Successful Management of Cold-Induced Urticaria/Anaphylaxis During Hypothermic Circulatory Arrest for Ascending Aortic Aneurysm Repair and Coronary Artery Bypass Grafting

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Abstract

Background: Cold induced urticaria/anaphylaxis is a potentially life threatening immunologic disorder characterized by swelling and edema of exposed tissue in response to a cold stimulus, and is occasionally associated with hypotension and cardiovascular collapse. Avoidance of cold is considered the mainstay of patient management, but on occasion, cold may be an important therapeutic intervention for other indications, such as in cardiac surgery.

Case Presentation: We report the case of a 70 year old male with a past history of hypertension and cold urticaria who had previously experienced anaphylaxis during a river water immersion 15 years prior to his development of cardiac disease. He presented with crescendo angina and a positive exercise stress test; coronary angiography revealed a critical left main artery stenosis in the setting of triple vessel disease. He was also found to have an ascending aortic aneurysm. Semi-urgent surgical treatment was deemed warranted and an urgent evaluation by Allergy & Immunology was requested pre-operatively. The patient was treated 3 days prior to Allergy assessment with cetirizine 10mg PO BID and ranitidine 150mg PO BID, which produced a partial suppression of his ice test. His pre-treatment protocol was expanded to include cetirizine 20mg PO BID, montelukast 10mg OD and prednisone 25mg PO BID for 5 days preoperatively. Perioperatively, he was treated with high dose methylprednisolone, ranitidine and diphenhydramine. Intraoperatively, the patient was cooled to a core temperature of 28◦C. Circulatory arrest was then commenced, employing selective antegrade cerebral perfusion (delivered at 28◦C) via the right axillary artery. The patient did require epinephrine infusion following cardiac arrest to maintain his blood pressure and suffered a temporary lactic acidosis, but pressor support was weaned by the end of the evening post-operatively, and his acidosis resolved with baseline renal function preserved.

Conclusion: Cold exposure should normally be avoided in patients with cold-induced urticaria, but aggressive pre-treatment regimens can allow for successful cold cardioplegia when medically necessary.

Background

- Cold induced urticaria/anaphylaxis is a potentially life threatening immunologic disorder characterized by swelling and edema of exposed tissue in response to a cold stimulus
- Severe cases are aassociated with hypotension and cardiovascular collapse
- Avoidance of cold is considered the mainstay of patient management
- On occasion, cold may be an important therapeutic intervention for other indications, such as in cardiac surgery
- To date, little guidance exists in the literature for the management of patients with cold-induced urticaria who require surgical procedures with a hypothermic component such as cold-cardioplegia

Methods

- We describe the successful management of a 70 year old male with a previous history of cold-induced urticaria and cardiovascular collapse following a cold river immersion who required a semi-urgent surgical repair of critical left main artery stenosis and ascending aortic aneurysm

Presentation of the Case

- A 70 year old male with a past history of hypertension and cold induced urticaria presented with crescendo angina and a positive exercise stress test
- Coronary angiography revealed a critical left main artery stenosis in the setting of triple vessel disease as well as an as well as an ascending aortic aneurysm involving up to the origin of the innominate artery. To accomplish an adequate repair circulatory arrest was deemed essential.
- His history of cold-induced urticaria was severe, having previously experienced anaphylaxis during a river water immersion 15 years prior
- Semi-urgent surgical treatment was deemed warranted and an urgent evaluation by Allergy & Immunology was requested pre-operatively
- The patient was contacted via telephone 3 days prior to Allergy assessment to allow for the urgent initiation of treatment with cetirizine 10mg PO BID and ranitidine 150mg PO BID
- The H1 and H2 receptor antagonism produced a partial suppression of his ice test, so his pre-treatment protocol was expanded to include cetirizine 20mg PO BID, montelukast 10mg OD (starting immediately) and prednisone 25mg PO BID for 5 days preoperatively (see Figure 1)
- The patient's metoprolol was also discontinued and replaced with amlodipine
- Perioperatively, he was treated with high dose methylprednisolone, ranitidine and diphenhydramine (See Figure 1)
- Intraoperatively, the patient was cooled to a core temperature of 28 C (compared to the common practice of cooling as low as 18 C).
- Circulatory arrest was then commenced, employing selective antegrade cerebral perfusion (delivered at 28◦C) via the right axillary artery
- Details of the Pump Run for the cardiac bypass were as follows: Pump time: 159 minutes (10:17 to 13:27) Clamp Time: 78 minutes (10:49 to 12:07) Circulatory arrest time: 11 minutes (11:31 to 11:42) Lowest nasopharyngeal temperature: 28.0 degrees. Cooling time: 74 minutes (10:17 to 11:31). Re-warming time: 61 minutes (11:44 to 12:45).The temperature gradient between water and blood was never greater than 10 degrees during cooling and re-warming.
- Serial serum tryptase and plasma histamine levels were performed intra- and post-operatively (Table 2)
- The patient did require epinephrine infusion following cardiac arrest to maintain blood pressure and he suffered a temporary lactic acidosis, but pressor support was weaned by the end of the evening post-operatively, and his acidosis resolved by the end of post-op Day 1, with baseline renal function preserved

