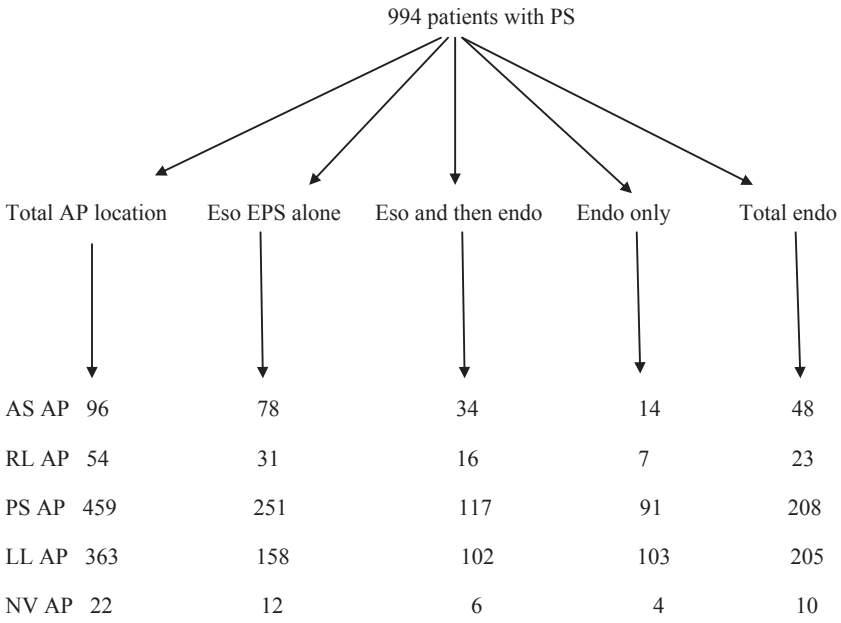

Fig. 1 – Representation of the whole population and the method of evaluation. Eso EPS: esophageal electrophysiological study, Endo: intracardiac electrophysiological study, AP: accessory pathway, AS: anteroseptal, RL: right lateral, PS: posteroseptal, LL: left lateral, NV: nodo-ventricular.

Pre-excitation syndrome was considered as malignant and at risk of sudden death when the following association was observed: the shortest RR interval between pre-excited beats was less than 250 ms in the control state or less or equal to 200 ms after isoproterenol infusion during induced sustained AF. EPS was considered as negative if no tachycardia was induced and a long refractory period of accessory pathway (≥250 ms in control state and >200 ms after isoproterenol) was noted [5,8].

When ablation was indicated, ablation was performed by the same senior operator with different assisting clinical fellows. AP ablation was made with a 7F deflectable catheter with a 4 mm electrode by searching the site where atrioventricular conduction was the shortest in bipolar and unipolar recording. Left AP generally was approached by retrograde catheterism.

After investigations, asymptomatic patients in whom there were no electrophysiological criteria for malignancy were not treated and ablation was not indicated. Ablation of AP was proposed in symptomatic patients or asymptomatic patients with detection of a potentially malignant form of the disease. Antiarrhythmic therapy with beta-blocker and/or flecainide was the preferred mode of treatment in small children, in patients with an anteroseptal AP and in patients who refused ablation.

Patients were followed during 5.1 ± 5 years

Patients in whom ablation was performed had a clinical visit and a standard-ECG systematic one month after ablation. In those who remained symptomatic despite a normal ECG, 24 h Holter monitoring was systematic and generally a transesophageal electrophysiological study was performed.

In patients in whom ablation was not performed, telephonic interviews with the patient and the medical referent were performed.

Statistical analysis

Data were expressed as means ± standard deviation (SD) or proportions, as appropriate. Categorical variables were compared using the Chi-square test and continuous variables with the unpaired t test.

Univariable logistic regression was used with the following dependent variables, age, gender, AP location, history of poorly-tolerated tachycardia and hemodynamically poorly-tolerated tachycardia occurrence during follow-up, malignant form at electrophysiological study. Variables associated with the considered outcome with a p value <0.10 in univariable analysis were entered in the multivariable models.

