

Clinical Practice Guideline for Perioperative Management of Patients with Pulmonary

Hypertension

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Despite advances in clinical diagnosis, treatment modalities, and monitoring, pulmonary hypertension (PH) remains a serious condition with significantly poor prognosis worldwide. Pulmonary hypertension is defined as a mean pulmonary arterial pressure of greater than 25mmHg at rest. Patients with PH undergoing surgery are at an increased risk of life threatening perioperative complications. This doctor of nursing practice (DNP) scholarly project proposal examines anesthetic implications of PH and evaluates its incidence, prevalence, and significance in patients presenting for surgery. Current literature pertaining perioperative management of patients with PH and suggested treatment modalities have been evaluated, and a clinical practice guideline is developed for the management of PH patients using Brower's Agree II tool and practitioner feedback questionnaire (PFQ). This DNP scholarly project consists of three major stages. In the first stage a literature review was conducted and a guideline with current evidence based recommendations was drafted. The draft guideline was then critically appraised by a team of appraisers using the Agree II tool. In the second stage, the guideline was evaluated by anesthesia providers using the practitioner feedback questionnaire. Data was collected from the questionnaire to determine the suitability of the guideline for practice and the likelihood of anesthesia providers incorporating the guideline in to their everyday practice. Finally, the completed guideline was presented to department administration and other key stakeholders for approval. Overall, the guideline was given a 71% approval rating using the Agree II tool and an 82% approval rating via practitioner feedback. The results indicate that the anesthetic management of patients with PH at a midsized community hospital could be improved by implementation of a CPG that offers current and evidence based recommendations while fostering formation of a multidisciplinary team to improve perioperative PH management.

Pulmonary hypertension (PH) is an intricate disease process of the pulmonary vasculature that can involve multiple organ systems and result in increased perioperative morbidity and mortality (Pilkington, Taboada & Martinez, 2015). Despite advances in clinical diagnosis, monitoring, and treatment modalities, PH remains a serious condition with a significantly poor prognosis (Hoepfer & Granton, 2011). Pulmonary hypertension is defined as a mean pulmonary arterial pressure (mPAP) of greater than 25mmHg at rest or greater than 30mmHg during exercise (Kaw, et al., 2011). Although it used to be considered a rare disease, in recent years, the incidence of PH has been steadily increasing worldwide (Price et al., 2010). Incidence of PH in the United States has been estimated to be around five per million (Strumpher & Jacobsohn, 2011). It has also been reported that incidence of PH is two to four times higher in women than men (Strumpher & Jacobsohn, 2011). The incidence of PH in patients with HIV is six to twelve times that of the general population despite recent utilization of effective antiretroviral therapies (Pritts & Pearl, 2010). In 6 to 10% of cases, PH is inherited mainly through mutation of BMPR-2 genes (Strumpher & Jacobsohn, 2011). Perioperative morbidity is reported to be between 14 to 42% and it mainly includes respiratory failure, myocardial infarction, renal failure, and heart failure (Pilkington et al., 2015). Post operative mortality associated to PH has been estimated to be between 1 to 18% (Pilkington et al., 2015).

Often, PH occurs in association with other disease processes including congenital heart defects, and connective tissue disorders. Right ventricular failure resulting from a pathologic increase in pulmonary vascular resistance and decreased pulmonary arterial flow is the most common cause of death in patients with PH (Hoepfer & Granton, 2011). Pulmonary hypertensive patients undergoing surgery are at an increased risk of perioperative complications that are potentially life threatening (Teo & Greenhalgh, 2010). Providing perioperative care to patients

with PH often proves to be challenging; aggressive management of triggers of pulmonary vasoconstriction and resulting pulmonary hypertension such as hypoxia, acidosis, hypothermia and hypercarbia is fundamentally vital (Teo & Greenhalgh, 2010).

An organizational approach to improving care of patients with PH perioperatively is through the development of a clinical practice guideline detailing the requirements for preoperative workups, appropriate classification of PH, and management of care. Thorough preoperative workups that include an echocardiogram or a right heart catheterization, optimization of patients' pulmonary function and right heart function, oxygen therapy with a goal of maintaining oxygen saturation above 90%, and administration of diuretics when there is evidence of a right heart volume overload are recommended. However, appropriate classification of patients' PH and understanding of comorbidities and contributing pathologies is key during diagnosis, treatment, as well as perioperative management of patients with PH (Teo & Greenhalgh, 2010). In recent years, several management modalities have been suggested with varying degrees of success. Administration of calcium channel blockers, prostacyclin analogues, endothelin receptor antagonists, and phosphodiesterase-5 (PDE5) inhibitors has shown significant improvement in perioperative management of patients with pulmonary hypertension (Teo & Greenhalgh, 2010).

The lack of a standardized clinical practice guideline (CPG) for the perioperative care of patients with PH at a mid-sized inner city community hospital located in the Washington Metropolitan area gave birth to this DNP scholarly project. The purpose of this project is to develop a clinical practice guideline to be utilized by providers in caring for patients with PH perioperatively for use at a mid-sized inner city community hospital. Following implementation of the PH clinical practice guideline, it is anticipated that providers at the above referenced

facility will make use of a standardized practice guideline that will enable them to give the safest and best evidence based care to patients with PH and maximize positive outcomes. It is also anticipated that morbidity and mortality rates of patients with PH will decline and patients will not have an unnecessarily prolonged stay at the hospital.

Theoretical Framework

In order to facilitate implementation of the pulmonary hypertension CPG that will be generated from this DNP scholarly project, an evidence-based practice framework namely Knowledge –to –Action (KTA) will be utilized. The KTA has been developed in Canada by Graham and colleagues in an attempt to address confusing multiplicity of terms often used to describe the transfer of knowledge in to evidence based practice (Field, Booth, Ilott, & Gerrish, 2014). The KTA framework has two major components identified as Knowledge Creation and Action Cycle (Field, Booth, Ilott, & Gerrish, 2014). Each of these major components contain multiple phases that are interconnected. The Knowledge Creation component of KTA framework consists of knowledge inquiry, synthesis, and generation of products or tools. On the other hand, the Action Cycle component of KTA consists of knowledge use monitoring, outcome evaluations, sustaining knowledge use, problem identification, adaptation of knowledge to local context, assessment of barriers, and selection and tailored implementation of interventions in a cyclical manner (Graham et al., 2006).

The KTA framework will be utilized during the development and implementation of the CPG. During the knowledge creation phase, a thorough inquiry and synthesis of evidence will be performed for an ultimate goal of developing a CPG to be used by all anesthesia providers of the facility. During the action cycle phase of the KTA, utilization of the CPG by anesthesia

providers will be monitored and evaluated. Barriers to adaptation of the CPG and problems will also be identified and the implementation of the CPG will be tailored.

Literature Review

A thorough evaluation of findings, supportive data, and recommendation based on the current and best evidence is a crucial step towards developing a clinical practice guideline. This review will begin with a discussion of common postoperative complications found among patients with PH. This will be followed by a discussion of measures that can be taken in order to minimize incidences of postoperative complications and the need for continuation of tailored care that has been started during the preoperative period through postoperative phase. Finally, the review will end with a summary of multidisciplinary evidence based pharmacologic and non-pharmacologic interventions recommended. Performing such a review will also help identify areas where more studies may be required to have a better understanding of PH as well as treatment modalities.

Patients with severe PH may have a relatively uneventful intraoperative course with current anesthetic and operative strategies; however, during the postoperative period, these patients are expected to encounter significantly higher incidences of major complications such as heart failure, prolonged tracheal intubation, and death (Lai, Wang, Lee, Ting, & Liu, 2007). The presence of pulmonary hypertension has been shown to have a significantly negative impact on postoperative outcomes of patients undergoing surgery (Kaw et al., 2010). In particular, the complications of hypoxia, acidosis, hypercarbia, and hypothermia greatly increase patients' risk of having postoperative morbidity and mortality and should be avoided (Teo & Greenhalgh, 2010).

