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The use of point-of-care antibody and antigen testing in small animal practice

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1. Introduction

Point of care testing for antigen or antibody vastly improves the clinician's ability to make prompt decisions in clinical practice. The specificity and sensitivity of tests are measurements of accuracy (truthfulness) of the result. Sensitivity relates to correctly identifying patients with disease (few false negative results) whilst specificity relates to correctly identifying patients without disease (few false positives). Interpretation of antigen tests is simple as they only indicate a positive or negative. A positive result on an antibody test may have different meanings for the pathogen under investigation.

It may demonstrate, protection, serve as proof of infection or indicate prior exposure to either vaccine or natural infection.

As the demand for antibody testing increases, it is important that clinicians familiarise themselves with these tests. Qualitative tests may either indicate a positive or negative depending on whether there is sufficient antibody in the sample to meet a specific defined titre or negative when it does not.

Semi-qualitative tests are those that are able to show that the antibody present in the sample fall between, below or above defined titres. Semi-quantitative tests that indicate results through colour shades are sometimes more difficult to read and render various results depending on operator. Semi-quantitative tests using apparatus to measure the range circumvent that problem.

2. Antigen tests for dogs and cats

2.1. Antigen tests for dogs

Package inserts should be consulted to guide the clinician which is the most appropriate sample type to take for the disease under investigation.

2.1.1. Canine parvo virus antigen test

Canine parvo virus (CPV)-antigen tests used on faecal samples test presence of CPV virus in the stool and is confirmative of parvovirosis. Most, but not all of these test kits are not influenced by recent vaccination in the preceding couple of days, but irrespective, a positive test in conjunction with authentic clinical signs of parvovirosis is highly significant.

The test can also be used to monitor environmental contamination with CPV, used to verify the efficiency of decontamination of an area in a clinic or breeding kennel and used to confirm that previously positive animals are currently clear and safe to re-introduce to other susceptible animals.

Some faecal antigen test kits approved and licensed for detecting CPV can detect FPV viral antigen in feline faeces.

2.1.2. Canine corona virus antigen test

In clinical practice, cases of canine corona virus (CCV) as confirmed by antigen tests are a reality. Based on this, some clinicians feel the need to vaccinate against CCV using vaccines available to them that offer some measure of protection.[21] In addition, clinicians are aware that comorbidity of CPV and CCV has been described leading to high fatalities in puppies and increased severity of disease.[42] There is however no consensus on clinical significance of CCV or the protection that CCV vaccines offer. Canine corona virus vaccine is a vaccine not recommended by most vaccination guideline authorities.

2.1.3. Canine distemper virus antigen test

The ante-mortem diagnosis of canine distemper based on clinical signs is challenging because of the many other diseases that mimic the clinic signs. CDV-antigen tests are useful for confirming the diagnosis of distemper in dogs showing suspect clinical signs of distemper albeit there are some false negatives for a variety of reasons.

2.1.4. Giardia antigen test

Giardiasis is an intestinal infection in animals, caused by a microscopic protozoan parasite *Giardia duodenalis* and is a zoonosis.

The disease is more prevalent in puppies and kittens but adult dogs and cats may also become infected. Disease outbreaks are common in breeding kennels and catteries. Although heavy infections may be detected by microscopy (faecal wet preparations), routine faecal flotation tests and smears evaluated by less experienced operators may fail to detect cysts and motile trophozoites and faecal antigen tests are more reliable.[38] Point of care *Giardia* antigen tests are useful in detecting the presence of antigen in faecal samples, distinguish this from *Tritrichomonas* and indicates that the animal has ingested *Giardia* cysts, may be actively infected and may be shedding cysts in faeces.

2.1.5. Rabies antigen test

Although a rabies antigen point of care test is available that can detect rabies in saliva ante-mortem and in brain tissue post-mortem, **the use of these tests are not advised**.

Only appropriately accredited laboratories are authorised to diagnose this controlled disease.

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2.2. Antigen tests for cats

2.2.1. Feline panleukopenia virus antigen tests

Feline panleukopenia virus (FPL) is also known as feline parvovirus and the antigen tests in cats are useful to diagnose mainly kittens but also young adult cats presenting with diarrhoeas and to manage this disease in breeding catteries.