A p-value <0.05 was considered statistically significant. All statistical analyses were performed using the SPSS package for Windows (version 20, SPSS Inc, Chicago, Illinois).

Results

1 General data on the location of AP in total population:

AS AP location was identified in 94 patients aged 6–57 years. Right lateral (RL) AP was noted in 51 patients. Remaining patients had a different location, right or left posteroseptal (PS) location in 459 patients, left lateral (LL) location in 359 patients and or nodo-ventricular (NV) AP in 22 patients.

In 8 patients, 2 locations were identified; one of them had right PS location associated with AS AP. This patient was classified with AS locations. Three patients had associated PS AP and right lateral AP; they were classified with right lateral location. Three patients had a LL and PS AP and another patient had a LL AP and a NV AP; they were classified as LL

location. In 2 patients only studied by esophageal route the differentiation of AS and RL was not possible and patients were classified with AS location.

Therefore, 96 patients were classified as having AS AP location, 54 as having RL AP location, 459 as having PS AP location, 363 as having LL AP location and 22 as having a NV AP.

2 Clinical data according to AP location (Table 1):

Patients with AS AP or RL AP were younger than patients with another AP location (25 ± 13, 25.5 ± 14 vs 33.2 ± 17.5 for PS AP, $p < 0.001$, 36.6 ± 16.7 for LLAP, $p < 0.0001$).

The incidence by range of age was significantly higher among patients with NV, AS and RL AP location before 20 years than after 19 years compared to patients with PS and LL AP location. The statistical differences for AS AP were 0.006 for PS AP and <0.0001 for LL AP. The statistical differences for RL AP were 0.03 for PS AP and <0.00001 for LL AP. The differences continuously increased with age (Table 2). After 59 years AS AP, RL AP or NV AP were exceptional.

Male gender was significantly more frequent in patients with RL AP (76.5%) (p 0.03) than in all other locations.

The indications for EPS differed according AP location but only for LL AP and NV AP location; patients with LL or NV AP were less frequently asymptomatic than patients with another AP location: the differences were highly significant for LL AP (0.0006 compared to AS AP, <0.0001 for RL AP and <0.0001 for PS AP). They were not different for NV AP because the group was too small. Poorly-tolerated arrhythmias were more frequent in patients with LL AP than in patients with another location (p 0.009 for AS AP, 0.0037 for RL AP and <0.0001 for PS AP). Patients with RL AP have less frequently spontaneous reentrant tachycardia than patients with LL AP (p 0.004).

3 Electrophysiological data according to AP location (Table 1):

Maximal rate conducted over AP was significantly slower in basal state in patients with AS AP than in patients with another AP location, except with RL AP location. Statistical data for AS AP were 0.002 compared to PS location, <0.001 compared to LL AP and 0.04 between RL AP and LL AP. After isoproterenol, maximal rate conducted over AP was significantly slower for AS and RL AP compared to PS and LL AP (0.03 for PS AP compared to AS AP, 0.044 for PS AP compared to RL AP; <0.0002 for LL AP compared to AS AP, 0.02 for LL AP compared to RL AP).

Atrio-ventricular reentrant tachycardia (AVRT) was more frequently induced in patients with LL AP (67%) than in patients with all other AP locations (0.002 compared to RL AP, 0.004 compared to AS AP, <0.0001 compared to PS AP).

The induction of AF was less frequent in patients with AS AP and PS AP than in patients with LL AP (0.005 between AS AP and LL AP, 0.0001 between PS AP and LL AP).

The number of potentially malignant forms at EPS was more frequent in patients with LL AP than in patients with AS AP (0.002) or patients with PS AP (0.001) and differences were not significant with patients with RL AP.