Figure 1: Pretreatment Schedule

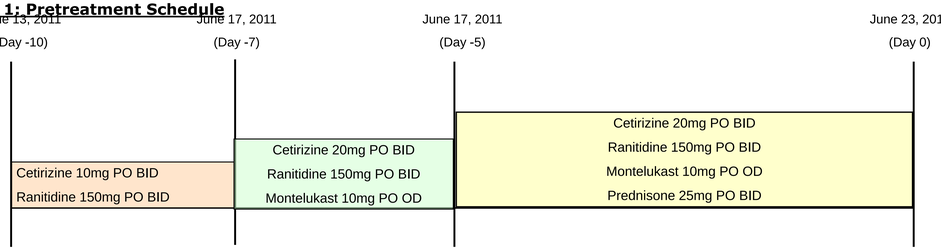

Table 1: Peri-operative Treatment

Planned Time Frame	Real Time	Medication(s) Given
1 hr Pre-Op	~07:30h	Solumedrol 2g IV x 1 Ranitidine 50mg IV x 1 Diphenhyrdamine 100mg IV x 1
1 hr Pre-Clamp/Bypass	~09:50h	Solumedrol 125mg IV x 1 Diphenhyrdramine 100mg IV x 1
Time of Cardiac Arrest/30 min Pre-Re-warming	~11:30h	Solumedrol 60mg IV x 1 Ranitidine 50mg IV x 1 Diphenhyrdramine 100mg IV x 1
6 hr Post-Op	~18:30h	Solumedrol 60mg IV x 1 Ranitidine 50mg IV x 1 Diphenhyrdramine 50mg IV x 1

Table 2: Tryptase/Histamine Measurements

Time/Date	Event Description	Histamine (nmol/L)	Tryptase (ug/L)
17-Jun-11; 12:05h	Allergy/Immunology Pre-Op Assessment	-	3.9
21-Jun-11; 08:30h	Baseline (Pre-Op in OR)	7	1.3
21-Jun-11; 10:53h	On by-pass for 5 min; cooling begun; Aortic cross-clamp "on"	8	-
21-Jun-11; 11:27h	Patient cooled to 28 deg	<5	-
21-Jun-11; 11:45h	3 min post circulatory arrest	<5	-
21-Jun-11; 12:45h	Warming of patient just complete; 36 deg	<5	2.8
21-Jun-11; 14:40h	2 hours post re-warm	5	2.7
21-Jun-11; 16:45h	4 hours post re-warm	<5	2.3
21-Jun-11; 18:50h	6 hours post re-warm	-	3.4

Discussion

- Cold-induced urticaria (CIU) is an uncommon but well-described phenomenon due to physical mast-cell degranulation with the subsequent release of inflammatory mediators following a cold challenge
- Mast cell products include histamine, cysteinyl leukotrienes, platelet activating factor, and prostaglandin D can be detected in these individuals
- Histamine appears to mediate most of the clinical manifestations, and its release is greatest on withdrawal of the cold stimulus; symptoms can progress to be systemic including hypotension and cardiovascular collapse
- Avoidance of short term and prolonged exposures to cold stimuli is central to the management of patients with CIU to avoid intra-operative instability; thus the need for cold cardioplegia presented a therapeutic dilemma
- Others have shown that a significant increase in plasma histamine occurs with re-warming during cardiopulmonary bypass
- Given the length and depth of cold exposure we developed an extensive pharmacologic regimen, based partially upon the two previously published cases in this arena, initiated well in advance of the OR date to ideally prevent the hemodynamic consequences of the systemic cold exposure and to allow for the safe conduct of the procedure in this patient
- Our patient did develop profound hypotension, but this can also accompany the baseline lowering of systemic vascular resistance result from cardiac arrest, and the lack of a tryptase rise suggested that we successfully achieved mast cell stabilization by including corticosteroids with the pre-treatment regimen in addition to the H1R, H2R and CysLTR1 antagonists employed

Conclusion

- This case experience suggests that patients with cold-induced urticaria/anaphylaxis can successfully undergo cardiac bypass surgery with cold cardioplegia with an aggressive and extensive pretreatment strategy
- Successful reports of this nature have included corticosteroids, H1 receptor antagonism and H2 receptor antagonism; we additionally provided a CysLT1R antagonist

References

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