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GOAL DIRECTED HAEMODYNAMIC THERAPY DURING VALVE SURGERY: MEASUREMENT OF TISSUE OXYGENATION

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Key words:

Hemodynamic optimization, cardiac surgery, tissue oxygenation, hemodynamic monitoring, valve diseases, high risk surgery, postoperative mortality, postoperative morbidity.

Summary :

Hemodynamic optimization is a strategy for managing a high-risk patients that aims to reduce postoperative mortality and morbidity.
The objective of this study is to measure the impact of hemodynamic optimization guided by the monitoring of tissue oxygenation on postoperative mortality and morbidity in valve surgery.
Goal directed haemodynamic therapy was achieved by optimizing vascular filling and the use of inotropics. Tissue oxygenation (complementary (or central) venous saturation of Oxygen (SvcO2) and blood lactate levels) were used to monitor response to treatment.
We compared two groups of patients, responders and non-responders.
Hemodynamic objectives were defined by adequate tissue oxygenation after filling and inotropics. Responders were patients with hemodynamic objectives (SvcO2>70% and lactates>5mmol/l), non-reresponders were those with hemodynamic objectives that were not met (SVcO2 70% and lactates > 5mmol/L).

The criteria for judgements used are early postoperative mortality (30 days post-operative), duration of stay in resuscitation, duration of artificial ventilation and duration of hospitalization.
The epidemiological profile of the patients observed is that of a young adult of an average age of 41 years, without significant comorbidities but with symptomatic and advanced valve diseases. The valve diseases mainly rheumatic, are mainly stenosing mitral, willingly bi or tri-valvular. The most performed interventions are mechanical replacements and are performed

in emergency in a quarter of cases.
The results obtained are satisfactory. Early postoperative mortality and morbidity were influenced by hemodynamic optimization, A statistically significant difference was found between responder and non-respondent patients for early mortality and duration of artificial ventilation. There was also a decrease in the length of stay in intensive care and in the length of hospitalization without this being statistically significant.
In conclusion, this study confirms the positive impact of hemodynamic optimization guided by tissue oxygenation parameters on postoperative mortality and morbidity on valve surgery.

Introduction:

Hemodynamic optimization is a strategy for managing high-risk patients. Maintaining cardiovascular homeostasis in per-operative settings reduces the incidence of post-operative complications and reduces post-operative mortality and morbidity [1][2][3] .
Cardiac surgery is a major surgery, its surgical mortality remains high. The «per operative» of these patients is marked by the intensity of hemodynamic constraints that the body undergoes and which could cause hemodynamic instability with hypo-perfusion of organs associated with an increase in postoperative complications. Optimizing intraoperative hemodynamics is a major imperative for improving patient prognosis [4] .

Goal directed haemodynamic therapy is a concept based on maintaining hemodynamic parameters at optimal values that ensure the adequacy between oxygen intake and consumption.
Studies that deal with hemodynamic optimization are numerous, they focused on studying the impact of an optimized therapy on mortality. These studies are marked by the uniformity of their results while the therapeutic protocols used are multiple and varied [5] .

Maximization of hemodynamics is based on strategies to optimize vascular filling and the rational administration of vasoactive amines guided by appropriate hemodynamic monitoring [6].

It is established that the measurement of cardiac output is a gold standard, its measurement is recommended in the various optimization strategies [7][8] nevertheless, it remains underused in current practice [9] and for many authors, it can be substituted by different hemodynamic monitoring parameters such as predictive dynamic indices of vascular fill response [10] and peripheral oxygenation parameters[11][12] .
The objective of this study is to measure the impact of hemodynamic optimization guided by the monitoring of tissue oxygenation parameters on postoperative mortality and morbidity in valve surgery.

Methods

Our study is observational prospective longitudinal mono-centric, it included all patients admitted to the cardiac surgery department of the university hospital of Oran for valve surgery during a period of 1 year (January 2011-December 2011). No exclusion criteria were used. Maximization of systolic ejection volume was achieved by optimizing vascular filling and the use of inotropics. Tissue oxygenation parameters (complementary (or central) venous saturation of Oxygen ($SvcO_2$) and blood lactate levels) were used to monitor response to treatment.

We compared two groups of patients, responders and non-responders. Hemodynamic objectives were defined by adequate tissue oxygenation after filling and inotropics. Responders were patients with hemodynamic objectives (SvcO2>70% and lactates>5mmol/l), non-responders were those with hemodynamic objectives that were not met (SVcO2 70% and lactates > 5mmol/L).
The main objective of the study was to measure the impact of hemodynamic optimization on postoperative mortality and morbidity in valve surgery.
The criteria for judgements used are early postoperative mortality (30 days post-operative), duration of stay in resuscitation, duration of artificial ventilation and duration of hospitalization.