4 Data of patients in whom intracardiac electrophysiological study was performed in view of AP ablation (Table 3):

Intracardiac study was indicated in 494 of 994 patients (49.7%) with a pre-excitation syndrome for spontaneous paroxysmal reciprocal tachycardia in 277 patients (56%), for well-tolerated AF in 19 patients (3.9%), for pathological esophageal study in 84 asymptomatic patients (induced AVRT in 30 patients, induced in AF with a rapid conduction over AP 44 patients, short AP ERP in 10 athletes); 35 patients (8.3%) had pre-excitation syndrome-related syncope at esophageal study (induced AVRT 30, induced antidromic tachycardia 1, induced AF with a rapid conduction over AP 4); 65 patients (13.2%) had a spontaneous poorly-tolerated tachycardia; in 13 patients the

Table 1 – Clinical and electrophysiological data of whole population according to the AP location. Sp: spontaneous; ERP, effective refractory period. See Table 1 for remaining abbreviations. Malignant form: shortest RR interval between pre-excited beats <250 ms in the control state or <200 ms after isoproterenol infusion during induced sustained AF; EPS: electrophysiology study. Bold numbers are results which differ significantly (details in the manuscript).

	AS AP	RL AP	PS AP	LL AP	NV AP
Number	96 (9.65%)	54 (5.4%)	459 (46.2%)	363 (36.5%)	22 (0.2%)
Age (years)	25 ± 14	25.5 ± 14	**33.2 ± 17.5**	**36.6 ± 16.7**	**32.4 ± 18**
Male gender	56 (58%)	**39(76.5%)**	287 (62.5%)	218 (60%)	13 (59%)
HD	10 (10.4%)	4 (7.4%)	34 (7.4%)	25 (6.9%)	5 (22.7%)
Asymptomatic	39 (40.6%)	30 (55.5%)	201 (43.8%)	**84 (23.1%)**	5 (22.7%)
Syncope	10 (10.4%)	3 (5.5%)	67 (14.6%)	31 (8.5%)	3 (13.6%)
Sp AVRT	42 (43.75%)	**16 (29.6%)**	160 (34.8%)	182 (50%)	14 (64%)
Sp AF	1 (0.1%)	3 (5.5%)	11 (2.4%)	16 (4.4%)	0
Sp malignant form	4 (4.2%)	2 (3.7%)	20 (4.3%)	**50 (13.8%)**	0
Max HR CS bpm	167.5 ± 58.3	176.5 ± 66	**189 ± 63**	**202 ± 67.4**	152 ± 40
Max HR iso bpm	212.9 ± 69.9	210.8 ± 72.4	231 ± 66.5	**247 ± 69.3**	189 ± 50
AP ERP CS ms	304.7 ± 67	310 ± 87	290.3 ± 74.5	**275.1 ± 72**	
AP ERP iso ms	243.7 ± 42	248 ± 57.4	234 ± 56.5	**220.6 ± 39.7**	
Induced AVRT	48 (50%)	24 (47%)	211 (46%)	**240 (66%)**	10(45.4%)
Induced AF	16 (17%)	15 (30%)	89 (19.4%)	**113 (31%)**	4 (18%)
Malignant form (EPS)	5 (5.2%)	6 (12%)	44 (9.6%)	**63 (17.4%)**	0
Ablation	48 (50%)	23 (42.6%)	208 (57%)	205 (56.5%)	10 (45%)
Successful ablation	23 (48%)	15 (65%)	**175 (84%)**	**184 (90%)**	6 (60%)

Table 2 – Prevalence of AP location according to the age of the patient.

