REVIEW ARTICLE

Human Immunodeficiency Virus: Anesthetic and Obstetric Considerations

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The pandemic of acquired immune deficiency syndrome (AIDS) is on the threshold of its third decade of existence. The World Health Organization-United Nations statistics show that human immunodeficiency virus (HIV)/AIDS pandemia is set to get much worse. Women of reproductive age are the fastest growing population with HIV. Common signs and symptoms have become more moderate or subclinical, and new clinical presentations have emerged. It is quite apparent that HIV-disease affects multiple organ systems. Advances have been made in elucidating the pathogenesis of HIV. In addition, the molecular technique of viral load determination and the CD + 4 T-lymphocyte count enable evaluation of the disease, its prognosis, and its response to therapy. There is limited specific information concerning the overall risk of anesthesia and surgery of HIV/AIDS patients. However, as far as can be determined, surgical interventions do not increase the postoperative risk for complications or death and should therefore not be withheld. There is also little evidence to suggest that HIV or antiretroviral drugs increase the rate of pregnancy complications or that pregnancy may alter the course of HIV infection. General anesthesia is considered safe, but drug interactions and their impact on various organ systems should be considered preoperatively. Regional anesthesia is often the technique of choice. Yet, one must take into consideration the presence of neuropathies, local infection, or blood clotting abnormalities. It should be emphasized that all practicing anesthesiologists should be familiar with the disease and should use prenatal anesthesia consultations and a team approach to assure optimal treatment for HIV patients.

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Acquired immune deficiency syndrome (AIDS) was first recognized more than 20 years ago, and since then it has reached pandemic proportions. Within 2 decades, more than 50 million people have been infected with the human immunodeficiency virus (HIV) and 20 million have died. Worldwide, two-thirds of the 36 million known carriers of HIV are living in sub-Saharan Africa (1). In the United States (US), 950,000 people have HIV/AIDS. In the year 2001, 15,000 of those people died from the disease (1). New infections occur at approximately 40,000 per year (2). Young women are the fastest growing population with HIV in the US. Almost 30% of new HIV infections in the year 2000 were among women. Eighty-two percent of the new infections occurred in ethnic/racial minorities, predominantly among African Americans. The parturient transmits the HIV perinatally; thus the epidemic in children parallels the epidemic among women (2,3). The transmission of the disease in nonbreast-fed infants occurs 30% of the time *in utero* and 70% during labor and delivery (4).

The overall risk of anesthesia and surgery in HIV positive patient needs further study. Twenty to 25 percent of HIV-positive patients will require surgery during their illness (5). Anesthesiologists need to be aware of the disease when deciding on the course of anesthesia. This multiorgan disease may be complicated either by opportunistic infections, tumors, substance abuse, or antiretroviral therapeutic drugs, which all can have an impact on anesthesia.

HIV is a member of the lentivirus family, a subtype of human retroviruses. It is characterized by a cytopathic action, a long latency period, and persistent viremia. As a result of impaired cell-mediated immunity, the infected person is more susceptible to viral, bacterial, mycobacterial, and malignant disease (6). Of the untreated patients, 10% will develop symptomatic

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AIDS in the first 2–3 yr of infection. The remainder will develop the disease over a 10-yr time period (7).

Diagnosis of HIV Infection

As the viral envelope is composed of different glycoproteins, antibodies to these proteins or to the p24 antigenic core can be detected. The diagnostic techniques include serologic tests, viral culture, genomic detection, and amplification of viral ribonucleic acid (RNA) or proviral deoxyribonucleic acid (DNA).

Specific HIV antibodies can be detected serologically 2–8 wk (usually within 3 wk) after infection. The first antibodies to appear are immunoglobulin (Ig) M to the viral envelope glycoprotein. After a few days the IgG to p24 core antigen and gycoprotein-gp120 appear. Antibody detection tests are the enzyme-linked immunosorbent assay (ELISA) and the more specific Western blot test (8).