Techniques and strategies that were vigilantly maintained preoperatively and intraoperatively should be carried over to the postoperative period to prevent complications (Teo & Greenhalgh, 2010). For example, targeted drug therapy that consists of the use of synthetic prostacyclin analogues, endothelin receptor antagonists, and phosphodiesterase-5 inhibitors such as sildenafil and tadalafil have been shown to improve exercise tolerance and decrease symptoms in PH patients postoperatively (Pilkington, Taboada, & Martinez, 2015). When a treatment modality consisting of these drugs is started preoperatively and continued through postoperative period, a 43% reduction in mortality has been noted (Strumpher & Jacobsohn, 2011).

Multidisciplinary postoperative assessments and interventions that are geared towards prevention of PH crisis and right ventricular failure should also be practiced. Respiratory failure (60%) and right ventricular failure (50%) are the two most frequent factors for mortality in this patient population (Pilkington, Taboada, & Martinez, 2015). Thus, postoperatively, patients with PH should be closely monitored in the intensive care unit, so that early signs of hemodynamic instabilities and deteriorations will not be missed.

During the immediate postoperative care of patients with PH, priority should be given to preservation of right ventricular function through augmentation of systemic blood pressure and reduction of right ventricular afterload (Hoepfer & Granton, 2011). Use of pharmacologic agents such as norepinephrine may be necessary to assure adequate systemic blood pressure required for coronary perfusion. Reduction of right ventricular afterload through the use of potent pulmonary vasodilators is also crucial in offsetting increased demand on the right ventricle that may lead to right sided heart failure and ultimate cardiovascular collapse.

Management of patients with PH often begins with measures to address underlying causes and symptomatic therapy (Pritts, Ronald, & Pearl, 2010). Postoperatively, administration

of diuretics for volume overload and oxygen to maintain arterial saturation greater than 90% is highly recommended for all PH patients. Coumadin has also been recommended in all patients with idiopathic PH while calcium channel blockers are indicated for patients who have demonstrated a desirable response to acute vasodilator testing.

Finally, Teo and Greenhalgh (2010) emphasize the need for providers to achieve satisfactory postoperative pain management when caring for patients with PH. If adequate analgesia is not provided to patients with pulmonary hypertension, as a physiologic response, catecholamine –induced pulmonary vasoconstriction that can lead to a pulmonary hypertension crisis may arise. Intravenous as well as oral narcotics and analgesics have been used for the management of postoperative pain in patients with PH. Regional anesthesia and utilization of peripheral nerve blocks have also been shown to be effective for the management of postoperative pain in this patient population (Teo & Greenhalgh, 2010). However, the recommendation made by Teo & Greenhalgh (2010) about the use of regional anesthesia is based on expert opinion, and further review of the literature is indicated.

In summary, PH has been found to be an independent risk factor for postoperative complications (Strumpher & Jacobsohn, 2011; Pritts, Ronald, & Pearl, 2010). Morbidity and mortality rates of patients with PH are exceptionally high when they undergo orthopedic procedures (Memtsoudis et al., 2010). The focus on the treatment of patients with PH is on the avoidance of hypoxia, hypothermia, and hypotension postoperatively (Pritts, Ronald, & Pearl, 2010; Pilkington, Taboada, & Martinez, 2015; Hoepfer & Granton, 2011). Initiation or continuation of pharmacologic agents that decrease severity of PH such as synthetic prostacyclin analogues, endothelin receptor antagonists, and phosphodiesterase-5 inhibitors has been shown to enhance positive outcomes (Pilkington, Taboada, & Martinez, 2015; Teo & Greenhalgh,

2010). A systematic and meticulous follow up as well as close hemodynamic status monitoring of patients with PH prior to, during, and after surgery is strongly recommended (Teo & Greenhalgh, 2010; Hoeper & Granton, 2011). Due to certain ethical constraints and the nature of the disease process, most of the publications reviewed are retrospective or prospective reviews or observational studies. Some authors such as Kaw et al. established control groups in their retrospective studies while others utilized data from large national databases and international PH centers in order to improve validity and generalizability of their findings.

Methods

Design, Setting, and Sample

The design for this project is the development and evaluation of a Clinical Practice Guideline (CPG) (see Appendix C). This DNP project will take place in the perioperative setting of a mid-sized community hospital located in the Washington Metropolitan area. There will be three samples in this DNP project. In phase one, the sample will consist of one anesthesiologist (MDA), one certified registered nurse anesthetist (CRNA), and three DNP students project leaders (n=5). In phase two, the sample will include all MDAs and CRNAs providing anesthesia care at the hospital (n=30). In phase three, the sample will include the chief anesthesiologist of the hospital.

Procedures

Stage 1. During the first week of this DNP project development, a team of experts consisting of one MDA and one CRNA will be recruited. Following recruitment of the expert panel, three to four one hour long meeting sessions will be scheduled. Project leaders will email meeting agendas the night before meeting dates. All meetings with team members will take place at the facility based on availability and suitability of time and location. If and when physical

presence at the meetings will not be possible by any member of the team, participation through phone conferencing will occur. Students will take turns in scribing key discussion points and updating the draft CPG after every meeting.

1st meeting. During the first meeting, the expert panel will be supplied with a preliminary draft of the CPG (see Appendix C) and the AGREE II tool (see link in references). A brief description of the AGREE II tool and its relevance to the CPG will be discussed. Team members will then be requested to evaluate the CPG using the AGREE II tool and provide feedbacks at the next meeting. Date and time to the next meeting will be selected.

2nd meeting. During the second meeting, team members will have reviewed the draft CPG using the AGREE II tool and will provide feedbacks. Time and location will be selected for the next meeting.

3rd meeting. Revisions made on the CPG will be discussed with team, and additional feedbacks will be requested from the expert panel. An effective way of presenting the CPG to anesthesia staff will be discussed with the expert panel. Time and location for a fourth meeting will be selected if student leaders and team members recognize the need.

Stage 2. During the second month of the project, the CPG will be presented to anesthesia staff at a staff meeting. The Practitioner Feedback Questionnaire to be completed and handed back prior to end of meeting will be provided to all MDAs and CRNAs (see Appendix D). Suggestions and comments from anesthesia providers on the CPG that will be collected through the survey will be incorporated in the CPG draft.

Stage 3. CPG will be presented to and discussed with the chief anesthesiologist and feedback will be incorporated into the CPG.

Data Collection

Data will be collected through utilization of the Appraisal of Guidelines for Research and Evaluation (AGREE II) tool (Appendix E) and the Practitioner Feedback Questionnaire (PFQ).

The AGREE II tool was developed to address the issue of variability in the quality of practice guidelines, and it is used to evaluate the methods by which guidelines are developed. In doing so, recommendations made by authors through guidelines will be evaluated for validity and reliability. The AGREE II tool is both valid and reliable and it has been used internationally to evaluate guidelines. Construct validity of the AGREE II tool has been tested using three core hypotheses for each of the six domains. It comprises of 23 items that systematically evaluate guidelines based on the following six domains: scope and purpose, stakeholder involvement, rigor of development, clarity of presentation, applicability, and editorial independence. The AGREE II tool is rated based on a 7-point scale (1-strongly disagree to 7- strongly agree). Assessment criteria and relevant considerations for each item are included in the tool. Scores are calculated by individually summing up all the scores in a domain and by scaling the total as a percentage of the maximum possible score for that specific domain. A paper document of the tool will be distributed to team members and all other anesthesia providers at the facility.