2.2.2. FeLV antigen tests

Diagnosis of FeLV relies on detection of the antigen in peripheral blood.[33] Most cats will test positive within 1–2 months of exposure depending on assay method, but this is variable. FeLV antigen tests have their limitations in signalling current infection.

Although most cats remain infected for life following exposure to FeLV and most will remain positive on antigen tests, some may revert to a non-viraemic state with no antigen present in the blood, complicating evaluation of true FeLV status.[40] Cats that repeatedly test positive are more likely to progress and develop FeLV related disease. A single positive test for FeLV is confirmative of infection whereas a single negative test may not be and retesting in 1–2 months may be indicated.

Susceptibility to FeLV infection is age-related, with the highest infection rates in very young kittens. However, in routine practice, it should not be considered mandatory to routinely test kittens prior to their initial FeLV vaccination.

This is because (a) there is no danger in vaccinating a potentially positive kitten (b) many more will be negative than positive and most importantly, (c) the cost of vaccination and testing may be prohibitive, depriving the kitten from much needed protection against a devastating infectious disease.[43] In contrast, older cats (that are more likely to be FeLV positive than young cats), should be tested and only vaccinated when the test is negative.

2.2.3. Feline corona virus (FCoV) antigen test

Feline corona virus is an enteric virus that causes either no clinical symptoms or a transient diarrhoea lasting a day or two. FCoV infection is widespread amongst domestic cats and most cats in multi-cat-households and large cat populations are seropositive[4] with seroprevalence approaching 100% breeding colonies.[29]

The main clinical significance of FCoV is its association with feline infectious peritonitis (FIP). Currently, FIP is considered to be a routinely fatal disease. It has been conclusively established that FIP inducing strains arise by mutation from FCOV to feline infectious peritonitis virus (FIPV).[7]

Neither the FCoV antigen test nor the FCoV antibody test can be used to diagnose FIP. Diagnosis of FIP rest upon clinical findings and supportive laboratory findings. Definitive diagnosis of FIP requires identification of viral RNA or proteins within macrophages in characteristic lesions or fluids or histopathology.

The main value of FCoV antigen tests is to identify cats that are currently or persistently shedding in breeding establishments and to segregate shedders from non-shedders in a quest to curb FIP or establish an FCoV free colony.

3. Correlation of antibody titres with protection, susceptibility and duration of immunity

3.1. Concept of sterilising immunity versus non-sterilising immunity

In case of canine distemper virus (CDV), canine parvo virus (CPV), and feline panleukopenia virus (FPL), also known as feline parvovirus (FPV), circulating antibody neutralises virulent virus following exposure.

Thus, if the animal has present in its blood sufficient antibody levels induced by vaccines (has known protective antibody titres above normal infection thresholds), the pathogen following natural exposure is eliminated before it actually infects the animal. Thus, the vaccine provided sterilising immunity. In contrast in cats, FHV and FCV antibodies are non-sterilising and cats do become infected and ill following natural exposure. Vaccination against FHV and FCV therefore do not prevent infection.

For these diseases, the aim of vaccination is to reduce the severity of the disease.[28] Depending on the pathogen, antibodies may play a minimal or no role in recovery from disease. For instance, recovery from CPV and CDV depends largely on cell-mediated immunity and not on antibodies. This may explain why serotherapy for parvovirosis renders inconsistent results in ameliorating the disease and reducing fatality.[6; 27]

3.2. Protection

Post-vaccination challenge studies are the gold standard for assessing whether a vaccine is effective in protecting the subject to the disease vaccinated against. Licensing authorities request demonstration of proof of seroconversion (four-fold or more-fold increase in antibody titres following vaccination) with titres that are considered protective for the disease in question. Depending on various factors this may be achieved after a single vaccination or a series of boosters.