HIV diagnosis can be made by direct detection of HIV using the ELISA test for p24 core antigen or by amplification and detection of proviral DNA or HIV RNA using polymerase chain reaction. This can be important for the monitoring of HIV treatment for detection of HIV in neonates of infected mothers (9). Viral load determination is used for diagnostic quantification and monitoring of HIV treatment (10). These viral load levels usually correlate with CD_4^+ T cell lymphocyte count. A successful anti-HIV therapy means viral load suppression to an undetectable blood level.

Clinical Manifestations of HIV Infection

Over time, antiretroviral therapy has changed the epidemiologic, demographic and clinical characteristics of AIDS. The signs and symptoms can be caused by the HIV infection, opportunistic infections, neoplasm, or by the antiretroviral drugs. As the highly active antiretroviral therapy (HAART) became more effective, life expectancy and the clinical appearance has become moderated or subclinical.

Central and Peripheral Nervous System. Some 30% of adults and 50% of children suffering from AIDS will develop neurological disorders (11). In the early stage of infection, headaches, photophobia, meningoencephalitis, depression, irritability, Guillain-Barre-like syndromes, or cranial and peripheral neuropathy can be observed. The latent phase of the disease is associated with demyelinating neuropathy and cerebrospinal fluid pathology. The late period of HIV infection is associated with meningitis, focal or diffused encephalopathy, myelopathy, myopathy, and peripheral neuropathy.

As the central nervous system (CNS) is the first crucial organ to be affected by anesthetic drugs, early diagnosis of HIV deserves careful evaluation of cognitive and neurologic dysfunction. Patients with AIDS are more sensitive to opioids and benzodiazepines, which also reflects the extent of neurological involvement. The probable mechanism is based on increased interleukin-1 levels causing an increased γ aminobutyric acid-mediator production (12). HIV infection, intracranial masses, or opportunistic infections may cause cerebral edema, cerebral hemodynamic disturbances, and increased intracranial pressure (ICP). These deserve anesthetic consideration and measures for reducing ICP and generally preclude the use of neuraxial anesthesia in patients with increased ICP. Peripheral neuropathy is the most frequent neurological complication in HIV patients (13). It affects approximately 35% of patients with AIDS and manifests clinically as a polyneuropathy and myopathy.

An autonomic dysfunction in the HIV-infected person may appear with or without CNS abnormalities. AIDS patients may present with uncommon autonomic disturbances, such as orthostatic syncope, hypotension, and diarrhea (14).

Pulmonary Abnormalities. The pulmonary manifestations of patients infected with HIV are caused mainly by opportunistic infections. The most common of these, *Pneumocystis carinii* infection, has become rarer with the use of HAART and prophylactic drug therapy (15). An immunocompromised person with a CD_4^+ lymphocyte count of <200 cells/mm^3 is at increased risk for developing *P. carinii* pneumonia. The disease may present as adult respiratory distress syndrome and may be complicated by pneumatoceles, pneumothorax, or respiratory failure (16). Computed tomography of the chest in the early stages of the disease may reveal bilateral haziness of both lungs, whereas chest radiograph appears normal (17).

Tuberculosis (TB) is another concern in AIDS patients. The incidence of HIV-associated TB has been increasing, especially among women of childbearing age (18). Patients with both infections may present with atypical manifestations of TB that causes difficulty in making a diagnosis. Other pathologies that may affect the lungs are Kaposi's sarcoma, lymphomas, and cavitary lung disease caused either by fungal pathogens or Nocardia.

Cardiac Manifestations. Advances in the treatment of HIV infection have improved longevity of HIV patients, thereby they develop more cardiac involvement (Table 1) (19). In the advanced stage of the disease, myocarditis is more common and is caused by opportunistic infections or neoplasm-like lymphomas and Kaposi's sarcoma (20).