The Practitioner Feedback Questionnaire (PFQ) is a tool developed to measure practitioners' assessment of guidelines. Practitioners' belief about the quality of a process in which a guideline is developed is often a strong predictor of guideline use (Brouwers, Graham, Hanna, Cameron, & Browman, 2004). The PFQ has a good construct and internal validity and reliability with Cronbach alpha coefficients ranging from 0.75 to 0.85. The PFQ also utilizes measures such as respondent exclusion following questionnaire answers that are ambiguous or neutral in order to improve internal consistency. The PFQ tool is composed of 23 items that are assessed using a five- point Likert scale (5=strongly agree, 1=strongly disagree). The PFQ tool

will be printed and distributed to anesthesia providers of the facility. A very basic demographic data collection tool with no provider identifiers will be added to the beginning of the PFQ and a descriptive demographic data of anesthesia providers will be gathered.

Data Analysis

Scores from the AGREE II tool will be calculated by individually summing up all the scores in a domain and by scaling the total as a percentage of the maximum possible score for that specific domain.

The AGREE II tool and the PFQ contain questions that are designed to measure a particular trait when collectively analyzed. Data analysis of the interval level data sets obtained from the AGREE II tool and the PFQ will be performed by using the means as indicators of central tendencies and standard deviations for variability. Means or medians for each item across subjects and a total score mean or median for each person will be calculated. Negative item scores will be reverse scored and results will be included in data analysis. Additional data analysis on both data sets will be performed using Pearson's r utilizing Microsoft Excel. The correlation between how anesthesia providers evaluate the CPG and the likelihood that they will use the CPG will be assessed.

Protection of Human Subjects

Proposal will be submitted to the University of Maryland Baltimore (UMB) Institutional Review Board (IRB) for a Non Human Subject Research (NHSR) determination. Proposal will also be submitted to the IRB of the facility at which the CPG will be developed and implemented. In order to protect anonymity of participants, no identifying information will be collected. The demographic data that will be collected, as part of the PFQ will strictly be basic and non-identifiable information pertaining anesthesia providers at the facility. Participation in

the development and evaluation of the CPG will solely be voluntary. Completed AGREE II and PFQ paper documents will be stored in a locked box only accessible to the three DNP student project leaders. When data from paper documents is transferred to a computer for a statistical analysis, the paper forms will be shredded and the computer will be password protected. A timeline for this project is provided as Appendix B.

Results

Table 1. *Quality score for domain one: Scope and Purpose*

Item	Appraiser 2	Appraiser 1	Appraiser 4	Appraiser 3	Item total score
1	5	7	7	6	25
2	6	7	7	2	22
3	6	7	7	7	27
Sum	17	21	21	15	74

Indicating a strong agreement, the highest available score using the AGREE II tool is a seven, while a one is the lowest possible score indicating a strong disagreement. The above listed CPG team appraisers independently rated each of the 23 questions from 1-7. Once every team member had completed their evaluation, the team then reviewed each of the scores anonymously, using the AGREE II website to blind reviewers to each other's scores. Per the specifications of the AGREE II tool users manual , the overall domain score is calculated by finding the maximum possible score for the domain (max score of 7 x 3 questions in domain one X 4 appraisers) and subtracting the minimum possible score of the domain (Minimum score 1 x 3 questions in domain one x 4 appraisers)

$$84-12=72$$

This number is then used as a dividend and the actual obtained score is subtracted from the minimum possible score as the divisor. The domain score is reported as a scaled percentage.

$$(74-12=62)/72 \times 100= 86\%$$

The quality score was calculated for each of the six domains and the results are displayed as a scaled percentage.

Table 2. *AGREE II Domain Scores*

	Scope and Purpose	Stakeholder involvement	Rigor of development	Clarity and Presentation	Applicability	Editorial Independence	Overall assessment
Mean	6.16	6.5	5.78	6.08	4.63	7	5.25
SD	1.46	1.45	1.34	1.49	1.67	0	1.56
95%CI	(3.29-9.04)	4.31-8.6)	(4.27-7.28)	(3.23-8.93)	(2.06-7.19)	(7)	(1.37-9.31)
Guideline Scores %	86	92	80	85	60	100	71 Recommended with modifications

Scope and Purpose

The domain Scope and Purpose consists of three questions that evaluate:

1. Principal goal of the guideline
2. The health questions the guideline addresses
3. The target group for which the guideline is intended.

The mean score for this domain was 6.16 SD1.46. The four appraisers rated each item from 1 to 7 as shown in table one. Two of the appraisers gave each of the questions in this section the highest possible score of seven, while the other two appraisers assigned lower values. Overall, the domain scored 86% indicating that fundamental objectives of the guideline were well described.

Stakeholder Involvement

This domain includes three questions that evaluate:

1. If the guideline has clearly specified its target users
2. If the views of the target population have been sought
3. If all pertinent groups have been consulted in the making of the guideline.

The score for this domain was high with a mean of 6.5 SD1.45. Most appraisers rated the three questions in this section a 7 out of 7. The sixth question, which assesses the target users of the guideline, was rated the highest, with every appraiser reflecting a strong agreement. Overall score of this domain was 92%. A significant level of agreement was noted among the appraisers that the CPG adequately describes the target population and intended users, and has satisfactorily addressed patient preferences.

Rigor of Development

This domain consists of seven questions that analyze:

1. The thoroughness of guidelines development
2. The procedure for guideline data collection & recommendations
3. Outline the procedure for updates to the guideline.

The mean score for this domain was 5.78 SD1.34. A relatively wide range of scores were assigned to this domain, the lowest score for this section was given to question (14) which inquires about a procedure for updating the guideline. Scoring only 80%, this domain has one of the lowest domain scores which in turn is suggestive of a room for improvement.

Clarity and Presentation

This domain consists of three questions that evaluate the format and overall presentation of the guideline. The mean score for the domain was 6.08 SD1.49. The majority of the questions in the domain were rated as a seven. The lowest score in this domain was given to the ability to identify key recommendations. An overall score of 85% was given to this domain.

Applicability

This domain covers four questions relative to the resources, barriers, and facilitators of guideline implementation. There was a relatively significant level of disagreement among appraisers in this section that was reflected in the overall score of the domain. The mean for this domain was 4.63 SD1.67. One appraiser scored all of the questions as a 1 while other appraisers gave scores between 3 and 7. The domain score for this section was 60%.

Editorial Independence

This domain consists of two questions to evaluate competing interests of the guideline developers. This was the highest score of the domains, with 100% agreement between appraisers. The mean for this domain was 7 indicating that there is no conflict of interest for the guideline developers.

Overall Assessment

This domain has appraisers choose a total score for the guideline then state if they believe the guidelines should be recommended for practice. The mean for this domain was 5.25 SD1.56 with all four appraisers stating the guidelines should be used for practice, although some appraisers indicated the need for guideline modifications before implementation. The overall score for this domain was 71%

Demographic Data

The proposed sample size for stage two of guideline development was n=30. This number was determined by guideline developers to be an adequate reflection of anesthesia providers within this hospital setting. However, actual response rates for the PFQ survey was lower than the originally targeted number. Soon after presentation of the CPG in stage two of project development, a total of 19 surveys were collected. Additional surveys were left with copies of

the guideline and presentation in the anesthesia break room, for a period of one week in an attempt to collect additional data. However, no additional data was received. Therefore the new sample size was made n=19. Each PFQ survey included questions about baseline demographic characteristics such as; age, gender, ethnicity, years worked at institution, and the providers' role within the anesthesia group. Table three lists how practitioners were grouped according to different categories.