		AS AP	RL AP	PS AP	LL AP	NV AP
6–19 years	283	46 (16.2%)	24 (8.5%)	137 (18.4%)	67 (23.7%)	9 (3.1%)
>19 years	711	50 (7%)	30 (4.2%)	322 (45.3%)	296 (41.6%)	13 (41.6%)
6–19 years	283	46 (16.2%)	24 (8.5%)	137 (18.4%)	67 (23.7%)	9 (3.1%)
20–29 years	215	22 (10.2%)	10 (4.6%)	84 (39%)	67 (31.2%)	2 (1%)
30–39 years	172	11 (6.4%)	11 (6.4%)	78 (45.3%)	69 (40.1%)	3 (1.7%)
40–49 years	159	10 (6.3%)	5 (3.1%)	64 (40.2%)	75 (47.1%)	5 (3.1%)
50–59 years	122	6 (4.9%)	4 (3.2%)	58 (47.5%)	52 (42.6%)	2 (1%)
60–89 years	73	1 (1.4%)	0	38 (52%)	33(45.2%)	1 (1.4%)

Table 3 – Clinical and electrophysiological data of patients in whom AP location was confirmed by intracardiac study. The Bold numbers are those where results differ significantly (details in the manuscript).

	AS AP	RL AP	PS AP	LL AP	NV AP
Number	48	23	208	205	10
Age (years)	25 ± 13	25 ± 12	**33 ± 17**	**36.5 ± 16**	**39 ± 18**
Male gender	29 (60.4%)	**20 (87%)**	124 (60%)	125 (61%)	6 (60%)
HD	5 (10.4%)	2 (9%)	16 (8%)	18 (9%)	2 (20%)
Asymptomatic	6 (12.5%)	**7 (30%)**	47 (22.5%)	27 (13%)	1 (10%)
Syncope	6 (2.5%)	2 (9%)	23 (11%)	13 (6%)	1 (10%)
Sp AVRT	**32 (67%)**	9 (39%)	118 (57%)	110 (54%)	8 (80%)
Sp AF	0	**3 (13%)**	5 (2.4%)	11 (5%)	0
Sp malignant form	4 (8%)	2 (9%)	1 (7%)	**44 (21.5%)**	0
Max HR CS bpm	172 ± 60.5	189.5 ± 81	**207 ± 68**	**214.5 ± 168**	32 ± 56
Max HR iso bpm	222 ± 74	197 ± 89	**251 ± 64.5**	**259 ± 69**	132 ± 56
AP ERP CS ms	**308 ± 58**	**306 ± 96**	268 ± 58.5	272 ± 73	
AP ERP iso ms	241 ± 47	**267 ± 84**	**218 ± 52**	**217 ± 45**	
Induced AVRT	41 (85%)	16 (69.5%)	140 (67%)	157 (77%)	8 (80%)
Induced AF	**14 (29%)**	**12 (52%)**	**57 (27%)**	**83 (40.5%)**	1 (10%)
Malignant form (EPS)	5 (10.4%)	6 (26%)	32 (15%)	**54 (26.5%)**	

initial exploration was performed directly by intracardiac route at the demand of the patient. The details of patients studied by intracardiac study are detailed in Fig. 1.

Patients with AS AP or RL AP were still younger than patients with another AP location (25 ± 13, 25 ± 12 vs 33 ± 17 for PS AP, $p < 0.002$, 36.5 ± 16, for LL AP $p < 0.0001$).

Male gender was significantly more frequent in patients with RL AP than in all other locations (87%) (p 0.01 for LL and PS location, 0.02 for AS AP) Fig. 2.

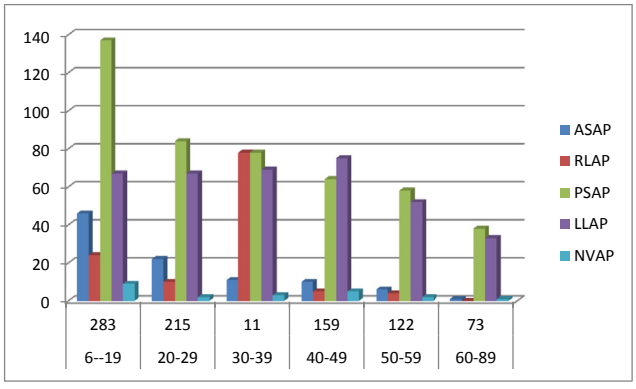

Fig. 2 – Prevalence of AP location according to the age of patient. The legend represents the ranges of age (6–19 years).

