ventricular tachycardia during cardiac catheterization of patient with wolff-parkinson-white syndrome

report of a case showing effects of atropine sulfate

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cardiac catheterization of a patient with probable wolff-parkinson-white syndrome was attempted to clarify the possibility of coexistent congenital heart disease. introduction of the catheter into the heart induced a multifocal ventricular tachycardia which endangered the life of the patient. after quinidine and other drugs had failed to control the arrhythmia that persisted for nine hours, a prompt and gratifying conversion to supraventricular tachycardia, and subsequently to sinus rhythm, followed the intravenous administration of atropine sulfate.

the wolff-parkinson-white syndrome consists of an abnormally short p-r interval, usually prolonged duration of qrs complexes, and history of repeated episodes of paroxysmal tachycardia. variations of qrs complex have been observed during tachycardia, following exercise or atropine sulfate, or even while patients were at rest. the paroxysmal tachycardias have been generally supraventricular, especially auricular, occasionally auricular fibrillation, and rarely paroxysmal ventricular tachycardia. although the wolff-parkinson-white syndrome is usually unassociated with organic heart disease, rheumatic disease has been observed not infrequently. sudden death of patients with this syndrome has warranted a guarded prognosis.

short paroxysms of ventricular tachycardia are known to occur occasionally during cardiac catheterization and to stop promptly following partial withdrawal of the catheter tip. two cases of wolff-parkinson-white syndrome, subjected to cardiac catheterization, have been reported by ferrer and associates. each ex-

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crescendo murmur along the left sternal border in the third and fourth intercostal spaces. The arterial
blood oxygen saturation was 84 per cent with \( P_{O_2} \)
49 mm. Hg; the hemoglobin was 20.3 Gm. per 100
cubic centimeters.

Cardiac catheterization was performed with a
double catheter (sampling tube and intracardiac
electrode combined) inserted into the right arm
vein. Under fluoroscopic control, the catheter was
readily passed into right atrium to the region of the
tricuspid valve. Immediately the patient complained
of palpitations and tachycardia. Neither ocular pres-
sure nor carotid sinus pressure were effective. He
rapidly became apprehensive, restless, and ashen
gray with a cyanotic tint, and perspired profusely;
sodium sulfate (1.0 Gm.), and a total dose of 2.4 Gm.
of quinidine sulfate (plus 0.6 Gm. quinine dihydro-
chloride parenterally), intravenous 1.0 per cent pro-
caine, and niacinamide, there was no significant
change (Fig. 2, upper). Then 1.2 mg. of atropine
sulfate was administered intravenously and promptly
the bizarre ventricular tachycardia converted to a
supraventricular tachycardia which superficially re-
ssembled auricular flutter with a 2:1 block and ven-
tricular rate of 146 per minute which lasted six hours
(Fig. 2, lower). (It may have been a nodal tachy-
cardia with retrograde depolarization of the auricles.)
Gallop rhythm and snapping of the first heart sound
were noted. Finally the tachycardia reverted to a
sinus rhythm, with a rate of about 86 per minute.

![Figure 1](http://circ.ahajournals.org/)

**Fig. 1.—Left:** Current electrocardiographic findings during Wolff-Parkinson-White mechanism
with normal rate. Note the slurred upstroke of QRS in Leads I and a V\(_1\), notched QRS in Leads III,
V\(_2\), V\(_4\) and V\(_6\) with short P-R interval. **Right:** A. Control tracing when catheter tip was in superior
vena cava (upper tracing shows intracardiac lead, lower tracing V\(_1\) lead). B, C. Paroxysmal ventric-
ular tachycardia arising from various foci.

the blood pressure was unobtainable. The peripheral
pulse at the wrist was irregular, faint, and about 50
to 70 per minute. A very rapid irregular rate was ob-
served at the apex of the heart. The legs were raised
to aid venous return and oxygen therapy was in-
situated. Electrocardiograms revealed multifocal
ventricular tachycardia with a rate of 220 to 250
per minute (Fig. 1, right B). Quinidine sulfate, 0.4
Gm., given by mouth, and followed in half an hour
by 0.6 Gm. quinine dihydrochloride intravenously,
was without any effect. Short intervals of bizarre low-
voltage complexes suggestive of incipient ventricular
fibrillation were observed frequently during almost
continuous recording of a chest lead electrocardio-
gram on a direct-writing instrument. The patient
never lost consciousness although he showed signs
of cerebral anoxia. Nine hours later, after futile
efforts using morphine sulfate (0.016 Gm.), magne-
and the color, heart rate, blood pressure and heart
sounds were restored to normal. There were no signs
of congestive heart failure. He was kept on a main-
tenance dose of quinidine sulfate, 0.4 Gm. every six
hours, for the next few days without any recurrence
of tachycardia. Electrocardiographic and pneumo-
cardiographic study after restoration of normal sinus
rhythm failed to show any residual effects of the
tachycardia. The patient recovered strength, felt
well, and was discharged five days later.*