There are reports of various abnormalities associated with a hypercoagulable state (21). These include pulmonary hypertension, accelerated coronary arteriosclerosis, a decrease in left ventricular contractility

Table 1. Manifestations of Human Immunodeficiency Virus Infection

Cardiovascular
Pericardial effusion
Myocarditis (opportunistic infections, neoplasms)
Dilated cardiomyopathy
Endocarditis
Pulmonary hypertension
Drug-related cardiotoxicity
Thromboembolic complications
Rheological impairment (increase of tumor necrosis factor and interleukin 1-alpha)
Decreased left ventricular contractility
Myocardial infarction
Gastrointestinal
Esophagitis, dysphagia, odynophagia
Diarrhea, gastrointestinal bleeding, abdominal pain
Hepatitis
Biliary disease (acalculous cholangitis)
Hematologic
Anemia
Leukopenia, lymphopenia
Thrombocytopenia
Bone marrow suppression (infections, drugs, neoplasms)
Hypercoagulability
Acquired immune deficiency syndrome-related lymphoma (Hodgkin's disease)

and myocardial infarction in young HIV patients. Preoperative cardiac evaluation is therefore mandatory and appropriate perioperative cardiovascular monitoring of these patients is of crucial importance (22).

Gastrointestinal Abnormalities. Gastrointestinal abnormalities are commonly encountered in patients with AIDS (Table 1). Signs and symptoms may originate from the oropharynx, esophagus, stomach, and hepatobiliary system (23). The main cause of dysphagia is *Candida albicans* esophagitis. Other common pathogens are cytomegalovirus (CMV), herpes virus, Kaposi's sarcoma, histoplasmosis, and squamous cell carcinoma. In advanced AIDS, esophageal reflux is common, which may increase the risk for pulmonary aspiration on induction of general anesthesia (24). Abnormal liver function tests are also common in advanced AIDS and reflect the decreased metabolic and secretory ability of the liver in addition to coagulation abnormalities. Finally, electrolyte abnormalities are caused by diarrhea and decreased oral intake resulting from dysphagia or nausea.

Hematological Abnormalities. A wide spectrum of hematologic abnormalities in HIV patients is very common and may appear at any stage of the disease (Table 1). Bone marrow involvement and coagulation abnormalities may result from HIV infection, anti-HIV drugs, nutritional factors, and bone marrow infiltration by opportunistic infection or neoplastic diseases (25).

The literature contains reports of thrombotic episodes and various predisposing abnormalities related to a hypercoagulable state that correlate with the severity of HIV disease (26). The coexistence of HIV-related illness, such as malignancies and autoimmune disease, as well as antiretroviral drug therapy itself, may also predispose these patients to thromboembolic events (26).

Another coagulation abnormality seen in the HIV patients is idiopathic thrombocytopenic purpura that is caused by platelet serum immunoglobulin, or direct adverse effects of HIV infection on the megakaryocytes (25). Some of the antiretroviral (zidovudine) or antiopportunistic drugs (ganciclovir) may contribute to these hematologic abnormalities as a result of bone marrow suppression (25).

Renal Abnormalities. HIV patients are at risk for developing various renal diseases caused by HIV infection, viral hepatitis, drug abuse, antiretroviral drugs, and dehydration (27). The HIV-associated nephropathy is a distinct clinico-pathological syndrome presenting as a nephrotic syndrome. The use of angiotensin-converting enzyme inhibitors, steroids, and antiretroviral treatment may slow down its progression to end-stage renal failure (28). The use of an antiretroviral drug, such as adefovir, may cause acute toxic tubular necrosis (29). Indinavir, which is also commonly used, is associated with a 3% incidence of nephrolithiasis (30).

Endocrinologic and Metabolic Abnormalities. The course of HIV infection or AIDS can be complicated by a variety of endocrine and metabolic abnormalities. This may be a direct effect of HIV on the respective glands, by opportunistic infections, neoplasm, or antiretroviral drugs. Primary or secondary adrenal insufficiency is still the most serious endocrine complication in HIV patients (31). Thyroid function tests in AIDS patients may be abnormal, although clinical hypothyroidism is rare.

Hypoglycemia is another metabolic abnormality that may be caused by islet cell damage resulting from pentamidine treatment. Hyperinsulinemic hypoglycemia may be associated with hypopituitarism in an AIDS patient or as a complication of protease inhibitor treatment (22).

HIV and Pregnancy

One-third of new HIV positive patients in 2000 were women (1). In the US, the nationwide seroprevalence of HIV during pregnancy has been reported as 1.7 per 1000 pregnancies (32). The majority of pediatric HIV infections resulted from vertical transmission of the virus from mother to infant. This occurred 4.4% of the time during pregnancy, 60% of the time during delivery, and 35.6% of the time during breastfeeding (33).