The indications for EPS did not differ except for spontaneous AVRT more frequent in patients with AS AP than in patients with RL AP and for spontaneous AF more frequent in patients with RL AP compared to patients with AS AP or PS AP. Spontaneous malignant form was more frequent in patients with LL AP than in patients with AS AP (p 0.04) and in patients with PS AP (<0.0001).

Electrophysiological data according to AP location were also similar to the data of whole population (Table 3).

The maximal rate conducted over AP was significantly slower in basal state in patients with AS AP than in patients with another AP location, except with RL AP location. The statistical data for AS AP were 0.001 compared to PS location and 0.0005 compared to LL AP. After isoproterenol maximal rate conducted over AP was significantly slower for AS and RL AP compared to PS and LL AP (0.0065 for PS AP compared to AS AP, 0.0065 for PS AP compared to RL AP; 0.01 for LL AP compared to AS AP, 0.004 for LL AP compared to RL AP).

The induction of AVRT was more frequent in patients with LL AP (67%) than with all other AP locations that did not differ for this induction ($p < 0.0001$ for RL AP, 0.023 for AS AP, <0.0001 for PS AP).

The induction of AF was less frequent in patients with PS AP than in patients with RL AP (0.013) and in patients with LL AP (0.005).

The number of potentially malignant forms at EPS was more frequent in patients with LL AP than in patients with AS AP (p 0.02) and patients with PS AP (0.006).

5 Follow-up

Patients were followed from 2 months to 20 years (mean 5.1 ± 5 years).

Ablation was indicated as frequently in patients with AS, RL, PS and LL AP. However the success of ablation was significantly higher in patients with LL AP compared to AS AP (<0.0001) or RL AP (0.008) and in patients with PS AP compared to patients with AS AP (<0.0001) or RL AP (0.02): ablation was successful in 403 patients. In 12 patients ablation was not performed because His potential recording was very near of AP in 11 patients with AS AP and in one patient with a RL AP because conduction over AP was poor and tachycardia was not induced. Reappearance of AP was noted in 35 patients (14 patients with LL AP (7%), 11 with PS AP (5.3%), 3 with a RL AP (13%) (NS) and 7 with AS AP (14.5%) (0.02 compared to LL AP and PS AP)). Ablation failed in 43 patients (7 with LL AP (3.4%), 22 with PS AP (10.5%), 6 with AS AP (12.5%) (0.01 compared to LL AP), 4 with RL AP (17%). One complete AV occurred in a patient with AS AP but this patient was seen at the beginning of the ablation technique.

Among the 591 patients with failure of ablation (n = 91) or not treated by AP ablation (n = 500) a spontaneous poorly-tolerated arrhythmia occurred in 9 patients: 3 patients with a LL AP developed this event; one patient only had initially reentrant tachycardia, one patient was asymptomatic and one had initially a well-tolerated AF. Six patients with a PS AP developed a spontaneous poorly-tolerated arrhythmia; 4 had initially reentrant tachycardia and 2 were asymptomatic. None patient with AS or RL AP developed adverse event after initial evaluation.

A second EPS was performed in 123 patients between 6 and 9 years later (mean 7.9 ± 4). The reasons were various: in 10 patients initially studied for unexplained syncope, 2 had still syncope, 4 had symptoms of tachycardia, 3 were asymptomatic and one presented AF. In 62 patients with initially reentrant tachycardia, 9 were asymptomatic, 3 had syncope, 3 had AF, 2 had a spontaneous malignant form and 45 had still symptoms of tachycardia. In 42 initially asymptomatic patients, 5 had syncope, 2 had AF, 2 had a spontaneous malignant form, 10 had symptoms of tachycardia and 23 patients remained asymptomatic. AP has lost the anterograde conduction properties in 9 of 40 patients with a LL AP (22.5%), 10 of 49 patients with a PS AP (20.4%), 8 of 20 patients with AS AP (40%) and 6 of 13 patients with RL AP (46%). The differences were not significant.