Results:

Twenty-fourteen (94) patients were observed. The epidemiological profile observed is that of a young adult without significant comorbidities but with symptomatic and advanced valves. The Sex Ratio is 0.74 with a female predominance. The Average age is 41.16 years [15.84-66.48] with extremes ranging from 06 to 67 years. The 41-50 age group is the most prevalent [Figure 1].

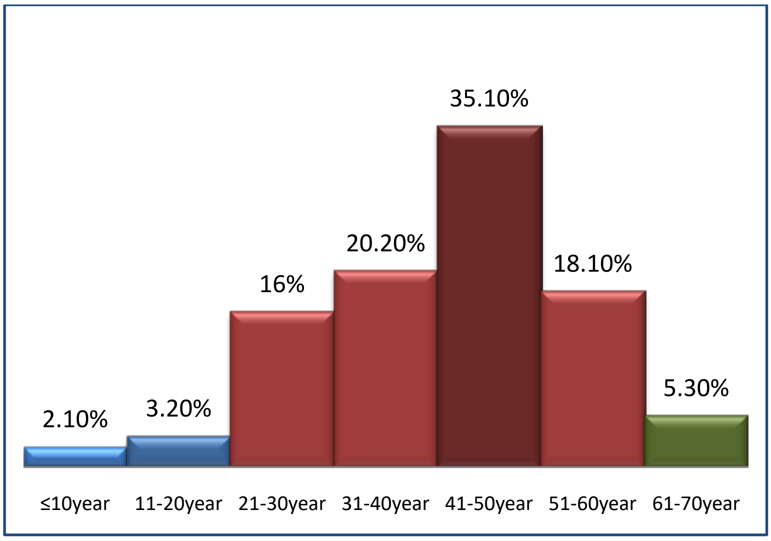

Figure 1: Age distribution of patients (N=94).

Essentially rheumatic valves [Table I], are mainly stenotic mitral lesions, willingly bi or tri-valvular (Tables II and III]. The frequency of mitral narrowing can be explained by the predominance of RAA in the etiologies of the valve diseases identified [Table I].

Etiologies n=94	n	%
RAA	86	91.5
RAA	69	73.4
RAA+ endocarditis	17	18.1
Dégénérative	1	1.1
Congénitale	6	6.4
Tumor	1	1.1
total	94	100

Table I: Etiopathogenia of valvulopathies operated in our series (N=94).

Valves diseases	n	%

n=202		
Mitral	**86**	**42.6**
Mitral stenosis	64	31.7
Mitral regurgitation	22	10.9
Aortic	**58**	**28.7**
Aortique stenosis	14	6.9
Aortique regurgitation	44	21.8
Tricuspid	**58**	**28.7**
Tricuspid stenosis	09	4.5
Tricuspid regurgitation	49	24.2

Table II: Valve Impairment Identified (N=94)

Number of valves affected n=94	n	%
One valve affected	**13**	**13.8**
V mitral	5	5.3
V aortic	7	7.4
V tricuspid	1	1.1
Two valves affected	**54**	**57.4**
V mitral+V aortic	24	25.5
V mitral+V tricuspid	30	31.9
Three valves affected	**27**	**28.7**
V mitral+V aortic+ V Tricuspid	27	28.7
Four valves affected	0	0
V mitral+V aortiqu + V tricuspid+ Vpul	0	0
Total	94	100

Table III: Number of valves affected in our patients (N=94).

The most frequently performed interventions are mechanical replacements (Table IV) and are performed in emergencies in a quarter of cases (25.5%). The two main indications of the emergency, for our patients, are massive aortic insufficiency post-endocarditis and major pulmonary artery hypertension

Operating procedures n=202	n	%
Plasty	**83**	**41.1**
Mitrale	23	11.4
Aortic	2	1.0
Tricuspid	58	28.7
Mechanical valve prothesis	**119**	**58.9**
Mitral	63	31.2
Aortic	56	27.7
Tricuspid	**0**	0

Table IV: Type of surgical procedures performed in our patients (N=94).