It is possible that a previously exposed or vaccinated animal may still be protected despite having no or low antibody titres. This is because immune memory exists, and such animals may muster a very rapid anamnestic response following challenge. Therefore, an animal that appears unprotected based on an antibody titre may not necessarily be susceptible. This immune memory is mediated by the clones of B-lymphocytes in lymphoid tissues that enable the subject to remember and recognise specific antigens on the offending pathogen and rapidly lead to antibody production.[44] It is not possible to predict or test immune memory and therefore demonstrating protective titres remains the only practical reference point for immune status and protection available to clinicians. This leaves the clinician with no other choice to assume that all animals which fail to

demonstrate protective titres should be considered at least potentially susceptible. The final interpretation of antibody titre results and the decision or need to re-vaccinate rests upon the clinician.

3.3. Duration of immunity

Assessing duration of immunity (DOI) is achieved by long-term studies demonstrating adequate and protective titres that persist for years. Such long-term studies can either be field studies[5] or laboratory based studies. The shortcoming of field studies is that boosting of the immune system by naturally occurring field infections is a reality that cannot be excluded, making it difficult to interpret whether the persistent antibodies can be attributed to the vaccine alone.[22] Long-term laboratory studies in controlled environments have demonstrated that, many but not all, multivalent, modified-live vaccine provided protection against virulent CAV-1, CPV, and CDV challenge for a minimum of 3 years following a primary vaccination and booster 4 weeks later[23], but such studies are expensive and raise welfare concerns. The presence of antibody titres for many diseases are well-correlated to protection as demonstrated by challenge studies and therefore antibody titres are generally accepted as surrogate markers of protection.[22]

Despite evidence in the literature that the vaccine may be protective for much longer than one year for the core diseases in dogs and FPV in cats, the manufacturers of the vaccine do not guarantee this or have a labelled claim to this effect in local package inserts. It therefore seems reasonable that practitioners may feel more comfortable in only recommending postponing re-vaccination beyond manufacturer's claims, based on antibody titre results.

4. Antibody tests for dogs, interpretation and clinical application

The clinical applications of antibody tests are discussed for various pathogens. Furthermore, their use to evaluate the immune status after vaccination in young and adult animals, to optimise a vaccination protocol in consideration of maternally-derived antibody and to schedule revaccination based on need and not routine, are highlighted.

4.1 CPV, CDV, CAV and FPV antibody tests

In adult dogs, a positive antibody test result for canine distemper virus, canine adeno virus, and canine parvo virus indicates that the animal has protective titres against mentioned diseases and is highly likely currently protected and likely protected for another year.[22] The same applies for FPV and therefore the antibody tests for these core diseases of dogs (CPV, CDV, CAV) and the FPV are discussed together.

4.1.1 Antibody tests to determine the age of last vaccination in the initial puppy or kitten series

Antibody tests may be useful to confirm the need to vaccinate beyond the third booster against core disease at 12 weeks of age. It is known that about 10% of puppies and kittens fail to respond to core vaccines when the last one is administered at 12 weeks of age[19; 41] due to persistent maternally derived antibody interference at that age.[20; 43]

For the remainder of this discussion it is important for clinicians to realise that antibody tests cannot distinguish between MDA and antibody elicited by vaccination. However, maternally derived antibodies decline in time whereas humoral responses to vaccine, increase titres.

In this regard, CPV requires special mention because it creates a huge dilemma for dog breeders and financial and emotional distress for puppy owners. Point of care antibody tests can be used as assurance (not guarantee), that a puppy or kitten is highly likely adequately protected by demonstrating the presence of high titres at the age of 16–18 weeks of age using a single test following its initial vaccination series at 6, 9, 12 and 15 weeks. High titres at 16–18 weeks are significant as MDA has generally declined by then.

For breeders and owners that are anxious to home the puppy earlier, yet safer from threat of CPV, there is a second method. This method is only recommended for breeders that apply early vaccination at 4 weeks against CPV using high titre vaccines.[12; 25] Puppies in these kennels are vaccinated at 4, 6, and 9 weeks. Antibody titres could be performed at 8 weeks and again at 11 weeks of age. A two-fold increase in titre is proof of seroconversion. Seroconversion proves response to vaccine as MDA generally declines with time.