6 Multivariate analysis:

Age, LL AP location and PS AP location were independent factors of the occurrence of a spontaneous poorly-tolerated arrhythmia (Table 4). Spontaneous poorly-tolerated arrhythmia and LL AP location were independent factors to find signs of malignancy at electrophysiological study (Table 4).

Table 4 – Multivariate analysis of the factors associated with spontaneous poorly-tolerated arrhythmia and factors associated with the presence of signs of malignancy at electrophysiological study. Sp AE: spontaneous adverse event (poorly-tolerated arrhythmia).

Sp AE	p	OR	CI 95.0% Inferior	CI 95% Superior
Age	0.000	1.026	1.013	1.040
Gender (male)	0.11	0.668	0.407	1.097
Heart disease	0.22	0.549	0.211	1.432
LL AP	0.000	3.001	1.861	4.861
PS AP	0.001	0.443	0.268	0.730
AS AP	0.363	0.616	0.217	1.748
RL AP	0.346	0.500	0.118	2.2116
Malignancy at EPS	**p**	**OR**	**CI 95.0% Inferior**	**CI 95% Superior**
Age	0.1	0.988	0.975	1.002
Gender (male)	0.451	0.451	0.521	1.336
Sp adverse event	0.000	28.249	16.000	49.874
Heart disease	0.089	0.367	0.115	1.167
LL AP	0.045	1.601	1.011	2.535
PS AP	0.502	0.854	0.540	1.352
AS AP	0.070	0.381	0.134	1.084
RL AP	0.762	1.161	0.443	3.040

Discussion

Patients with AS AP or RL AP are younger than patients with another AP location. They had a slower maximal heart rate conducted over AP than patients with another AP location. Spontaneous malignant form and malignant form identified by electrophysiological study were more frequent in patients with LL AP than in patients with another AP location. During the follow-up in untreated patients, spontaneous poorly-tolerated arrhythmia only occurred in patients with LL or PS AP. Failure of ablation was less frequent in patients with LL or PS AP. Therefore in the case of difficult or failed AP ablation of young patients with AS or RL AP, it is recommended to wait a spontaneous disappearance of AP except in patients with signs of malignancy. Data on patients with NV AP were not analyzed because these patients were too rare to obtain significant differences. As previously known, their prognosis was excellent.

We could provide hypothesis, even if speculative, for these results and these different features of APs according to their location. Left-sided APs have higher rates of induced AF because of their higher conduction rates; but older age of these patients could be the cause of favoring AF vulnerability with consequently that left APs represent more malignant substrates?

Several studies reported the data of electrocardiographic characteristics according to their localization [13–18]. Haghjoo [17] compared the data of 120 patients with AS, midseptal and PS AP and reported that midseptal APs were characterized by faster orthodromic tachycardia, whereas posteroseptal APs had a higher inducibility of atrial fibrillation.

Several data differ from previously reported data probably because the old group studies were of small number.

For example, Arya [19] reported that conduction properties of accessory pathways (APs) are independent of location and conduction mode (except in patients with multiple, Mahaim, and slowly conducting APs). Patients with right-sided APs

showed higher rates of atrial fibrillation and longer arrhythmia cycle length due to slower anterograde conduction over the atrioventricular node during atrioventricular reentrant tachycardia.

Some of our data were similar to data of de Chillou and al [20] in 1992. The authors reported that location of the accessory AV pathway was associated with specific electrophysiologic characteristics. As in our study later age at onset of symptoms in the left free wall versus other AP locations and later age at the time of EPS in the left free wall AP location were reported. Other data differ. Orthodromic reentrant tachycardia was induced less frequently in the right free wall than in other locations and inducibility of AF was greater in anteroseptal (62%) than in right free wall (21%), left free wall (44%) and posteroseptal (36%) locations ($p = 0.01$). In the present study induction of AVRT was only more frequent in patients with LL AP than in other AP locations and AF was rarely induced in patients with AS AP (17%).

