Validating the assessment of bull sperm morphology by veterinary practitioners

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Abstract — The objective of this study was to validate the assessment of bull sperm morphology done by veterinary practitioners. Out of 1606 bulls, 1400 (87.2%) and 1344 (83.7%) were designated by practitioners and an experienced andrologist, respectively, as having ≥ 70% morphologically normal sperm. In 92% of the evaluations, there was agreement between the designations chosen.

In the Bull Breeding Soundness Evaluation (BBSE), minimum standards include ≥ 70% morphologically normal sperm and ≤ 20% sperm with head defects (1). The importance of sperm morphology has been well-documented (1–4). Although BBSE is a common procedure in veterinary practice, the reliability of the assessment of sperm morphology has not been evaluated. The objective of this study was to validate the assessment of bull sperm morphology by veterinary practitioners.

Six veterinary clinics involved in routine BBSE were identified based on geographical location to represent all parts of Alberta. During 2009, BBSE reports and semen smears were received from 1642 beef bulls that had been examined by 14 practitioners in these 6 clinics. The semen smears were prepared by the practitioners by mixing semen with eosin-nigrosin stain on a glass microscope slide, spreading it across the slide, and allowing it to dry. The smears were then examined by the practitioner, using bright field microscopy (magnification, 1000 to 1200×). At each examination, 100 sperm were evaluated, and the morphology of each sperm was judged as either normal or abnormal. Abnormalities were designated as defects involving the head, midpiece, or tail, with variations among individual practitioners regarding more detailed characterization of sperm abnormalities.

Following their arrival at the andrology research laboratory (Faculty of Veterinary Medicine, University of Calgary),
these semen smears were evaluated by an experienced andrologist, using a phase contrast microscope (Leica DM2500; Leica Microsystems, Wetzlar, Germany) at 1000×. A total of 100 spermatozoa were counted per slide from each bull and each normal sperm formed a single record. However, as identification of specific abnormalities was an important consideration, each defect was counted separately, even if multiple defects occurred on the same sperm. Sperm defects observed were grouped as follows: head defects (such as detached head, defects in size and shape, nuclear vacuoles, acrosomal defects); mid-piece defects (such as distal mid-piece reflex, bowed mid-piece, proximal droplet); and tail defects (such as bent tail, coiled tail) (Table 1).

Among 1642 bulls subjected to BBSE, 1395 (85.0%) were classified by the veterinary practitioners as satisfactory and the remaining bulls (n = 247) were classified as either unsatisfactory (6.4%), decision deferred (8.0%), or questionable (0.6%) based on various causes. Of the 247 bulls found not satisfactory, sperm morphology (< 70% morphologically normal sperm) accounted for 211 (85.4%) decisions. Therefore, the comparison between practitioners and the andrologist were limited to the 1606 bulls designated by the practitioners as either satisfactory or unsatisfactory (with the latter confined to those with < 70% morphologically normal sperm). Of these 1606 bulls, 1400 (87.2%) and 1344 (83.7%) were declared as satisfactory potential breeders based on sperm morphology by the veterinary practitioners and the andrology research laboratory, respectively. The clinics and the andrologist agreed on 1306 bulls having < 78% and 168 bulls having > 77% normal sperm (agreement in 91.8%; 1474/1606 of evaluations). Of the 132 remaining bulls, 38 (28.8%) were failed by the clinics and passed by the laboratory (indicated by negative differences), and 94 (71.2%) were passed by the clinics and failed by the laboratory (indicated by positive differences; Figure 1). The range of differences in normal sperm percentage observation by bull was from −78% to +77%. The sperm morphology counts differed by no more than 20 percentage points for these bulls 98 times out of 132 (74.2%) and exceeded 20 percentage points only 34 times (25.8%).

Of the 1642 bulls evaluated, approximately 83% were classified as satisfactory potential breeders based on sperm morphology (in addition to being satisfactory in all other aspects of the BBSE, including sperm motility, scrotal circumference, body structure, function, and general health). Comparison of bull evaluation decisions made at the veterinary clinics and the andrology laboratory based on sperm morphology revealed approximately 92% agreement, which confirmed the reliability of field BBSE data as a clinical tool and for research purposes. In approximately 75% of cases where the decision was not in agreement, the differences in the morphology counts were ≤ 20%. We inferred that these differences were due to the use of a better quality microscope, more knowledge and experience, and a more detailed examination of the smears in the research facility. Sperm defects such as nuclear vacuoles, acrosomal defects, abnormal DNA condensation and segmental aplasia of midpiece require a phase contrast microscope for easy identification and these were the defects missed by the majority of the field veterinarians (Figure 2). In a few occasions (38 of 132), bulls classified as not satisfactory by the veterinarians were passed by the andrology laboratory. This might be due to the random selection of representative fields from the stained smears used for morphology and the subsequent detailed examination of them at the andrology laboratory. However, based on the present study, BBSE data available at the field veterinary clinics were generally reliable.

Acknowledgments
The authors thank the veterinary practitioners who participated in this study by providing blinded BBSE reports and semen smears for morphology evaluations. Funding support was provided by the Department of Production Animal Health, University of Calgary.

References