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# Acquired Aortic Disease after Radiotherapy: About a Clinical Case with Literature Review

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**Abstract**

Radiotherapy is an adjuvant treatment for thoracic cancers which exposes to an increased risk of cardiovascular toxicity, in particular severe valvular, years after exposure. The identification of early symptoms as well as regular ultrasound follow-up remains essential to watch for cardiotoxicity early. We report the case of a patient followed for adenocarcinoma of the left breast treated with radiotherapy and complicated 10 years later by a predominantly stenosing aortic disease.

***Keywords:*** radiotherapy; aortic disease**.**

## 1. Introduction

Due to its anatomical position and the relative radiosensitivity of some of itsstructures, the heart is a “critical” organ for thoracic radiotherapy. He isusually accepted as cardiaccomplications of ionizing radiation (IR)represent the second leading cause of death after progression of neoplastic disease in patients who received mediatisnal irradiation [1-2]. Side effects can occur any time during radiation therapy, right after or a few days or even weeks later. Or after months or years (late effects) [3,4]. In general, the side effects of radiation therapy depend on the following: overall health, part of the body treated, amount (dose) of radiation and how it is given, and the type of radiation therapy Manifestations of radiation injury include valvular disease dominated by aortic stenosis, pericardial disease, coronary heart disease, cardiomyopathy, and conduction abnormalities.

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We report the case of a 55-year-old patient with a history of adenocarcinoma of the left breast treated by radiotherapy in whom symptomatic aortic stenosis was discovered 10 years later.

Observation : We report the case of a 55-year-old patient, married and mother of 3 children, having as a history adenocarcinoma of the left breast treated by radio chemotherapywith normal pre-radiotherapy transthoracic echocardiography and ascardiovascular risk factor: dyslipidemia, menopause and overweight;The patient presented 20 years later with worsening exertional dyspnea. Shecomplained of long-lasting left lateral chest and left arm pain at night. Cardiovascularexamination: TA=134/65mmHg, HR=69batt/min. Cardiac auscultation finds a systolic murmur at the rough rasping aortic focusat the level of the 3rd intercostal space radiating towards the vessels of the neck. The rest of the somatic examination is unremarkable. The electrocardiogram registers a regular sinus rhythm with an HR at 80 bpm Axis of the heart in place. PR at 200 ms. No left ventricular hypertrophy. The chest X-ray showed: Calcification at the level of the aortic button, no cardiomegaly., Concave middle left arc. A transthoracic echocardiography was done which showed tight aortic stenosis with an aortic surface area of 0.8cm2, indexed at 0.44. Vmax at 4.2m/s, Mean gradient at 40mmHg, Permeability Index (PI) at 22%. -The valve is tricuspid, calcified reworked with a limit opening. The sub-aortic diameter at

20mm.Undilated LV left ventricle (45/31mm) has slightly hypertrophied wall ofgood global and segmental contractility.
-An EF ejection fraction estimated at 60% right ventricle RV not dilated in good TAPSE systolic function at 23mm and S tric wave at 13cm/s.

- Echo-free dilated left atrium without thrombus and non-dilated right atrium.

-The ascending aorta at 28mm non-dilated.

-The thin and compliant inferior vena cava.

-The dry pericardium. On Doppler:

-Minimal mitral insufficiency (MI).

-Aortic insufficiency (IAo) grade III

-Minimal tricuspid insufficiency (IT) with a PAPS at 26mmHg and no PAH A coronary angiogram was performed which is normal.

-A Doppler echo of the trunk -supra -aortic and a Doppler echo of the lower limbs without anomalies.

-The patient benefited from a pre-anaesthetic consultation: complete blood test,eradication of infectious foci, gynecological consultation, dental care, etc.Correct kidney function and no respiratory problems So the

indication is retained, this patient must be operated in surgery after assessment of the extracorporeal circulation (ECC) and request for blood. Myocardial protection will be ensured by a myocardial potassium arrest by thecardioplegia which will be done according to the preference of each surgical team. For thispatient onechose anterograde cold blood cardioplegia directly in the ostiacoronaries, repeated every 20 minutes combined with pericardial refrigeration with iceplunders according to the method of Shumway. The approach to access the aortic valve is made by transverse aortotomy in hockey cross, then resection of the aortic valve taking care not to injure the mitral valve, decalcification of the ring then insertion of a prosthesis mechanical according to the size of the ring calibrated by a measurer, in the intra-annular position by a series of U-shaped patch points, then closure of the aortotomy by 2 semi-overlocks using a 4/0 monofilament thread.
The intervention is finished, the patient is transferred to intensive care under monitoring of blood pressure, scope, ECG, Sao2 with artificial ventilation.