A meta-analysis of the International Perinatal HIV group included 15 prospective European and North American studies of 8500 parturients. A reduction of

Table 2. Antiretroviral Drugs [Nucleoside Analogue Reverse Transcriptase Inhibitors (NRTIs)] and Side Effects

Generic Name	Trade Name	FDA Pregnancy Category	Dose	Adverse Side Effects
Zidovudine (AZT)	Retrovir*	C	100 mg 6×/day	Anemia, neutropenia, pancytopenia, headache, neuropathy, myopathy
Didanosine (ddi)	Videx†	B	200 mg b.i.d.	Peripheral neuropathy, pancreatitis, gastrointestinal disturbances
Stavudine (d_4T)	Zerit†	C	40 mg b.i.d.	Peripheral neuropathy, pancreatitis
Zalcitabine (ddC)	Hivid‡	C	0.75 mg t.i.d.	Peripheral neuropathy, pancreatitis
Abacavir	Ziagen*	C	300 mg t.i.d.	Gastrointestinal disturbances, skin rash, myalgia
Lamivudine (3Tc)	Epivir*	C	300 mg b.i.d.	Peripheral neuropathy, skin rash, gastrointestinal disturbances
Zidovudine plus Lamivudine	Combivir*	C	300 mg b.i.d.	Peripheral neuropathy, pancreatitis
Adefovir	Hepsera§	C	120 mg/day	Gastrointestinal disturbances, increased liver enzymes, renal toxicity

Food and Drug Administration (FDA) Pregnancy Category = "B" (animal reproduction studies failed to demonstrate a risk to the fetus); "C" (safety in human pregnancy has not been determined).

* Manufactured by GlaxoSmithKline, Research Triangle Park, NC; † manufactured by Bristol-Myers Squibb, New York, NY; ‡ manufactured by Roche Pharmaceuticals, Basel, Switzerland; § manufactured by Gilead Sciences, Foster City, CA.

vertical transmission by more than 50% was observed when elective cesarean delivery was performed (34). More recently, elective cesarean delivery combined with antiretroviral therapy has reduced vertical transmission to <5% (35). The American College of Obstetricians and Gynecologists (ACOG) committee opinion of May 2000 stated that when viral loads are more than 1000 copies per milliliter, the benefit from elective cesarean delivery is beyond that achieved by antiretroviral therapy alone (36). It has been further noted that the mode of delivery should be individually assessed and that the viral load testing has to be followed every 3 mo. Many practitioners do not recommend elective cesarean delivery for HIV-infected women who are compliant with antiretroviral therapy and have undetectable HIV viral loads (37). The revised ACOG Committee Opinion also considers routine delivery by cesarean section to be problematic and potentially dangerous, especially in rural hospitals in Africa where maternal mortality approximates 230 per 100,000 (36). The incidence of complications is significantly increased when the CD_4^+ count is $<200\ mm^{-3}$ (38,39). Routine HIV testing should be offered to every pregnant person at risk of HIV infection.

The percentage of women diagnosed before delivery in the US has improved from 51% in 1993 to 80% in 1996 (40). The European Collaborative study has shown that 14% of HIV-infected pregnant women are immunocompromised, and there is no evidence to suggest that pregnancy alters the course of HIV infection (41).

Intrauterine growth retardation and premature delivery were reported among infants of HIV-infected women regardless of their infectious condition (41).

HIV Therapy Interaction with Anesthesia and Obstetrics

Combined HAART has dramatically improved survival of HIV-diseased patients, has delayed the progress of the disease, and has caused a decline in AIDS incidence and death. More than 14 drugs have been used. Most of them produce side effects that interact with anesthetic drugs. Some of these adverse effects may mimic signs and symptoms of the HIV disease itself. Side effects may also result from drugs used for prevention or treatment of opportunistic infections.

Pregnancy may affect timing and choice of therapy, but it is not considered a contraindication or a reason to postpone treatment, although dosing must take into consideration blood volume and volume of distribution changes during pregnancy. In addition, there are potential toxic drug effects on the fetus and the newborn (42,43). New guidelines suggest that pregnant women should continue or start with combined HAART therapy at a maximally suppressive regimen, although little data on animal and human toxicity support these recommendations (43). Additional information is available at http://www.aidsinfo.nih.gov.