* An exercise tolerance test performed eight
days after the paroxysmal ventricular tachycardia
showed a conspicuous reduction in the physical fit-
ness index from 16 to 10.6 due to tachycardia. Subjectively the patient did not tolerate the exertion as well as before but denied any specific symptoms.
The history is confusing in determining the cause of the cardiac enlargement. The laboratory data are compatible with rheumatic mitral valvulitis, auricular hypertrophy, and pulmonary insufficiency. Presumably the hypoxemia indicates right-to-left shunting of blood from an unrecognized auricular septal defect, or diffuse vascular anastomoses of the lungs. Unfortunately the ventricular tachycardia precluded a definitive diagnosis. The persistent arrhythmia did not respond to reflex vagal stimulation. Significant quantities of quinidine, niacinamide, magnesium sulfate, morphine sulfate,* as well as procaine hydrochloride (up to 350 mg. intravenously) failed to revert the arrhythmia. However the intravenous adminis-

* Sabathie14 found that morphine sulfate, 0.01 to 0.04 Gm. intravenously, was effective in controlling paroxysmal ventricular tachycardia in 9 out of 10 patients.
enlargement of 1.2 mg. of atropine sulfate was promptly followed by a conversion to supraventricular tachycardia, either auricular flutter with 2:1 block, or nodal tachycardia with reentrant auricular depolarization. This in turn converted to sinus rhythm with a normal rate in another six hours. Fortunately there were no sequelae after recovery indicative of myocardial injury or ischemia. This feature has been observed in other reported cases when the initial impression of myocardial infarction could not be supported by subsequent events. Nevertheless, the alarming severity of the circulatory collapse observed in this patient stood in marked contrast to the not infrequent episodes of fleeting paroxysms of ventricular tachycardia recorded during manipulation of the intracardiac catheter in other patients.

The mechanism of the beneficial action of atropine sulfate in converting a ventricular to a supraventricular tachycardia is largely speculative. It is known that atropine may prevent the occurrence of ventricular tachycardia during cyclopropane anesthesia or epinephrine induced tachycardia in dogs. Wilburne and co-workers believed that atropine acts on the “acetylcholine-cholinesterase” mechanism to prevent reflex vagal-induced premature systoles, paroxysmal ventricular tachycardia, and fibrillation. Further experimental studies in dogs by Lenel and associates indicated that ventricular tachycardia is induced by hyperexcitability of the idioventricular pacemakers in the presence of epinephrine, or by stretching of the myocardium due to a sudden increase in pressure, or by vagal inhibition of the higher pacemakers. Bilateral vagotomy always stopped the paroxysm, and neither epinephrine nor vagal stimulation alone was capable of inducing a paroxysm in the vagotomized animal. Furthermore, ventricular tachycardia can be inhibited by pentobarbital anesthesia, dibenamine, and to some extent morphine.

**Summary**

An unusual case of multifocal paroxysmal ventricular tachycardia occurring during cardiac catheterization in a patient with cardiac enlargement and probable Wolff-Parkinson-White syndrome is reported. The etiology of the heart disease was not established, but features indicative of rheumatic valvulitis and congenital septal defect could not be excluded. The tachycardia was accompanied by profound circulatory collapse and did not respond to quinidine sulfate by mouth, or to quinidine dihydrochloride intravenously. Intravenous atropine sulfate (0.0012 Gm.) promptly converted the ventricular tachycardia to a supraventricular tachycardia resembling auricular flutter, which changed to sinus rhythm with a normal rate. The possible actions of atropine are briefly discussed.

**REFERENCES**

3. **Aranza, R., and Cossio, P.:** Fibrilacion auricular y taquicardia ventricular como eventualidad posible en el P-R corto con QRS ancho y melado. Rev. argent. de Cardiol. 5: 43, 1938.


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