Table 3. *Frequency Distribution of Participant Demographics from Practitioner Feedback Survey*

Variables	n	%
Age		
20-30	4	21.1
30-40	8	42.1
40-50	3	15.8
50-60	3	15.8
60-70	1	5.3
Gender		
Male	9	47.4
Female	10	52.6
Participant's Role		
CRNA	9	47.4
SRNA	5	26.3
MDA	5	26.3
Ethnicity		
AA	3	16.7
Caucasian	12	66.7
Other	3	16.7
Missing	1	5.6
Years Practicing in Role		
<5	7	38.9
5-10	5	27.8
10-15	2	11.1
15-20	0	0
20-25	2	11.1
>25	2	13.3
Missing	1	5.6
Years Practicing at Facility		
<5	9	50.0
5-10	7	38.9
10-15	1	5.6
15-20	0	0
20-25	0	0
>25	1	5.6
Missing	1	5.6

Note. Table displays the demographic characteristics of the sample (n=19). Three variables (Ethnicity, Years practicing in role and Year practicing at facility) used n=18 due to missing data within PFQ dataset. AA = African American; CRNA = Certified Registered Nurse Anesthetist; SRNA = Student Registered Nurse Anesthetist; MDA = Anesthesiologist

From a total of 19 practitioners surveyed, there were a total of 5 SRNAs, 5 MDAs, and 9 CRNAs. A fairly even distribution of male (47%) and female (52%) providers completed the survey. The majority of providers (37%) had less than 5 years of experience practicing anesthesia. A large majority (63%) of respondents identified themselves as Caucasian, (16%) described themselves as African American, and (20%) of the sample chose to identify themselves as other or left the response blank. One of the practitioners only provided a demographic data and failed to complete the survey in its entirety reducing the total sample size used in the calculations of PFQ data to (n=18). Included in the total number of respondents were PFQ surveys completed by members of the guideline development team. 21% (n=4) of the sample was involved in the guideline development.

Practitioners were requested for opinions on CPG draft through use of the PFQ. The practitioner feedback questionnaire attempts to assess the respondents' perception as well as the likelihood of the anesthesia providers incorporating the CPG in to their practice while also assessing the guidelines ability to meet a clinical need. Table four lists responses to 18 of the 23 items asked in the PFQ. The table reflects the number of providers who either Agree or Strongly Agree with each of the questions. The overall mean score for each question is listed.

Table 4. *Practitioner Feedback Questionnaire - Summary of Agreement*

Survey Item	Percentage of Agreement (%)	Mean (SD)
2.The rationale for developing a guideline is clear.	88	4.5 +/-1.06
3.There is a need for a guideline on this topic.	88	4.6+/-1.04
4.The literature search is relevant and complete (e.g., no key evidence was missed nor any included that should not have been) in this draft guideline	77	4.1+/-1.09
5. I agree with the methodology used to summarize the evidence	77	4.4+/-1.15

included in this draft guideline.		
6.The results of the evidence described in this draft guideline are interpreted according to my understanding of the evidence.	77	4.3+/-1.13
7.The draft recommendations in this report are clear.	72	3.9+/-1.09
8. I agree with the draft recommendations as stated.	88	4.3+/-1.05
9.The draft recommendations are suitable for the patients for whom they are intended.	83	4.3+/-1.07
11.When applied, the draft recommendations will produce more benefits for patients than harms.	88	4.3+/-1.05
12.The draft guideline presents options that will be acceptable to patients.	77	3.8+/-0.99
16. The draft guideline recommendations are likely to be supported by a majority of my colleagues.	83	4.1+/-1.06
17. If I follow the draft guideline recommendations, the expected effects on patient outcomes will be obvious.	72	3.9+/-1.10
18. The draft guideline recommendations reflect a more effective approach for improving patient outcomes than is current usual practice.	83	4.3+/-1.11
19.When applied, the draft guideline recommendations will result in better use of resources than current usual practice.	88	4.3+/-1.05
20. I would feel comfortable if my patients received the care recommended in the draft guideline.	83	4.2+/-1.05
21.This draft guideline should be approved as a practice guideline.	77	4.2+/-1.12
22. If this draft guideline were to be approved as a practice guideline, I would use it in my own practice.	88	4.3+/-1.05
23. If this draft guideline were to be approved as a practice guideline, I would apply the recommendations to my patients.	88	4.3+/-1.05
Mean Approval rating/score	82	4.3+/-0.60

*Questions # 10, 13, 14, 15 were not included in the dataset because they require reverse scoring.

**Question one was also omitted due to the fact that it was not rated on a Likert Scale

From the data collected, agreement or strong agreement was shown 88% of the times when practitioners were questioned about the rationale for guideline development, the need for a guideline, or agreement with guideline content. An equally positive response was noted when providers were asked if guideline use could improve clinical practice. The approval rates for the methodology, literature search, and unaltered guideline draft received a 78% approval rating.

Written comments occurred in 27% of respondents, and most involved encouraging comments for the CPG development group guideline development.

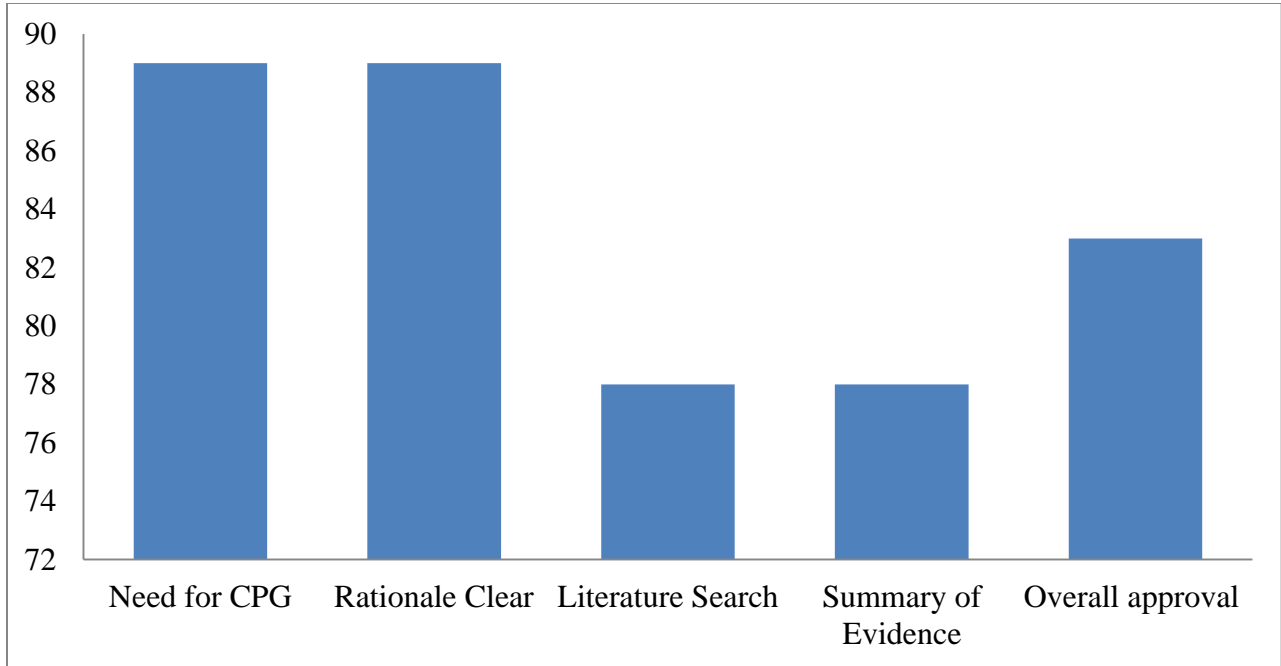


Figure 1.0 Percentage of Quality rating for CPG

Discussion

A needs assessment conducted at a midsized community hospital located in the Washington Metropolitan area that revealed the necessity of developing and implementing a clinical practice guideline to be used by anesthesia providers of the facility gave birth to this DNP scholarly project. In order to facilitate the knowledge creation and translation of current and evidence-based recommendations into practice, a theoretical framework, namely the knowledge to action framework (KTA), has been utilized. The KTA framework facilitated the process in which PH was evaluated as a significant disease affecting patient outcomes.

