Capstone for Impact Submission | GY2019

Project Title: WBC predicts outcomes in infants undergoing cardiac surgery

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Advisor Names(s): John Charpie

Branch: Procedure Based Care

Path of Excellence: Scientific Discovery

Handover/Transition:
If this project can be continued by another UMMS student, you may contact them at the following email
address/phone number (N/A if project cannot be handed over): **N/A**

Summary:

 The majority of congenital heart defects (CHD) are amenable to surgical repair or palliation. However,
cardiac surgery with CPB results in a systemic inflammatory response (SIR) and transient immunoparalysis
that may lead to multi-organ dysfunction and adverse outcomes (1-3). A biomarker that reflects both
inflammation and immune status could be valuable for predicting outcomes and for monitoring patient
responses to therapeutic interventions.

        The NLR has been studied as a biomarker for systemic inflammation and stress response, and a high
NLR has been reported to be an indicator of poor prognosis in several malignancies and other chronic
diseases. The NLR provides information on both inflammation (neutrophils) and immune function
(lymphocytes), and is a simple, readily available, and inexpensive test (4, 5). Recently, NLR was also shown to
correlate with postoperative outcomes in adult patients undergoing cardiovascular surgery (6-8). The cutoff
for the definition of a high NLR varied from 2.5-4 in these studies suggesting that the optimal cutoff value
for NLR must be defined for specific patient cohorts.

    Despite a number of adult studies examining the predictive value of NLR in different disease states, there
is a paucity of information in the pediatric population. Mitchell and colleagues retrospectively studied a
cohort of infants with hypoplastic left heart syndrome undergoing hybrid stage I palliation where a possible
complication is stenosis in the aortic arch isthmus. These authors showed that the post-procedure NLR was
higher in patients who later required aortic arch re-intervention compared to those who did not (9), and they
attributed this difference to a local inflammatory response in the re-coarctation patients.

This is the only study to our knowledge that sought to correlate NLR with outcomes in pediatric congenital
heart disease patients following cardiac intervention. Therefore, we believe that it is important to assess the

ability of NLR to predict outcomes after cardiac surgery with CPB in neonates and infants with congenital heart disease.

Methodology:

Study design:

We will begin working on our IRB application to obtain permission for access to these charts. We anticipate that informed consent will be waived. We plan to use a retrospective chart review using existing patient and laboratory data from the electronic medical record (MiChart) to obtain NLR data. We will use the complete blood count (CBC) and the absolute neutrophil and absolute lymphocyte counts to calculate the NLR. Current standard of care is to draw a CBC with differential pre-operative and post-operative day #1, 24 hours after surgery. Currently we are working on an IRB application to obtain permission for access to these charts. After IRB approval, we will use MiChart as our chart review database and plan to include at least 600 cases that fit within our eligibility criteria. These will be our primary collecting points, however if there are additional CBCs with differential we will continue to record the NLR up to two weeks after the index operation.

Statistical analysis:

In conjunction with M-CHORD statisticians, we will describe the NLR before and after cardiac surgery for each patient. We will collect the pre-operative NLR to establish the patient's baseline NLR, then collect the post-operative NLR and compare the two. This comparison will assess the change in the patient's inflammatory state following cardiac surgery. We will determine if there are statistically significant trends or patterns in the NLR pre-CPB and post-CPB.

Results/Conclusion:

High pre-operative WBC was associated with worse outcomes in infants undergoing CPB

WBC $\geq$ 15.4 x 109/L was optimal discriminatory value

High pre-op WBC remained significantly associated with outcomes after controlling for BSA, STAT category and circulatory arrest times

High pre-op WBC (WBC $\geq$ 15.4 x 109/L) was also associated with mortality alone, and trended towards an association with infection

Reflection/Lessons Learned:

Flexibility and perseverance is important in research because we started out with a different question in mind then realized it would not be feasible so switched gears to this project.