



## UNIVERSITY OF CALGARY FACULTY OF VETERINARY MEDICINE

*This review accompanies the relevant episode of the Cutting Edge veterinary podcast. In each episode of this podcast, 3rd year students in the University of Calgary's veterinary medicine program fill you in on the most up-to-date literature and evidence-based practices on topics that matter to you, the practising veterinarian.*

### The Value of Routine Pre-Anesthetic Hematology and Serum Biochemistry Screening

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The purpose of this review is to elucidate existing evidence-based recommendations on routine pre-anesthetic bloodwork in both human and veterinary medicine. Routine or screening pre-anesthetic bloodwork (SBW) refers to performing laboratory tests, including a complete blood count (CBC), biochemistry, and urinalysis, independent of clinical suspicion necessitating testing prior to anesthesia. Veterinarians recommending pre-anesthetic SBW has become standard practice in small animal medicine prior to elective surgical and dental procedures. However, this practice is controversial across medical disciplines. The proposed advantages of pre-anesthetic SBW include detection of unsuspected subclinical disease, alterations to the American Society of Anesthesiologists (ASA) physical status classification and perioperative management, and establishing patient baseline values. Disadvantages include cost, client and patient stress, unnecessary tests and treatments, and procedure delay. We will focus on the value of pre-anesthetic SBW prior to elective procedures on healthy small animal patients (ASA 1-2).

To assess the value of pre-anesthetic SBW, it is important to understand the limitations associated with any screening test. For example, a positive heartworm test on a young dog in Alberta with no travel history is unlikely to be a true positive as the positive predictive value (PPV) is low when disease prevalence is low. This reasoning applies to SBW on healthy, young patients with no concerns identified through history and thorough physical exam. Abnormalities identified on SBW can be challenging to interpret, as the pre-test probability (PTP) for each parameter is low in the absence of clinical suspicion necessitating the test. As a result of the technique used to establish reference intervals (population-based), 5% of healthy animals will have slightly abnormal values on any given parameter (1). Each parameter measured within a CBC and chemistry is considered a distinct test because the reference intervals are statistically determined individually, meaning each parameter measured increases the likelihood of at least one abnormal result due to chance. A pre-anesthetic CBC and chemistry measures approximately 36 parameters, meaning at least one parameter is expected to be abnormal in 84% of healthy patients due to chance (1,2). This statistical reasoning is supported by literature assessing the role of pre-anesthetic SBW. Across studies, up to 97% of cats and 95% of dogs had

at least one value outside the reference interval, with the majority deemed clinically insignificant (3). The proportion of patients with all parameters within the reference intervals were low, between 5% (3) and 13% (4) of dogs and 2.35% of cats (3). The proportion of healthy human patients with SBW abnormalities is similar with 82.5% showing at least 1 abnormal value (5). Therefore, the major disadvantage of SBW is over-diagnosis when an abnormality of no apparent significance is identified (6) which may result in a series of costly, unnecessary tests contributing to patient and client stress, morbidity, and procedure delay. Screening tests are not recommended as the PTP and PPV are low, and statistically probable abnormalities are challenging to interpret.

The aim of pre-anesthetic screening is to reduce risk and increase quality of care by identifying pre-existing conditions and potential anesthetic challenges. The emphasis during pre-anesthetic screening should be placed on a thorough physical exam and history. First, we will examine the evidence for pre-anesthetic SBW intended to inform anesthetic protocols, patient management, and risk assessment. Human guidelines in Canada recommend against SBW for asymptomatic patients scheduled for low-intermediate risk surgeries as it has been deemed unnecessary and does not affect perioperative management or patient outcome (7). The Association of Veterinary Anesthetists voted in 1998 that pre-anesthetic screening is unnecessary if clinical examination is adequate (6). A retrospective short communication reported that anesthetic protocols were altered in 4% and 9% of dogs and cats, respectively, due to abnormal bloodwork (3). A prospective study found ASA status increased in 1.2% of patients, and fluid therapy and drug protocol were altered in 2.1% of patients and 0.7% of dogs, respectively (8). A retrospective study found that 8% of dogs would have been re-classified as a higher ASA status, altered drug protocol in 0.2%, and additional pre-anesthetic therapy instituted in 1.5% of animals (9). Another retrospective study showed significant variability among recommended alterations in anesthetic and patient management with slight to poor agreement among anesthesiologists (4). All anesthesiologists agreed to alter case management in 3% of cases while 64% of changes were made by a single anesthesiologist (4). Poor agreement among anesthesiologists suggests that interpretation of SBW and assigning ASA status can be subjective, and that many changes may not significantly influence outcome. Further, the effect of hematological and biochemical assessments on anesthetic protocols will depend on the typical protocol utilized within a practice and its applicability to higher risk cases (9). This likely explains the discrepancy between studies assessing the effect of pre-anesthetic SBW on alterations to anesthetic protocol and patient management (4,9). It is important to note, effects on patient outcome cannot be assessed in any of these studies as alterations were either theoretical or patient outcomes were not reported. Most studies assessing the value of preanesthetic SBW conclude that it is of little benefit with respect to anesthetic risk and management if no problems were identified through history and physical exam (9,10). This is similar to findings in human medicine throughout age groups (5,11,12).