The need for the midsized community hospital to adapt and implement a thorough preoperative methodology through which patients with PH presenting for surgery are well evaluated, classified, and optimized prior to surgery has been emphasized. Initiation of cardiac and pulmonary consults in a reasonable period of time prior to patients' arrival for scheduled procedures has been agreed upon to be instrumental in avoiding last minute case cancellations and unforeseen delays of patients from receiving care they require. It is also believed that early preoperative multidisciplinary involvement and determination of the facility's capability of delivering safe and effective care to patients with PH will facilitate the process in which patients with severe PH who will require advanced treatment modalities will be rerouted to larger facilities with the resources to do so.

In line with preoperative preparations, measures to be executed during the intraoperative phase have been outlined. Initiation or continuation of pharmacologic treatments shown to optimize patients' status and enable them to withstand the bio physiological stress that maybe induced by surgical interventions is highly advised during the intraoperative and postoperative phases. Throughout the literature, pulmonary hypertension has been identified as an independent

risk factor for perioperative complications including but not limited to respiratory failure, right-sided heart failure as well as death.

Following recommendations of several evidence based practice models and studies, a clinical practice guideline that puts the facility's limitations has been developed and presented to anesthesiologists, CRNAs, and other important stakeholders of the facility during various occasions. Feedback and recommendations from providers and stakeholders have been incorporated in to the clinical practice guideline. In order to assess the quality and rigor of the development of the clinical practice guideline and evaluate the likelihood of anesthesia providers incorporating the clinical practice guideline in to their everyday practice, the AGREE II guideline evaluation tool and the practitioners' feedback questionnaire have been utilized. Results from both tools are suggestive of the satisfactory quality of the clinical practice guideline and a high likelihood of anesthesia providers adherence to the recommendations outlined. It is anticipated that, following implementation of the clinical practice guideline and operationalization of recommendations included, the facility will be better equipped to care for patients with pulmonary hypertension undergoing surgery and reduce perioperative complications significantly. It is also anticipated that the number of last minute case cancellations will decrease following perioperative measures based on the clinical practice guideline's recommendations.

Patients with PH are often counseled against having surgical procedures that are considered elective due to numerous reports stating that early and sudden postoperative deaths have been noted. Patients with PH are unable to tolerate physiologic alterations that may result changes in right ventricular preload or afterload due to fluid shifts, hypoxia, hypercapnia, or stress induced by surgical interventions. Systemic hypotension will further precipitate right

ventricular ischemia and markedly decreased right ventricular function leading to right sided heart failure.

Perioperative care of patients with PH should be guided by interventions that avoid systemic hypotension while avoiding acute elevations in pulmonary arterial pressure. Safe and effective anesthetic management is dependent on understanding of pathophysiology and avoidance of a pulmonary hypertension crisis.

In order to enable anesthesia provider of the facility guide their practice with current and evidence based recommendations and supply them with a document to be used in tailoring care provided at the facility, a final version of the CPG has been placed in the anesthesia workroom as hard copy and in folders created on two workstation computers. It has been noted that CRNAs and MDAs have been utilizing the document provided during in-services and morbidity and mortality (M&M) department meetings.

Conclusion

Complications and major adverse outcomes involving patients with PH undergoing surgery during the perioperative period have been well documented in the literature. Appropriate preoperative optimization and symptom management of patients with PH has been associated with improved outcomes. A multidisciplinary effort that is patient centered and effective will be instrumental in triggering consults and wide array of bio-physiologic tests as well as pharmacologic treatments geared towards patient optimization. An effective preoperative screening will also avoid last minute cancellation of surgical procedures by anesthesia providers in light of patients' PH symptoms that were not well investigated. Avoidance of last minute case cancellations will in turn allow the facility to allocate resources appropriately and assure better workflow while reducing incidences of delays of patients receiving surgical care. During the

preoperative period anxiety, pain, over sedation, hypoventilation, and sympathetic stimulation should be avoided.

During the intraoperative period, use of appropriate invasive monitors, providing adequate anesthesia, and delivery of higher level of oxygen concentration is recommended. Intraoperative hypotension must be treated aggressively. Sinus rhythm with normal rates optimizes right ventricular function.

Poorly managed pain and prolonged shivering should be avoided during the postoperative period. Close monitoring of post surgery patients in the intensive care unit is required due to the significant risk that patients can go in to a pulmonary hypertension crisis once intraoperative medications that help optimize their care are eliminated from the body.

Pulmonary hypertension has been found to be an independent risk factor for postoperative complications (Strumpher & Jacobsohn, 2011; Pritts, Ronald, & Pearl, 2010). Morbidity and mortality rates of patients with PH are exceptionally high when they undergo orthopedic procedures (Memtsoudis et al., 2010). The focus on the treatment of patients with PH is on the avoidance of hypoxia, hypothermia, and hypotension postoperatively (Pritts, Ronald, & Pearl, 2010; Pilkington, Taboada, & Martinez, 2015; Hoeper & Granton, 2011). Initiation or continuation of pharmacologic agents that decrease severity of PH such as synthetic prostacyclin analogues, endothelin receptor antagonists, and phosphodiesterase-5 inhibitors has been shown to enhance positive outcomes (Pilkington, Taboada, & Martinez, 2015; Teo & Greenhalgh, 2010). A systematic and meticulous follow up as well as close hemodynamic status monitoring of patients with PH prior to, during, and after surgery is strongly recommended (Teo & Greenhalgh, 2010; Hoeper & Granton, 2011).

Future plans and recommendations

In an attempt to fulfill a request of having a short and brief document that can be utilized as a workable document, an algorithm containing major evidence based recommendations of the CPG will be generated and supplied to the anesthesia providers of the facility. Anesthesiologists and CRNAs will be advised to refer to the CPG and other supporting resources when indicated. Due to the increasing incidence of PH nationwide and growing number of patients with PH presenting to this facility for surgical procedures, further investigation of best practice models and recommendations will be required in order to enable anesthesia providers of the facility deliver a safer and efficient care that puts the hospitals limitations in to account.

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Appendix A

Evidence Review

Author, year	Study objective/intervention or exposures compared	Design	Sample (N)	Outcomes studied (how measured)	Results	*Level and Quality Rating
Kaw, Pasupuleti, Deshpande, Hamieh, Walker, & Minai, 2010	To assess perioperative risks associated with pulmonary hypertension patient undergoing non-cardiac surgery	Controlled retrospective study	Patients with pulmonary hypertension undergoing non-cardiac surgery (n=173)	Perioperative complications such as hemodynamic instability, infections, respiratory failure and prolonged ventilator support requirements were evaluated.	In addition to presence of traditionally identified risk factors for outcomes following non-cardiac surgery, presence of pulmonary hypertension can have a significant impact on perioperative outcomes. ($p=0.002$)	4 A
Memtsoudis, Ma, Chiu, Walz, Voswinckel, & Mazumdar, 2010	To assess the risk of mortality and morbidity for patients with pulmonary hypertension undergoing total knee arthroplasty and total hip arthroplasty	Retrospective review of a large national database (the National Inpatient Sample NIS)	Patients with pulmonary hypertension undergoing a total knee arthroplasty or total hip arthroplasty (n=2184) for total knee arthroplasty and (n=1359) for total hip	Mortality rates following the orthopedic surgeries forementioned	Patients with pulmonary hypertension undergoing total hip arthroplasty experienced approximately 4-fold increased risk or mortality and those undergoing total knee arthroplasty experienced a 4.5-fold increased mortality compared to patients without pulmonary hypertension ($p=0.001$)	4 A