Antiretroviral Drugs

Three classes of antiretroviral drugs have gained Food and Drug Administration approval and are currently used in the management of HIV disease (44) (Tables 2–4).

1. Nucleosides analog reverse transcriptase inhibitors. These drugs inhibit the completion of reverse transcription by binding to the viral DNA. Side effects commonly reported with zidovudine treatment include headache, insomnia, nausea, and vomiting. Prolonged therapy can lead to neuropathy, malaise, myalgia and myopathy with increased creatinine-phosphokinase, and pancytopenia. Peripheral neuropathy is the most common side effect of zalcitabine. It correlates with the severity of HIV infection and may affect

Table 3. Antiretroviral Drugs (Non-Nucleoside Reverse Transcriptase Inhibitors) and Side Effects

Generic Name	Trade Name	FDA Pregnancy Category	Dose	Adverse Side Effects
Nevirapine	Viramune*	C	200 mg q.d.	Gastrointestinal disturbances, increased liver enzymes, skin rash, P-450 enzyme induction
Efavirenz**	Sustiva†	C	600 mg q.d.	Skin rash, gastrointestinal disturbances, increased liver enzymes
Delavirdine	Rescriptor	C	400 mg t.i.d.	Skin rash, gastrointestinal disturbances, increased liver enzymes

Food and Drug Administration (FDA) Pregnancy Category = "C" (safety in human pregnancy has not been determined).
* Manufactured by Boehringer Ingelheim, Ridgefield, CT; † manufactured by Bristol-Myers Squibb, New York, NY; ‡ manufactured by Pfizer, New York, NY.
** Efavirenz should be avoided during the first trimester of pregnancy.

Table 4. Antiretroviral Drugs (Protease Inhibitors) and Side Effects

Generic Name	Trade Name	FDA Pregnancy Category	Dose	Adverse Side Effects
Saquinavir	Invirase fortovase*	C	600 mg t.i.d.	Gastrointestinal disturbances, hyperglycemia, lipodystrophy, inhibits cytochrome P-450-isoenzyme (CYP_3A)
Indinavir	Crixivan†	B	800 mg t.i.d.	Gastrointestinal disturbances, hyperglycemia, skin rash, nephrolithiasis, renal failure, unusual distribution of fat, inhibits cytochrome P-450
Ritonavir	Norvir‡	B	600 mg b.i.d.	Gastrointestinal disturbances, hyperglycemia, increased liver enzymes, lipodystrophy, inhibits cytochrome P-450
Nelfinavir	Viracept§	C	750 mg t.i.d.	Gastrointestinal disturbances, hyperglycemia, lipodystrophy, inhibits cytochrome P-450
Amprenavir	Agenerase‖	C	1200 mg b.i.d.	Skin rash, inhibits cytochrome P-450

Food and Drug Administration (FDA) Pregnancy Category = "B" (animal reproduction studies failed to demonstrate a risk to the fetus); "C" (safety in human pregnancy has not been determined).
* Manufactured by Roche Pharmaceuticals, Basel, Switzerland; † manufactured by Merck, Whitehouse Station, NJ; ‡ manufactured by Abbott Laboratories, North Chicago, IL; § manufactured by Pfizer, New York, NY; ‖ manufactured by GlaxoSmithKline, Research Triangle Park, NC.

30% of patients treated (45). Lamivudine is the least neurotoxic of the currently used nucleoside analogues. It may exacerbate preexisting neuropathy (46). However, combined antiretroviral therapy was shown to improve HIV-related peripheral neuropathy (47). Peripheral neuropathy is generally reversible on cessation of therapy.