Preanesthetic SBW has not been shown to predict anesthetic complications or mortality in human or veterinary studies (5,9–12). This is primarily due to the nature of the most common complications and the inability of screening tests to evaluate parameters that may be predictive. Most small animal anesthetic complications are cardiovascular or respiratory, including

hypovolemia, cardiac arrhythmia and arrest, failed intubation, airway trauma, insufficient ventilation, and mixed gas inhalation (13). Only two studies in veterinary medicine assessing the value of pre-anesthetic bloodwork report complications and patient outcome. Alef et al., reported 25 critical events, while only 4 patients had relevant laboratory findings (9). Toews and Campbell reported 17 complications including 6 horses that had an abnormal CBC indicative of mild neutrophilia (10). The PPV was 0.11, suggesting abnormal CBC results were not predictive of complications (10). To our knowledge, the only bloodwork parameter associated with an increased risk of mortality in small animals is a packed cell volume (PCV) outside the reference interval. The odds of mortality were 5.5 times higher in dogs with an abnormal PCV (14). The effect of low PCV on anesthetic complications and mortality was not found in the only study examining the use of a CBC on equine orchiectomy outcomes, presumably due to limited sample size (10). Importantly, red blood cell and platelet counts, serum albumin, renal parameters, hepatocellular and cholestatic enzymes, and electrolytes were not significantly associated with increased risk of anesthetic mortality (14). It is important to note, these findings are primarily based on healthy patients (ASA 1-2). Preoperative SBW was associated with reduced odds of mortality in ASA 4-5 dogs, suggesting SBW may be more beneficial in sicker patients (15).

There may be benefits to performing SBW as although rare, previous studies have identified abnormalities on SBW that were not indicated by the history and physical exam. In one retrospective analysis, unsuspected diseases were identified through SBW alone in less than 0.9% of patients including one with elevated urea of unknown cause (3). The mean age of dogs and cats included in this study were 9.64 and 11.65 years, respectively (3). A prospective study examining preanesthetic SBW in geriatric dogs (>7 years) identified previously undiagnosed disease in nearly 30% of patients (16). However, this study included history, physical exam, and bloodwork together to detect underlying disease. Most of these diagnoses, including atrial fibrillation, osteoarthritis, and collapsing trachea, cannot be alluded to by SBW and urinalysis (16). Joubert concluded pre-anesthetic SBW had questionable value for the purpose of anesthetic risk evaluation as there was little evidence these diagnoses would impact how anesthesia was managed (16,17). However, pre-anesthetic screening provided an opportunity to identify undiagnosed pathology and prevent terminal patients from undergoing unnecessary procedures. Unfortunately, the degree to which SBW alone was beneficial in this study cannot be determined. The decision to perform SBW in older animals, as in all patients, should be based on the assumption that diagnosis of an underlying disease would alter patient management and outcome. The value of SBW in geriatric patients may be improved if the decision considers population disease prevalence; for example, dogs >12y have 5x the odds of CKD relative to dogs 7-12y and the prevalence of CKD increases from 2-4% to 30-40% in cats >10y (18,19). When SBW is performed, transparent client communication regarding the intended purpose and potential outcomes is essential.