			arthroplasty			
Meyer, McLaughlin, Seyfarth, Bull, Vizza, Maitland, Preston, Barbera, Hassoun, Halank, & Jais, 2013	An international multi-center evaluation of outcomes after non-cardiac surgery in patients with pulmonary hypertension	International prospective multicenter questionnaire-based survey study	Patients with pulmonary hypertension undergoing surgery at various international pulmonary hypertension centers (n=114)	Morbidity and mortality rates following non-cardiac surgeries in patients with pulmonary hypertension	Major perioperative complications occurred in 6.1% of patients. Four patients died. In emergency procedures the mortality rate was noted to be 15%, $p=0.01$. Major surgery in patients with pulmonary hypertension continues to be a high-risk procedure, most importantly when emergency surgical procedures are needed	6 A
Pilkington, Taboada, & Martinez, 2015.	To explore interventions and outcomes of patients with pulmonary hypertension undergoing non-cardiac surgery	An integrated literature review	Patient with pulmonary hypertension undergoing non-cardiac surgery (n=145, 21, 62, 28, 3543, 96)	Improved perioperative outcomes of patients with pulmonary hypertension	Availability of new treatment modalities have resulted in improved survival rates. A multidisciplinary approach of PH has been shown to yield good results	4 B
Price, Montani, Jais, Dick, Simonneau, Sitbon, Mercier, & Humbert, 2010	To evaluate incidence of perioperative morbidity and mortality in pulmonary hypertension population despite optimal management	Retrospective study with no control	Patients with pulmonary hypertension undergoing major (57%) and minor surgery under general and regional anesthesia (n=28)	The numbers of patients who have developed perioperative complications despite optimal care modalities have been analyzed.	Perioperative complications occurred in 29% of patients and in 17% of those with no deaths during scheduled cases. 92% of the complications occurred during the first 48 hours following surgery.	5 B

<p>Pritts & Pearl, 2010</p>	<p>To outline appropriate classifications of pulmonary hypertension and understand most relevant treatment modalities to each type</p>	<p>Descriptive study</p>	<p>Not applicable</p>	<p>The Fourth World Symposium defined pulmonary hypertension as a mean pulmonary artery pressure (mPAP) >25mmhg at rest and >30 during exercise. This symposium also introduced five classifications of pulmonary hypertension.</p>	<p>The five clinical classifications of pulmonary hypertension are 1) Pulmonary arterial hypertension 2) Pulmonary hypertension owing to left heart disease 3) Pulmonary hypertension owing to lung disease or hypoxia 4) Chronic thromboembolic pulmonary hypertension 5) Pulmonary hypertension with unclear multifactorial mechanisms.</p> <p>Pulmonary hypertension occurs in a familial context (50-90%)</p> <p>Forty three percent reduction in mortality has been noted in patients with pulmonary hypertension during randomized controlled trials of prostanoids, endothelin-receptor blockers, and PDE-5 inhibitors</p>	<p>5 A</p>
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Appendix B

Timeline

- ✓ April 2016-Submit Proposal to committee members
- ✓ May 2016-present CPG to committee members for approval
- ✓ May-June 2016 – Submit CPG proposal to UMB and hospital IRB determination
- ✓ Implement project from September 2016- December 2016
 - September 2016- Develop CPG with team members
 - October 2016- present CPG to anesthesia providers
 - November 2016 – Submit CPG to administrator for approval
- ✓ March 2017- Analyze, synthesize, and evaluate data and submit a final scholarly project manuscript to committee for review
- ✓ Prior to April 17, 2017 –present final scholarly project to committee

Appendix C

Guideline Title: Clinical Practice Guidelines for the Anesthetic Management of Patients with Pulmonary Hypertension

Guideline Status: Guideline developed in 2016

Scope

Disease/Condition(s): Confirmed Pulmonary Hypertension

Guideline Category Preoperative evaluation and risk assessment, Intraoperative Management, Postoperative care

Clinical Specialty: Anesthesiology

Intended Users: Nurse Anesthetists and Anesthesiologists within St Agnes Hospital

Guideline Objective

To reduce the risk of adverse outcomes in pulmonary hypertension patients by improving the perioperative management of adult patients with pulmonary hypertension who receive anesthesia services from providers at St Agnes Hospital

Target Population

Patients with confirmed Pulmonary Hypertension (PH) (as diagnosed by right heart catheterization) who are at increased risk of perioperative morbidity and mortality due to the physiologic alterations of the disease. This population includes patients who have a Pulmonary Hypertension diagnosis in WHO classification Groups 1- 5

Note: These guidelines do not focus on patients with the following conditions: Eisenmenger syndrome, Obstetrics, Cardiac Surgery, Pediatric population

Major Outcomes Considered

Risk of adverse outcomes in patients with Pulmonary Hypertension (PH) such as:

- Right sided heart failure
- Respiratory arrest
- Hypoxemic events
- Sepsis
- Unexpected intensive care unit admission
- Acute congestive heart failure

- Intraoperative hemodynamic instability/ abortion of surgical procedure,
- Renal failure
- Myocardial infarction
- Hemodynamic collapse

Methodology

Description of Methods Used to Collect/Select the Evidence: Evidence used in the development of these guidelines is based on an extensive literature review. Literature citations are obtained from PubMed, One Search, CINHALL, EBSCO, and Medline

State of the Literature: A literature review of published studies from 2005-2015 was conducted, the focus of the search were articles related to the perioperative management of patients with pulmonary hypertension. A total of 13 articles contained direct linkage-related evidence were used in this review.

Limitations: The evidence lacked well-defined experimental designs or randomized controlled trials. A complete bibliography used to develop these Guidelines, is described below

Methods Used to Assess the Quality and Strength of the Evidence

Rating Scheme for the Strength of the Evidence: (Melnik & Fineout-Overholt, 2011)

Quality Rating Scheme: (Newhouse et al, 2007)

Methods Used to Formulate the Recommendations

The guidelines were developed by a Task Force of 4 members, consisting of anesthesiologists, and Registered Nurses. The Task Force developed the guidelines by means of a staged model. In the first stage sources of evidence were acquired via literature review, and the evidence was graded using Melnik & Fineout-Overholt. A literature review table is included (see *appendix A*). A team of stakeholders then drafted guidelines based on the available evidence. After drafting guidelines, the task force used the AGREE II tool to evaluate the CPG. The second stage consisted of feedback from practitioners at St. Agnes, who were asked to review and comment on a draft of the guidelines developed by the Task Force via a modified practitioner feedback survey (see *appendix D*). The multidisciplinary team then revised guidelines, determined barriers to implementation and submitted the guideline to administration for review. After administrator feedback, the guideline was once again revised, and submitted for final approval.

Description of Method of Guideline Validation

The validity of the AGREE II tool and Brower's 2004, Clinicians' assessments of practice guidelines in oncology is well established. The AGREE tool was updated to the AGREE II tool in 2013 to maintain reliability and validity (Brouwers, et al. 2010). The AGREE II tool consists of 23 items within 6 quality domains; each domain focuses on a specific feature of a clinical practice guideline (Brouwers, et al. 2010). The internal consistency measurement of the six

domains demonstrated the reliability of the AGREE II tool with a Chronbach alpha score ranging from 0.64 to 0.89 (Brouwer et al., 2010a).