If at the 11-week antibody test, seroconversion has not been achieved, then the puppy should be vaccinated again at 12 weeks and the antibody test done again at 14 weeks. However, in some cases, re-vaccination at 15 weeks may be required and proof of high antibody levels confirmed using a further test, all increasing cost and delaying transfer to the new owner.

Practitioners may also have concerns about nosocomial disease in young puppies or kittens that require a procedure such us juvenile sterilisation, vasectomy, umbilical hernia or other procedures. In such young animals, elective surgeries should be postponed and be vaccinated until seroconversion is confirmed or protective titres are achieved at 16 weeks or older.

Vaccine non-responders and low-responders are heritable traits and have been identified in various dog breeds.

4.1.2 Antibody tests to support extending vaccination intervals beyond one year for adult dogs (CDV, CPV, CAV and FPV in cats)

Triennial vaccination recommendation as outlined in current local and international vaccination guidelines, highlight 3-year booster intervals for the core vaccines rather than the conventional "annual booster" recommendation.[10; 11; 19]

The local vaccination guidelines and evidence supporting document may be downloaded from the web:
http://www.sava.co.za/2019/04/29/dog-and-cat-vaccination-guidelines-for-south-africa-2019-evidence/.

The reality is that there are clients who have strong convictions about the need to re-vaccinate their pet even though the last booster may have been administered more than three years ago. Such clients are very anxious because of the potential for vaccine-associated injury, albeit that this is rare. Strategic vaccination of pets owned by such clients guided by antibody tests offers an acceptable alternative for such clients that wish their pets only to be vaccinated when there is proof of need.

Using antibody tests, low responders can be identified and vaccinated annually. Because monovalent vaccines are not available for all the diseases, it is not possible to only vaccinate against one specific disease based on such antibody tests.

The test may for instance indicate that the antibody is low for only CDV, but antibodies for CPV and CAV were adequate. In such case it is acceptable to use the multivalent vaccine. Some practices have introduced antibody tests into their annual wellness-testing of pets in exchange for routine annual vaccination.

4.1. Antibody tests to assess vaccine efficacy for breeders and shelters

Serological testing may be used to monitor and assess the efficacy of vaccines and vaccination protocols in breeding kennels and catteries.

4.2. Assessment of protection in shelters during a disease outbreak

Despite recommendations that dogs and cats with unknown vaccination histories should be vaccinated upon arrival at animal shelters and that such vaccinations in young adult and older dogs is effective.[32] many shelters fail to do so because of financial constraints.

These constraints prompt them to only vaccinate the pets after an adoption is assured, which leaves them vulnerable to contagion for days or weeks. When plagued by infectious disease outbreak such as distemper or parvovirosis, some shelters have adopted the policy of destroying all the animals indiscriminately and irrespective of whether they are truly susceptible or not.

This policy is based on the knowledge that around 2/3 of dogs entering shelters have insufficient titres for antibodies against CDV, CPV, or both.[31] Antibody testing at the onset of such outbreaks may be used to identify animals with protective antibody titres and be saved.

4.3. Assessment of protection in patients with increased risk or history of vaccine induced injury

There are a range of confirmed and suspected adverse reactions to vaccines including the onset of inflammatory, allergic, autoimmune or neoplastic diseases.[9] The vast majority of adverse reactions to vaccines in dogs are allergic responses that are diagnosed by virtue of immediate-type allergic reactions such as circulatory collapse, cyanosis, dyspnoea, facial oedema, and vomiting within 1 h after vaccination.[37]

Other more rare vaccine-associated adverse events are; immune-mediated haemolytic anaemia in dogs, immune-mediated polyarthritis, post-vaccinal polyneuropathy, hypertrophic osteodystrophy, autoimmune thyroiditis and immune-mediated thrombocytopenia.[8; 13; 16; 26] Such animals should only be re-vaccinated if there is proof of need.

4.4. Ehrlichia canis

The antibodies against *Ehrlichia canis* do not persist for long after clinical resolution[17] and therefore a positive antibody test result for *Ehrlichia canis* should raise the index of suspicion for clinical ehrlichiosis but should not be viewed as absolute confirmation of current infection. The definitive diagnosis of *Ehrlichia canis* requires molecular techniques[24] and other supportive laboratory findings and clinical signs.