We were able to achieve the hemodynamic objectives decided in 70 of our patients (74.5%). There are 24 non-responsive patients (25.5%).
The results are satisfactory. Early postoperative mortality and morbidity are influenced by hemodynamic optimization. A statistically significant difference was found between responder and non-responder patients for early mortality (p: 0.000 with OR: 0.52 [0.35-0.72) [Table V] and duration of artificial ventilation (4.16h [0.48-7.84] versus 6.23h [0.83-13.3])

[Tables VI]. There is also a decrease in the duration of stay in intensive care and in the duration of hospitalization respectively 19.95h [12.49-27.41] and 26.76j [-3.36-50.16] versus 21.49h [-2.93-40.05] and 30.27 j [17.31-43.23] without this being statistically significant [Tables VI].

Variable	P responders	P no-responders	p	OR
Early mortality	1.4%	12.5%	0.000	0.52 [0.35-0.72]

Table V: Correlation of early postoperative mortality between the two groups.

Variable N=91	Répondeurs n=70	Non répondeurs n=24	t	p
VA duration (h)	4.16h [0.48-7.84]	6.23h [0.83-13.3]	6.42 [-1.17-1.81]	0.04
stay in intensive care**(h)**	19.95h [12.49-27.41]	21.49h [-2.93-40.05]	-0.737[-5.67-2.60]	0.46
hospitalization **(day)**	26.76day [-3.36-50.16]	30.27 day [17.31-43.23]	1. 24[-2.09-9.12]	0.42

Table VI: Correlation of immediate postoperative morbidity between responder and non-respondent patients.

Discussion:

In the literature consulted, there is no consensus on the modalities of hemodynamic optimization. The work focused on studying the impact on mortality of an optimized therapeutic compared to a standard therapeutic
The hemodynamic objectives to be achieved, the monitoring used and the therapeutic protocols are multiple and very varied.
In common practice, it is established that the measurement of cardiac output is an essential parameter, its measurement is recommended in the various optimization strategies [7][8] .The first studies were conducted on hemodynamic data measured by pulmonary arterial catheter which was subsequently gradually replaced by less or non-invasive techniques. Most recent studies use esophageal doppler [13] [14] [15] or invasive pulse wave analysis to measure cardiac output[16].
In common practice, perioperative monitoring of cardiac output remains under-utilized [9], it is substituted for many authors by other parameters, including tissue oxygenation parameters.

Hamilton et al. [5] published in 2011 in "Anesthesia & Analgesia" a meta-analysis of 29 randomized studies (including several in cardiac surgery) with a total of 4,805 patients included. The objective of the study was to update the literature on hemodynamic optimization and to verify the impact of practice changes (monitoring and therapy) on the outcomes of the strategy in at-risk surgeries. They concluded that perioperative hemodynamic optimization reduced post-operative mortality and morbidity, regardless of the monitoring tool chosen.
Cannesson in 2011 [9] publishes a practice assessment study on the use of hemodynamic monitoring in high-risk surgeries. A questionnaire is sent to 2500 practitioners who are members of ASA (American society of anesthesiologists) and ESA (European Society of Anaesthesiology), 299 responses were obtained. The study found a significant gap between recommendations and practice in this area. Cardiac output is used only in 34.9% of cases for

ASA practitioners to 35.4% of cases for ESA. In 14.1% to 24.9% of cases practitioners believe that the measurement of cardiac output does not provide any additional information compared to the usual monitoring (central venous pressure, blood pressure, venous oxygen saturation).

All studies converge on the absolute need to measure the adequacy of cardiac output to tissue metabolism, systemic oxygenation parameters such as SVcO2 and lactate levels are most commonly used [10]. Several studies have shown that absolute values or variations in cardiac output cannot adequately reflect local blood flow and have highlighted the need to measure tissue oxygenation [17].

A decrease in morbidity and mortality is found by the teams that used ScVO2 and lactates to monitor the adequacy between Qc and tissue oxygenation during volemic expansion in patients receiving surgery at risk [4] [18] [19].

Pölönen in 2000 (n=403) [12] and Bee in 2012 (n=60) [11] conclude that SVcO2 and lactate levels are relevant for optimizing cardiac surgery patients.

Bee Bee in the same study showed that one third of patients had occult hypoperfusion (SVcO2 70% and lactate>2mmol/L) while macrocirculatory parameters were normal and hypoperfusion was responsible for perioperative overmorbidity [11].

We used peripheral oxygenation parameters for hemodynamic monitoring of our patients and our results are conclusive.

Conclusion:

Hemodynamic optimization is a strategy to manage high-risk patients, it reduces mortality and post-operative morbidity. It must be integrated into the overall management of post-operative rehabilitation aimed at improving the future of patients.

The therapeutic protocols and hemodynamic monitoring used to optimize management should be adapted to patients, to the types of surgery but also to the habits of the practitioners in charge of patients.

Declaration of conflicts of interest:

The authors declare that they have no conflict of interest

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