Major Recommendations

I. Preoperative Evaluation

- The anesthesia provider should work with surgeons to develop a protocol whereby patients who are clinically suspected to have Pulmonary Hypertension, are evaluated before the day of surgery to allow preparation of a perioperative management plan.
 - This evaluation may be initiated in a pre-anesthesia clinic (if available) or by direct consultation from the operating surgeon to the anesthesiologist.
- A preoperative evaluation should include a comprehensive review of previous medical records (if available), an interview with the patient and/or family, and conducting a physical examination.
 - Medical records review should include (but not be limited to) checking for a history of dyspnea, cardiovascular problems especially CAD and PE, CKD, and other congenital or acquired medical conditions.
 - The patient and family interview should include focused questions related to symptoms, METS, exercise tolerance, how previous surgeries were tolerated
 - A physical examination should include an evaluation of lungs, heart, kidneys, and vascular system functionality
 - I. Assess for episodes of chest pain, arrhythmia, syncope, shortness of breath, haemoptysis, enlarged jugular veins, edema and their medication compliance
- If any characteristics noted during the preoperative evaluation suggest that the patient has PH, the anesthesia provider and surgeon should jointly decide whether to (1) manage the patient perioperatively based on clinical criteria alone or (2) obtain further studies, conduct a more extensive examination, and initiate the indicated PH treatment in advance of surgery.
- If the preoperative evaluation does not occur until the day of surgery, the surgeon and the anesthesia care team together may elect for presumptive management based on clinical criteria or a last-minute delay of surgery.
- The severity of the patient's PH, the invasiveness of the diagnostic or therapeutic procedure, and the requirement for postoperative analgesics should be taken into account in determining whether a patient is at an increased perioperative risk from their underlying PH
- The patient and his or her family as well as the surgeon should be informed of the potential implications of PH on the patient's perioperative course.

III. Preoperative Preparation and optimization

- Multidisciplinary team approach
- Evaluate the patients need for surgery, assess risks and benefits
- Detailed history and physical
- Preoperative testing should include:
 - Laboratory blood tests: complete blood count, comprehensive metabolic panel, coagulation studies, B-type natriuretic peptide (if available)
 - Electrocardiogram
 - Echocardiogram: there is no strong evidence to support when this needs to be done before surgery, however the practitioner should obtain the most recent report on the patient's ejection fraction
 - RHC in patients with RVF signs and symptoms
- Risk assessment for 1-year mortality in PAH:
 - Low risk (< 5%): NYHA functional class I or II, reports no syncope episodes, 6MWD >440m, RA area <18cm², no pericardial effusions, RAP <8mmHg, CI >2.5 l/min/m², SvO₂>65%
 - Intermediate risk (5-10%): NYHA functional class III, reports occasional syncope, 6MWD 165-440m, RA area 18-26cm², non to minimal pericardial effusion, RAP 8-14mmHg, CI 2.0-2.4 l/min/m², SvO₂ 60-65%
 - High risk (>10%): NYHA functional class IV, reports repeated syncope episode, 6MWD <165 m, RA area >65cm² and pericardial effusion, REP >14mmHg, CI <2.0 l/min/m², SvO₂ <60%
- Strong indicators of function and prognosis of RV are: RA pressure, cardiac index, and mixed venous oxygen saturation
- Evaluation patient's 6MWT, if available, to assess exercise capacity

IV. Intraoperative Management

- Due to the fragility of the PH population and the heightened surgical risk all anesthetic goals should focus on the maintenance of right ventricular function and avoidance of PH crises.
- Regardless of type of anesthetic used, the practitioner should uphold the following principles: Maintain SVR, Prevent an increase in PVR, Avoid hypoxemia, hypercapnia, acidosis, fluid overload and pain.
- Because of their propensity for hemodynamic collapse and right sided heart failure, patients at increased perioperative risk from PH are especially susceptible to the respiratory depressant and airway effects of sedatives, opioids, and inhaled anesthetics; therefore, the potential for postoperative respiratory compromise, and subsequent increased PVR, should be considered in selecting intraoperative medications. The anesthesia provider should maintain a judicious use of benzodiazepines and opioids during the procedure

- There is no strong evidence to support one type of anesthetic has an influence on morbidity and mortality, any approach may be used as long as hemodynamic instability is avoided and rapidly recognized
- For superficial procedures, consider the use of local anesthesia or peripheral nerve blocks, with or without MAC. If MAC is used, ventilation should be continuously monitored by Capnography, because hypercapnia must be avoided in these patients.
- General anesthesia with a secure airway is preferable to deep MAC sedation without a secure airway, particularly for procedures that may compromise the airway.
- For general anesthesia, the sympathetic response to direct laryngoscopy must be avoided and depth of anesthesia should be adequate before airway instrumentation is attempted.
- Consideration for an awake Fiberoptic intubation must be weighed against the possibility of avoiding a period of hypoxia or poor ventilation
- Etomidate and Ketamine are preferable to Propofol as induction agents in that they preserve SVR with little effect on PVR
- Of all the inhalation agents Nitrous Oxide causes the greatest increase in PVR this drug should be avoided in the PH population
- Neuraxial anesthesia (spinal/epidural) should be considered for peripheral procedures, but the sympathectomy associated with neuraxial anesthesia must be avoided.
- No recommendations consistently support the use of an arterial line, central line or a SWAN GANZ catheter; however, these may be beneficial in higher risk procedure. Specifically, invasive arterial monitoring allows the anesthesia provider to quickly recognize hemodynamic changes, and allows access to frequent arterial blood gas monitoring.
- Intraoperative trans-esophageal echocardiography should be considered for guiding fluid management in patients with severe PH. Fluid overload must be avoided in this population as it can propensities right sided heart failure.
- Sympathomimetic vasopressors may be necessary to maintain adequate SVR
- Epinephrine, dobutamine, norepinephrine, and levosimendan have been shown effective in the treatment of right sided heart failure.
- In the face of acute decompensation, measures should be taken to reduce PVR.
- The use of inhaled nitric oxide, prostacyclin, or parenteral sildenafil should be used to acutely reduce PVR.
- Inhaled agents combined with intravenous inotropes may be more beneficial than either class of medication used alone.

- If pharmacologic management is not adequate to maintain hemodynamics then a surgically implanted device, such as an intra-aortic balloon pump, or left ventricular assist device for hemodynamic support should be considered.
- Full reversal of neuromuscular block should be verified before extubation, to ensure the patient has full and adequate use of the diaphragm. Reduced muscular function may cause hypercapnia, hypoxia and acidosis and precipitate right sided heart failure

V. Postoperative Management

- Regional analgesic techniques or other pain management modalities such as a patient controlled analgesia (PCA) should be considered for post operative pain control
- If patient-controlled systemic opioids are used, continuous background infusions should be avoided or used with extreme caution, avoid respiratory depression
- Supplemental oxygen should be administered continuously to all patients who are at increased perioperative risk from PH until they are able to maintain their baseline oxygen saturation while breathing room air. .
- If possible, patients at increased perioperative risk from PH should be placed in the intensive care unit for close monitoring where early signs of hemodynamic instabilities will be recognized and acted up on.
- Hospitalized patients who are at increased risk of respiratory compromise from PH should have continuous pulse oximetry monitoring after discharge from the recovery room.
- If frequent or severe airway obstruction or hypoxemia occurs during postoperative monitoring, initiation of nasal CPAP or noninvasive positive pressure ventilation should be considered.
- Pharmacological treatments that pulmonary hypertension patients were on preoperatively should be continued during the postoperative phase
 - Prostacyclin analogues
 - Endothelin receptor antagonists
 - Phosphodiesterase-5 inhibitors (Sildenafil, Tadalafil)

Clinical Algorithm(s) : Pending

Evidence Supporting the Recommendations : narrative reviews, retrospective cohort studies, and opinion-based evidence (see bibliography)

Benefits/Harms of Implementing the Guideline Recommendations: The potential benefits of implementing this CPG include: improved perioperative care and reduced risk of perioperative morbidity and mortality in patients with PH who receive anesthesia services from providers at St

Agnes Hospital

Potential Harms: None indicated

Qualifying Statements : Practice guidelines recommendations based off of evidence that the practitioner may use to guide decisions about health care. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints, and are not intended to replace local institutional policies.