2. Non-nucleotide reverse transcriptase inhibitors (NNRTIs). These drugs inhibit the enzyme reverse transcriptase by direct binding. Because they bind only to the HIV-1, resistance to them develops rapidly when given as a single drug. The recommendations are to use NNRTIs in combination with three or more drugs to enhance their effectiveness (48). The NNRTIs most commonly used are nevirapine, delavirdine, and efavirenz (Table 3). Their major side effect is skin rash, including Stevens-Johnson's syndrome. Nevirapine causes cytochrome P_{450} enzyme induction (CYP_3 A3/4) and may decrease serum levels of some anesthetic or sedative drugs (i.e., midazolam, fentanyl) (49).
3. Protease inhibitors (PIs) (Table 4). These drugs inhibit the HIV protease by binding to the active cleavage site. The most commonly used PIs are saquinavir, ritonavir, indinavir, and nelfinavir. Side effects are gastrointestinal symptoms, hyperglycemia, peripheral neuropathy, obstructive uropathy (30), increased liver enzymes, and hypertriglyceridemia (50). Efavirenz is a potent teratogenic drug that should be avoided during the first trimester of pregnancy (45). Indinavir may be associated with mild hyperbilirubinemia, hematuria, and renal failure resulting from obstructive uropathy (30). The PIs are metabolized by the cytochrome P_{450} isoenzyme cytochromeP_3A_4 (CYP_3A_4). They competitively inhibit the enzyme and may increase the effects of drugs metabolized by cytochrome P_{450}. Therefore, these anesthetic drugs should be titrated carefully (49). Ritonavir is the most potent inhibitor of CYP_3A_4 and CYP_2D6 and is a less potent inhibitor of $CYP_2C_{9/10}$ (51). Fentanyl, a synthetic opioid analgesic, is metabolized mainly by CYP_3A_4 (51) and to a lesser extent by other CYPs (52).

Anesthetic Management

Assessment of risk and coexisting diseases during preoperative evaluation should focus on the patient's status, type of surgery, and anesthesia, which, combined

with the Centers for Disease Control stage of HIV infection, the immunologic status (CD_4^+ cell count), and the coexistence of opportunistic infections and malignancies, should allow a good prediction for the perioperative risk of the HIV-patient to be construed. Advanced HIV infection, when accompanied with opportunistic infections or malignancies, may complicate the perioperative course and management. The CD_4^+ count/mortality relationship is useful in risk assessment. Regardless of surgical procedure, there is a 13.3% mortality rate 6 mo postoperatively when the CD_4^+ count is <50 mm^{-3} and a 0.8% mortality rate when the CD_4^+ count is more than 200 mm^{-3} (53).

Preoperative assessment consists of the history, physical examination, and laboratory studies. The history should include evaluation of opportunistic infections and malignancy and concurrent treatments with antiretroviral or antiopportunistic drugs. The laboratory work-up should include complete blood count, clotting functions, and glucose, liver, and renal function tests. Verification of the immunological status, i.e., the CD_4^+ lymphocyte cell count and viral load during the previous 3 mo, is important. Chest radiograph and electrocardiogram should be performed in all patients. Patients with a history or signs of cardiac or pulmonary dysfunction should undergo a more thorough evaluation (blood gases, pulmonary function tests, echocardiography, cardiac effort test, and radioactive cardiac scanning or even cardiac catheterization). One must remember that these patients have often been subjected to cardiotoxic antiretroviral drugs, may be in a hypercoagulable state, may have accelerated coronary arteriosclerosis, and often have decreased left ventricular contractility (19–22). They will require appropriate preoperative work-up and therapy before any anesthetic or surgical procedure.

Anesthetic Techniques

Factors that need to be considered when administering general anesthesia include the possible effects of anesthesia and opioids on the immune system, the pulmonary and neurologic status of the HIV patient, and possible interactions with anti-HIV medications. Laboratory data suggest a detrimental effect of opioids on immune function (54). However, the clinical significance of short-term opioid administration during general anesthesia is unclear and there are not enough clinical data available to justify its avoidance. The presence of neurologic manifestations, such as overt dementia, may impair the ability of the patient to provide preoperative consent (55) and may increase brain sensitivity to sedative or psychoactive drugs (opioids, benzodiazepines, and neuroleptics). Opportunistic infections may be associated with increased ICP, predominantly with toxoplasmosis. Because these infections respond rapidly to medical therapy, surgery should be postponed whenever possible when they are present. Increased ICP and CNS infections (meningitis, encephalopathy, or myelopathy) are contraindications to neuraxial anesthesia (56).