In a small group of 45 patients, Kentsch [21] reported that antegrade effective refractory periods of septally located accessory pathways were significantly longer than of pathways located in the free wall of the ventricles. Luria [22] in a small group of 24 patients with inducible antidromic tachycardia reported a significantly longer anterograde conduction time through the AP and retrograde atrioventricular nodal conduction time in patients with paraseptal versus lateral pathways.

In the literature, complications of RF AP ablations were not rare and mainly reported for AS location [23–30] despite a trend for an actual lower risk [31–34]. In the study of Shaffer [12] in children, inadvertent atrioventricular block was related to the ablation anatomic site: (2.7%) anteroseptal, (10.4%) midseptal, and (1.0%) right posteroseptal sites ($P = 0.0007$ for anteroseptal, $P = 0.0001$ for midseptal, and $P = 0.17$ for right posteroseptal versus left septal sites). Moreover, in the present study, the prevalence of unsuccessful ablation was higher in patients with AS AP or RL AP without real negative prognosis value for the follow-up.

Even there was no statistical difference, but more than 20% (from 20 to 45%) of these patients demonstrated loss of antegrade AP conduction with time and this data should be noted in patients with ablation at risk of complications or in patients with few symptoms refusing ablation.

Limitations of study.

They are many.

Only 494 of 994 patients had the confirmation of exact AP location by intracardiac study. As noted previously ECG in maximal pre-excitation cannot always differentiate anteroseptal and right lateral AP (errors in 25% of cases). However, clinical and electrophysiological data of these 2 locations were similar (younger age and slower anterograde conduction over AP). The discrepancies only concerned spontaneous symptoms of the whole population studied for a pre-excitation syndrome compared to data obtained at the time of ablation. They are explained by the fact that asymptomatic patients frequently did not require invasive studies. Esophageal EPS is sufficient to evaluate the prognosis of patients with a pre-excitation syndrome [35]. Patients who require ablation are more symptomatic or have more induced arrhythmias or malignant forms. The data are confirmed in the present study.

Only 4 main locations were studied. More precise locations could have been used. Katsouras (18) report the ECG data of AP's located at left atrioventricular ring, right atrioventricular ring, left lateral/left anterolateral, left posterior/left posterolateral, left posteroseptal, right midseptal, right posteroseptal, right posterior/right posterolateral, right lateral/right anterolateral and right anterior/right anteroseptal. The author did not find specific criteria for the many locations frequently often close to each other. For example the successful ablation of a PS AP may require applications of radiofrequency energy at right and left posteroseptal site.

We have excluded from statistical analysis the patients with nodo-ventricular AP. The EP features of this AP are compatible with fasciculo-ventricular APs which are known to have a bystander/innocent role and do not require ablation. Nodo-ventricular APs might be associated with pre-excitation change depending on their take-off level from the AV node, and they may also participate in reentrant tachycardias requiring ablation.

The rationale for the classification of 10 patients with multiple or unknown location and the exclusion of statistical analysis is debatable.

This study is retrospective including single center data. Caution should be taken when analyzing other cohorts of patients with different races, demographical and genetic characteristics.

Other limitation is that a part of patients were included in the very early era of catheter ablation (since 1990). This may have contributed to less favorable outcomes of catheter ablation.

Conclusions

AS and RL AP location in pre-excitation syndrome was more frequent in young patients. Maximal rate conducted over AP was lower than in other locations. Absence of poorly-tolerated arrhythmias during follow-up and higher risk of ablation failure in these young patients should be taken into account for preventive indications of AP ablation or in children with few symptoms.

Disclosure

No disclosures.

Abbreviations

AP	accessory pathway
AF	atrial fibrillation
AS	anteroseptal
AVRT	atrioventricular reentrant tachycardia
EPS	electrophysiological study
ERP	effective refractory period
LL	left lateral
NV	nodo-ventricular
PS	posteroseptal
RL	right lateral

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