## 2. Discussion

While post-radiation damage to the other cardiac tunics and coronaries has been the subject of numerous publications and controversies, the mural and valvular endocardium, meanwhile, has aroused less interest until recently. However, FAJARDO and his collaborators described as early as 1970 modifications of the mural endocardium after irradiation [5], modifications reminiscent of those observed in congenital fibroelastosis (focal fibrosis associated with an increase in the number of elastic fibres). The exact frequency of valvular lesions and endocardial damage secondary to radiotherapy is impossible to specify. The cases described are sporadic and it is necessary, here again, to distinguish between what amounts to the attack itself and what amounts to the muscular or coronary attack. A dose lower than 30 Grays does not seem to induce valvular lesion. A dose of 31 to 41 Grays causes 12% valvular damage. These attacks are certainly not as rare as the few special cases would suggest. BROSIUS [6] found in his autopsy study concerning 16 young irradiated subjects, 13 cases of fibrous thickening of the valvular endocardium. It should be noted that the appearance of valvulopathy almost always accompanies other post-radiation therapy complications and is only very rarely found in the foreground. During this same study, BROSIUS highlighted:

- 15 cases of pericardial thickening

- 2 cases of endocardial fibrous thickening

- 8 cases of myocardial interstitial fibrosis

A Norwegian ultrasound study conducted in 1996 on 116 patients irradiated for Hodgkin's disease found a frequency of regurgitation, especially aortic but also mitral, significantly higher than that observed in a control group. The female sex seems to be more exposed without the authors being able to explain the fact. Moreover, the addition of chemotherapy would not increase the risk of valvular damage.
The common pathogenic hypothesis involving, as an initiating mechanism, post-radiation damage to the microcirculation does not apply to valvular tissue, which is non-vascular. The latter appears to be relatively resistant to the immediate effects of ionizing radiation. Nevertheless, over time, the cellular damage associated

with the microtrauma linked to the incessant modifications of the pressure regimes, will cause valvular thickening, then valvular deformation first causing regurgitation and then stenosis becoming hemodynamically significant over time. But the observed lesions can be multifactorial, secondary to damage to the cords and pillars, to ventricular dilation or to ischemia.

In the anatomopathological series of BROSIUS [6] the systematic examination, carried out on average 4.5 years after mediatisnal irradiation, revealed in 80% of the patients, a fibrous thickening of the valvular endocardium without previous clinical manifestation. This thickening appears to mark the initial stage of valve disease. It mainly concerns the valves of the left cavities, while the mural endocardium seems more affected at the level of the atrium and the right ventricle. It should be noted that radiation can give rise to subvalvular stenosis, particularly in the lungs, through fibrosis or inflammation of the wall endocardium and myocardium. Valvular manifestations are more frequent during systematic monitoring thanclinically symptomatic. According to DETRANO [7], the onset time between radiotherapy and valvular damage ranges from 5 to 11 years. CARLSON shows in a series of 35 cases thatasymptomatic valvular damage is diagnosed on average 11.5 years after the first irradiation, whereas it only becomes symptomatic after 16.5 years. Post-radiation valvular manifestations are essentially leaky valvulopathies.Mitro-aortic lesions are more frequent (93%) than tricuspid or pulmonary lesions. At the level of the left cavities Mitral insufficiency is the most frequently described in the literature: 15 to 30% according to some studies. The fibrotic process concerns continuity mitro-aortic, carrying out a more or less complex bivalvular attack. It is the most often a true valvular disease, associating stenosis and regurgitation invarying proportions over time. Minimal, moderate to moderate regurgitations are the anomalies most frequently detected in the early phase, then the evolution is almost towards a predominant valvular stenosis. The mechanism of aortic insufficiency generally proves to be mixed: restrictive: by restriction of the movement of the leaflets or by annular dilation or modification of the valvular geometry. At the level of the right cavities Tricuspid insufficiency is most often the consequence of right ventricular dysfunction. Thetreatment is surgical when the valvular damage is significant, the local and general condition and the evolution of the neoplasia allow it. This surgical treatment is difficult and risky: as we have seen, valvulopathy is generally not isolated but always accompanies other post-radiation cardiac complications. It is therefore necessary to combine valve replacement with other surgical procedures (coronary aorto bypass, pericardectomy), or to carry out a double valve replacement, CARLSON and his collaborators describe in 1991, the first medium-term success of a combined surgery comprising double replacement mitro aortic by means of a mechanical winged prosthesis and a single marginal saphenous bypass [8].

The best treatment for cardiac complications from ionizing radiation (IR) remains prevention. The effects of IR on the heart essentially depend on three factors: the dose per fraction, the total dose and the volume of heart irradiated [9, 10]. Reducing these factors reduces the risk of heart damage. The dose per fraction plays a significant role. J.M.Cosset and his colleagues showed that the cumulative incidence of pericarditis at 5 years was 5% for a fractional dose of 2.5 Gy and nearly 7.5% for fractions of 3.3Gy [11]. The relative risk is multiplied by 2 when the dose per fraction is equal to or greater than 3 Gy. However, the volume of heart irradiated is probably the most important factor. The larger the volume, the higher the risk of complications. If

the entire pericardium is irradiated, the incidence of acute and chronic complications reaches 20%, compared to only 7% when the left ventricle is protected [11].

## 3. Conclusion

Reference [1] thoracic radiotherapy, whose beneficial role is also indisputable, can be responsible for potentially serious cardiac complications. The risk is increased in patients who have classic cardiovascular risk factors and in those who were irradiated young; it increases further when combined with chemotherapy, typically with anthracyclines. Considerable progress has been made on the technical level to limit these risks. The reduction in irradiated volumes, the improvements in ballistics, the adaptation of doses per session and the reduction in total doses have already made it possible to drastically limit the risk of these cardiac complications. Conformal radiotherapy with intensity modulation could represent a solution by reducing the cardiac volume irradiated. Similarly, respiratory servoing, a technique consisting in delivering irradiation at a precise moment in the respiratory cycle, would make it possible to reduce cardiac irradiation by moving the heart away from the tangential irradiation beams used for breast cancer. these effects are therefore conclusive, but, the latency time of these complications being long, it is advisable to remain cautious and to monitor our patients very closely over the long term.

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