4.5. Brucella canis antibody test

Canine brucellosis is a zoonosis and controlled disease in many countries caused by the organism *Brucella canis*. It is a significant cause of reproductive failure in dogs worldwide. The infection causes urogenital infections in the bitch and infection of the testis (orchitis and epididymitis) in male dogs and discospondylitis may develop in both sexes. There is no treatment for the condition and infected dogs remain infected and seropositive for life.

Point of care *Brucella canis* antibody tests are generally considered screening tests and definitive diagnosis should be made on results obtained from accredited laboratories. Recent serological surveys to determine the prevalence of *Brucella canis* infection in dogs within some provinces in South Africa showed that 52/1191 tested positive for *B. canis*, representing an overall occurrence of 4.4%.[39] Positive dogs were mainly those from informal settlements and welfare organisations. This finding has human welfare implications for those communities. In addition, this reservoir population threatens the current locally yet unaffected pedigree dog breeding population in South Africa.

The majority of dogs in South Africa are not tested for *Brucella canis* because of lack of awareness of *Brucella canis* and lack of clinical suspicion.[18] Point of care *B. canis* antibody tests are a useful tool in changing this perception and increasing the clinician's diagnostic arsenal to prevent further spread.

4.6. Canine babesia antibody test for detection of Babesia gibsoni

The small *Babesia*, *B. gibsoni* has been diagnosed in an imported dog in South Africa[35] but a subsequent survey failed to detect any further cases.[34]

The role of the *Babesia gibsoni* antibody test in South Africa is limited to screen dogs that have suspicious clinical signs, have been imported recently and as a first line screening towards further serological surveys. The test is generally only accurate from three weeks following infection as only then sufficient antibodies are present.

5. Antibody tests for cats, interpretation and clinical application

5.1. FPL antibody tests (see also section 4.1)

FPV is also known as feline panleukopenia (FPL) is a highly contagious enteric disease of cats. The disease is more prevalent in young cats in large colonies. Infection in pregnant queens can result in foetal resorption, mummification, abortion, or stillbirth.

In addition, foetuses infected in utero that survive and kittens less than a few weeks of age that become infected may develop cerebellar hypoplasia, retinal dysplasia, and optic neuropathy.[3; 45] Live vaccine against FPL may cause the same problems in pregnant queens and kittens inoculated under 4 weeks of age.[43]

In otherwise healthy cats, a positive antibody test result for FPV correlates strongly with protective immunity. Therefore, the main clinical application of FPV antibody tests are to justify reducing FPV vaccination from the traditional annual regimen in adult cats as explained in section 4.1.

5.2. FHV and FCV antibody test

In contrast to FPV, annual or strategic serologic testing for FHV and FCV has less application in cats because the correlation between positive titres and protective immunity is only fair.[46] Up to 30% of cats with a positive FHV titre may indeed still be susceptible or even intermittently shed the virus during periods of stress.

Nevertheless, it was shown that vaccination against core diseases in cats induces a response (demonstration of adequate antibodies) that lasts up to and beyond 48 months.[36] Therefore, antibody tests for the core diseases in cats are useful for those practitioners wishing to vaccinate cats with intervals longer than one year.

5.3. Rabies antibody tests (dogs also)

Point of care rabies antibody tests should only be used as a screening test to predict whether the animal is likely to meet the minimum rabies titre required by law as assayed by accredited certified laboratories.