In addition to increased odds of underlying disease in older animals, the risk of anesthetic mortality increases with increasing age in dogs, cats, and horses (13,14,20). The association of increased age and odds of mortality is supported in human literature (13). Age-related anesthetic risks are primarily attributed to increased susceptibility to the depressant effects of

anesthesia, hypothermia, and prolonged recovery associated with reduced metabolic function (13) while the effect of underlying disease has not been described. Choosing Wisely (CW) is an international consortium of more than 30 countries emphasizing evidence-based practices that avoid unnecessary medical tests, treatments, and procedures (21,22). CW Canada recommends a CBC only in patients over 70 and less than 1 years of age (7). The remainder of the recommendations are specific towards known disease processes or targeted testing in symptomatic patients (7). The National Institute for Health and Care Excellence updated guidelines to consider ASA status only, and removed recommendations based on patient age as this was considered generic testing unrelated to patient status (23). It is unclear if SBW would be of value in older healthy patients as the suspected causes of increased mortality are largely undetectable on SBW. If performed, it is imperative to assess SBW results critically, as previous studies have suggested clinically insignificant bloodwork abnormalities increase with age (4).

Although available literature in veterinary medicine aligns with findings in human medicine with respect to the value of pre-anesthetic SBW, there are important practical differences that should be addressed. In both, a thorough history and physical exam are the most important factors determining anesthetic risk and protocol and should be used to guide targeted testing if indicated. However, the history provided to veterinarians is dependent on the vigilance of the client leading to opportunities for omission of important information. Limited patient history was not significant in one study assessing the importance of a CBC before sterilization in shelter medicine, nor was leukocytosis indicative of infection (24). Thorough physical exams may be limited in uncooperative or fractious patients prior to sedation, leading to alterations in physical exam parameters and inability to assess parameters that require patient response. Failure to record pre-anesthetic physical exam findings was associated with over 247x increased odds of mortality in dogs (14). One study assessing the value of SBW in human pediatric patients prior to elective cardiothoracic surgery found it did not significantly impact decision making and was unnecessary (5). This is comparable to young veterinary patients presenting for ovariohysterectomy as they are both invasive surgeries with history provided by a third party and variable degrees of cooperation facilitating thorough physical exams. The primary limitation when assessing the value of pre-anesthetic SBW in veterinary medicine is the quality of evidence in existing literature. Randomized controlled trials are required for an accurate assessment and to comprehend the applicability of stronger evidence presented in human literature.

Provided pre-anesthetic SBW rarely influences perioperative management and patient outcome, it is important to highlight the concept of value in health care. Value is defined as the health outcome achieved per dollar spent, and therefore emphasizes cost efficiency rather than absolute cost reduction (25). Considering unsuspected abnormalities are identified in less than 1% of patients, estimating an average of 250\$/patient for SBW (26), SBW costs clients approximately 25,000\$ to identify one patient with an abnormality not detected through history and physical exam. Implementation of CW Manitoba is estimated conservatively to result in annual savings of nearly a million dollars with SBW listed as the most common pre-operative test ordered unnecessarily (82%) (27). Veterinarians are commonly criticized for the cost of services; although veterinarian's notoriously undercharge for their services and expertise,

recommending SBW in the face of mounting evidence that does not support its value may become a source of additional scrutiny.

Finally, there is no evidence that performing pre-anesthetic SBW in healthy patients provides protection from malpractice or that failure to perform SBW is a liability. It is important, should you choose to routinely perform pre-anesthetic SBW, that it is assessed and documented thoroughly. A systematic review found a significant proportion of abnormal laboratory tests, 7-62%, were not reviewed by the medical team for out-patient surgeries in human medicine (28). There are many opportunities in veterinary practice that may result in failure to review SBW prior to anesthesia. Despite weak correlations between adverse outcomes and SBW abnormalities, failure to address abnormalities on SBW once performed may be a considerable liability (29).

In conclusion, there is no strong evidence supporting routine SBW prior to elective anesthetic procedures in healthy veterinary patients (ASA 1-2). As in human medicine, SBW does not affect patient outcome and rarely alters perioperative management. A PCV/TS on all patients prior to elective surgery is recommended as this is the only parameter associated with increased risk of mortality. Veterinarians should use targeted testing that is indicated by patient history and physical exam findings to inform anesthetic risk and management. Screening bloodwork may be considered to supplement determination of ASA status in fractious animals where a thorough physical exam cannot be performed prior to sedation, while remaining mindful of the interpretation limitations outlined. Client communication is imperative when SBW is desired for healthy patients in which targeted testing is not indicated. SBW may rarely suggest subclinical disease that would otherwise remain undetected. SBW may be considered in older patients if disease prevalence increases the PPV and diagnosis would significantly alter patient outcome. Veterinarians should consider the value of SBW, as well as their own and the client's risk tolerance for each patient to determine if SBW is appropriate. Clients should be aware of the reason SBW is recommended and reach a shared decision with their veterinarian.

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