Source(s) of Funding : None

Identifying Information

Guideline Committee: Task Force on Perioperative Anesthetic Management of Patients with Pulmonary Hypertension

Task Force Members: Amlakie Gebeyehu, Katy Woods, Jessica Naper, Dr. Richard Muwowo

Project Chair : Joseph E. Pellegrini, PhD, CRNA, FAAN

Financial Disclosures/Conflicts of Interest: The authors declare no competing interests.

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doi:10.1097/EJA.0b013e328335474e

Appendix D

Modified Practitioner Feedback Questionnaire

For each item, please check off the box that most adequately reflects your opinion.

Please list demographic data			
Age 20-30 30-40 40-50 50-60 60-70	Ethnicity AA CAUC OTHER	Years practiced in current role	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<5 5-10 10-15 15-20 20-25 >25	
		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
CRNA MDA	Gender Male Female	Years at current hospital	
<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<5 5-10 10-15 15-20 20-25 >25	
		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	

1. Are you responsible for the care of patients for whom this draft guideline report is relevant? This may include the referral, diagnosis, treatment, or follow-up of patients.	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unsure <input type="checkbox"/>		
If you answered “No” or “Unsure”, there is no need to answer or return this questionnaire. If you answered “Yes”, please answer the questions below and return to [enter expected destination of surveys] .					
(1=Strongly Disagree - 5= Strongly Agree)	1	2	3	4	5
2. The rationale for developing a guideline is clear.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. There is a need for a guideline on this topic.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. The literature search is relevant and complete (e.g., no key evidence was missed nor any included that should not have been) in this draft guideline.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I agree with the methodology used to summarize the evidence included in this draft guideline.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. The results of the evidence described in this draft guideline are interpreted according to my understanding of the evidence.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. The draft recommendations in this report are clear.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I agree with the draft recommendations as stated.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. The draft recommendations are suitable for the patients for whom they are intended.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. The draft recommendations are too rigid to apply to individual patients.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. When applied, the draft recommendations will produce more benefits for patients than harms.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. The draft guideline presents options that will be acceptable to patients.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. To apply the draft recommendations will require reorganization of services/care in my practice setting.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. To apply the draft guideline recommendations will be technically challenging.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. The draft guideline recommendations are too expensive to apply.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. The draft guideline recommendations are likely to be supported by a majority of my colleagues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17. If I follow the draft guideline recommendations, the expected effects on patient outcomes will be obvious.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. The draft guideline recommendations reflect a more effective approach for improving patient outcomes than is current usual practice. (If they are the same as current practice, please tick NA). NA <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. When applied, the draft guideline recommendations will result in better use of resources than current usual practice. (If they are the same as current practice, please tick NA). NA <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. I would feel comfortable if my patients received the care recommended in the draft guideline.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. This draft guideline should be approved as a practice guideline.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. If this draft guideline were to be approved as a practice guideline, I would use it in my own practice.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. If this draft guideline were to be approved as a practice guideline, I would apply the recommendations to my patients.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Adapted from: Brouwers, M.C., Graham, I.D., Hanna, S.E., Cameron, D.A., & Browman, G.P. (2004). Clinicians' assessments of practice guidelines in oncology: The CAPGO survey. *International Journal of Technology Assessment in Health Care*, 20(4), 421-6.

Appendix E

Agree II Tool

Appraisal of Guidelines for Research & Evaluation II

DOMAIN 1. SCOPE AND PURPOSE

1. The overall objective(s) of the guideline is (are) specifically described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

2. The health question(s) covered by the guideline is (are) specifically described

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
---------------------------	---	---	---	---	---	------------------------

Comments

DOMAIN 2. STAKEHOLDER INVOLVEMENT

4. The guideline development group includes individuals from all relevant professional groups

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
---------------------------	---	---	---	---	---	------------------------

Comments

5. The views and preferences of the target population (patient, public, etc.) have been sought.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
---------------------------	---	---	---	---	---	------------------------

Comments

6. The target users of the guideline are clearly identified.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

DOMAIN 3. RIGOUR OF DEVELOPMENT

7. Systematic methods were used to search for evidence.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

8. The criteria for selecting the evidence are clearly described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

9. The strengths and limitations of the body of evidence are clearly described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

10. The methods for formulating the recommendations are clearly described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

11. The health benefits, side effects, and risk have been considered in formulating the recommendations.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

12. There is an explicit link between the recommendations and the supporting evidence.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

13. The guideline has been externally reviewed by experts prior to its publication.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

14. A procedure for updating the guideline is provided.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

DOMAIN 4. CLARITY OF PRESENTATION

15. The recommendations are specific and unambiguous.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
---------------------------	---	---	---	---	---	------------------------

Comments

16. The different options for management of the condition or health issue are clearly presented.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

17. Key recommendations are easily identifiable.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

DOMAIN 5. APPLICABILITY

18. The guideline describes facilitators and barriers to application.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

19. The guideline provides advice and/or tools on how the recommendation can be put into practice.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

20. The potential resource implications of applying the recommendations have been considered.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

21. The guideline presents monitoring and/or auditing criteria.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

DOMAIN 6. EDITORIAL INDEPENDENCE

22. The views of the funding body have not influenced the content of the guideline.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
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Comments

23. Competing interests of guideline development group members have been recorded and addressed.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
---------------------------	---	---	---	---	---	------------------------

Comments

OVERALL GUIDELINE ASSESSMENT

1. Rate the overall quality of this guideline.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
---------------------------	---	---	---	---	---	------------------------

Comments

2. I would recommend this guideline for use.

Agree II Tool

Appraisal of Guidelines for Research & Evaluation II

DOMAIN 1. SCOPE AND PURPOSE

1. The overall objective(s) of the guideline is (are) specifically described.
2. The health question(s) covered by the guideline is (are) specifically described
3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.

DOMAIN 2. STAKEHOLDER INVOLVEMENT

4. The guideline development group includes individuals from all relevant professional groups
5. The views and preferences of the target population (patient, public, etc.) have been sought.
6. The target users of the guideline are clearly identified.

DOMAIN 3. RIGOUR OF DEVELOPMENT

7. Systematic methods were used to search for evidence.
8. The criteria for selecting the evidence are clearly described.
9. The strengths and limitations of the body of evidence are clearly described.
10. The methods for formulating the recommendations are clearly described.
11. The health benefits, side effects, and risk have been considered in formulating the recommendations.
12. There is an explicit link between the recommendations and the supporting evidence.
13. The guideline has been externally reviewed by experts prior to its publication
14. A procedure for updating the guideline is provided.

DOMAIN 4. CLARITY OF PRESENTATION

15. The recommendations are specific and unambiguous.
16. The different options for management of the condition or health issue are clearly presented.
17. Key recommendations are easily identifiable.

DOMAIN 5. APPLICABILITY

18. The guideline describes facilitators and barriers to application
19. The guideline provides advice and/or tools on how the recommendation can be put into

practice.

20. The potential resource implications of applying the recommendations have been considered

21. The guideline presents monitoring and/or auditing criteria

DOMAIN 6. EDITORIAL INDEPENDENCE

22. The views of the funding body have not influenced the content of the guideline.

23. Competing interests of guideline development group members have been recorded and addressed

OVERALL GUIDELINE ASSESSMENT

1. Rate the overall quality of this guideline.

2. I would recommend this guideline for use.