Rabies is a controlled disease and rabies re-vaccination should be scheduled as dictated by law and not based on antibody tests. Government Gazette, 7 April 2000 - No 21045 page 21) states the following: "**All dogs and cats in the Republic shall be immunised with an efficient remedy by an official, veterinary or authorised person at the age of three months followed by a second vaccination between one and nine months later (before the pet turns 1 year of age) and then once every three years**"

5.4. FIV antibody test

FIV antibody tests are the most common and practical method of diagnosis of FIV infection. FIV antigen is present in very low concentration in circulation after the acute stage of infection therefore not accurate for diagnoses. FIV antibodies persist for life and can therefore act as sentinel for proof of infection and used to diagnose FIV.[33]

5.5. Toxoplasma antibody tests

Toxoplasmosis caused by *Toxoplasma gondii* is both a clinical disease sometimes encountered in dogs and cats and also a serious zoonosis. Toxoplasmosis can be contracted from the ingestion of undercooked or raw meat and from contact with contaminated soil or cat faeces.[15]

People that are immunocompromised (suffer from AIDS or are on immunosuppressive medication) are a lot more likely to develop clinical toxoplasmosis than others.

Pregnant women who acquire toxoplasmosis are usually asymptomatic but may transmit the infection to their foetuses with severe consequences. Prevention efforts should focus on educating cat owners about the importance of collecting cat faeces in litter boxes, spaying owned cats to reduce overpopulation, reducing the numbers of feral cats and promoting rigorous hand hygiene after gardening or soil contact.[15]

Toxoplasma antibody test results from healthy cats are useful for assessing human health risks. The incidence of *Toxoplasma*-related injury to pregnancy and infants was 2.4/1000 pregnancies.[30] Women that are pregnant or planning towards pregnancy may therefore be advised by their obstetricians to have their cat assessed as potential shedder. A seronegative cat may be shedding oocysts (early during infection, before antibodies had time to develop) and will likely shed oocysts if exposed for the first time. In contrast, an antibody-positive cat is unlikely to shed oocysts as they usually shed only once in their lifetime. It is also unlikely to shed oocysts if re-exposed or immunosuppressed.[14]

5.6. FCoV antibody test (see also FCoV-antigen test 2.2.2)

From the onset it is important to mention that FCoV antibody test only evaluates FCoV antibody. The main problem with antibody tests with regards to diagnosis of FIP is that both FCoV and FIPV, being virtually identical to each other, evoke the same antibody responses. Hence the FCoV antibody test is not diagnostic for clinical FIP. However, high levels of antibody to FCoV along with signs of the disease significantly raises the index of suspicion for FIP. Most reference books consider an FCoV titre to be high when at least 1:1280 or above. Kittens may be seropositive from maternally derived antibodies and therefore testing kittens less than three months of age is of little value.

In endemic FCoV colonies, 33 % of the seropositive cats will be found to shed virus at any time. More importantly, it is known that seronegative cats do not shed virus.[2] Therefore, the FCoV antibody test is very useful in conjunction with the FCoV antigen test to manage FIP in breeding colonies or attempt to establish a seronegative colony and help in conjunction with the antigen test identify shedders.[1]

References available on request.

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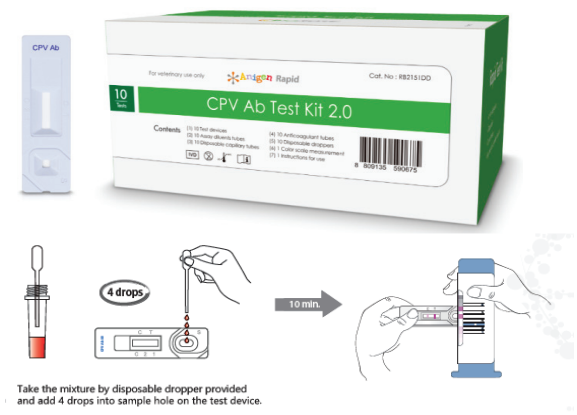

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QUESTION 1

If an assay has a specificity of 100% IT MEANS that:

a. It will detect no false negatives
b. It is a very accurate test
c. Its sensitivity will also be high
d. It will detect no false positives
e. It is specific for one species

QUESTION 2

Which of the following statements is CORRECT with regards to antigen and antibody tests?

a. Only antigen tests can be used to diagnose disease
b. Antibody tests can only be used to assess immune status
c. Interpretation of the specific test depends on the pathogen
d. The sample type for antigen tests is always whole blood
e. A positive antigen tests indicates protective immunity

QUESTION 3

Which of the following statements is CORRECT with regards to antigen tests for canine parvovirus (CPV) and canine corona virus (CCV)?

a. The CCV antigen test has less clinical significance than CPV test
b. The CPV-antigen test may show up positive many weeks following vaccination using a CPV live vaccine
c. Both CPV and CCV antigen tests will respectively detect other parvo and corona viruses in other species
d. The CPV-antigen test is useless in puppies that have completed their initial vaccination series
e. Dead CCV vaccine can interfere with the CCV-antigen test on a faeces sample

QUESTION 4

Which of the following statements is INCORRECT with regards to the antigen tests for *Giardia*?

a. *Giardia* can be confused with other protozoa in faecal samples
b. The test can be used in dogs and cats
c. The test is useful for control of disease in dog kennels and catteries
d. The test is useful in both young and adult cats and dogs
e. A faecal examination will always reveal the presence of always *Giardia*

QUESTION 5

Which of the following statements is INCORRECT with regards to the antigen test for feline leukaemia virus (FeLV)?

a. The FeLV-antigen test has more significance in kittens than adult cats
b. The FeLV-antigen test has more significance in older cats than kittens
c. A single positive test for FeLV is confirmative of infection
d. The FeLV vaccine does not interfere with the FeLV-antigen test
e. The FeLV-antigen test has more significance in sick cats

QUESTION 6

Which of the following statements is INCORRECT with regards to antigen tests AND antibody tests for feline corona virus (FCoV) in cats?

a. FCoV antigen tests are valuable in controlling FIP in cat colonies
b. High levels of antibody to FCoV along with signs of the disease significantly raises the index of suspicion for FIP
c. Both the FCoV antigen test and FCoV antibody test can be used to identify cats shedding FCoV
d. Both the FCoV antigen test and the FCoV antibody test can be used to diagnose FIP
e. FCoV-seronegative cats do not shed virus

QUESTION 7

With regards to antibody titres and immunity, which of the following statements is INCORRECT?

a. Only antibodies are important in long term protection and susceptibility
b. Antibodies can be used to assess duration of immunity
c. It is possible that a previously exposed or vaccinated animal may still be protected despite having no or low antibody titres
d. High antibody titres offer the assurance that an animal is likely protected
e. Demonstration of high levels of antibodies cannot be used as the gold standard for assessing whether a vaccine is effective in protecting the subject to the disease vaccinated against

QUESTION 8

When assessing immunity in puppies, which of the following statements is INCORRECT?

a. Antibody tests can distinguish between maternally derived immunity (antibodies) and humoral immunity
b. Not all puppies will have protective titres against the core diseases when assessed at 12 weeks of age
c. High antibody titres against core diseases at 16–18 weeks are significant as maternally derived antibodies MDA has generally declined by then
d. Antibody tests are useful in identifying non-responders and low-responders to vaccines
e. Antibody tests are useful in control of infectious disease in dog and cat colonies

QUESTION 9

When assessing the need for revaccination in adult dogs, which of the following statements is INCORRECT.

a. Antibody tests can be used to support extending vaccination intervals beyond one year for adult dogs (CDV, CPV, CAV and FPV in cats)
b. Assessing cell mediated immunity is challenging and therefore demonstration of high antibody titres is the most practical surrogate marker of immunity
c. Antibody tests are useful in the risk benefit assessment of vaccinating animals with a history of known or suspected vaccine induced injury
d. Antibody tests are useful in protecting the interests of both practitioners and their patients when opting to re-vaccinate with longer intervals than indicated by manufacturers' instructions
e. Fully vaccinated adult dogs need never be vaccinated or tested again once one antibody test revealed high antibody levels

QUESTION 10

Which of the following statements is INCORRECT?

a. A positive antibody test result for *Ehrlichia canis* raises the index of suspicion for clinical Erlichiosis
b. *Toxoplasma* antibody test results from cats are useful for assessing human health risks
c. Point of care diagnostic tests for feline immunodeficiency virus test for antibody and not antigen
d. The *Brucella canis* antibody test has no significance locally as the disease is not present in South Africa
e. There is only fair correlation between positive titres and protective immunity when interpreting antibody tests for feline herpesvirus and feline calici virus

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