The diagnostic approach to patients with HIV infection and neuropathy, myopathy, or other neurological deficit consists of taking a comprehensive neurological history and physical examination. Blood studies are needed to exclude diabetes mellitus, vitamin deficiencies, alcoholism, hereditary diseases, and infectious diseases such as CMV or Lyme disease. Cerebrospinal fluid analysis and nerve or muscle biopsy may be required. Radiological studies of the spinal cord should be performed as part of the neurological evaluation to exclude compressive lesions in symptomatic patients. This is particularly important in a patient scheduled for a surgical procedure under regional anesthesia (57).

The complications associated with the use of succinylcholine, such as hyperkalemia or hyperpyrexia, are only a potential risk to be considered in the HIV patient with progressive neuropathy, myopathy, and muscle wasting. No such complication in HIV patients has been reported in the literature; hence, the use of succinylcholine is not absolutely contraindicated (58).

Pulmonary complications can occur as a consequence of opportunistic infections. This may lead to respiratory distress and hypoxemia, aggravated by a decrease in functional residual capacity seen during pregnancy. Regional anesthesia may be a preferable technique in these patients. However, a high motor block with intercostal muscle paralysis may not be tolerated. Regional anesthesia was shown to be associated with reduced morbidity and mortality in a wide range of patients, including treated HIV parturients having cesarean delivery under spinal anesthesia (59).

Toxic Side Effects and Drug Interaction with Anesthesia

Before administration of any anesthetics, the anesthesiologist should be aware of the possible toxic side effects or to the possible interaction of antiretroviral drugs with the anesthetics. For example, neuropathy or myopathy may dictate change of anesthetic techniques. Anemia and thrombocytopenia are major toxic side effects of zidovudine. PIs can affect glucose metabolism. Foscarnet and PIs can cause renal toxicity. Foscarnet can also alter calcium and magnesium balance. Other side effects include increased liver enzymes (trimethoprim-sulfamethoxazole), bronchospasm (aerosolized pentamidine), and ventricular arrhythmias (IV pentamidine).

Pis, such as ritonavir, are inhibitors of CYP_{450}, which impair the metabolism of multiple anesthetics and analgesics, such as midazolam and fentanyl, and cardiac drugs, such as amiodarone and quinidine (51).

Nevirapine is an inducer of CYP_{450} and therefore increasing doses of anesthetic drugs may be required in patients receiving the drug (60). Etomidate, atracurium, remifentanil and desflurane are not dependent on CYP_{450} hepatic metabolism, and therefore, are preferable drugs.

When considering the type of anesthesia, regional anesthesia has the advantage of not interfering with the immune system or with antiretroviral drugs. Contraindications to regional anesthesia in these patients are sepsis and platelet abnormalities. The presence of neuropathy may reduce the appeal of regional anesthesia but there are no data to contradict its use. In a review of 96 HIV positive parturients, of whom 36 delivered under regional anesthesia, the advantages of regional anesthesia were confirmed (61). In a recent article (59), the effect of spinal anesthesia was studied in 45 HIV-treated parturients who underwent cesarean delivery. There were no perioperative complications or changes in immune function or viral load. The American Medical Association addressed the issue of providing care for patients with HIV and stated that physicians have an ethical duty to provide any treatment needed to HIV patients and avoid discrimination against such patients (62).

Postdural puncture headache may occur after regional anesthesia and may necessitate epidural blood patch. Tom et al. (63) found no increase in neurologic abnormalities in 6 HIV patients receiving an epidural blood patch during a follow-up period of 2 yr. There is no evidence to contraindicate the use of blood patch in HIV-positive patients. However, the small numbers reported may justify a conservative management as a first choice (64).

Magnetic resonance imaging (MRI) studies of the spinal cord in 55 symptomatic HIV patients showed neurologic involvement of the spinal cord in 49 patients, mostly of infectious origin (57). Currently, MRI is not often done in the preoperative HIV patient presenting with neurologic involvement, but is considered in a comprehensive neurological work-up or for neurosurgical indications to verify soft tissue pathology. There are increasing numbers of compromised HIV patients who are drug abusers, diabetics, postorgan transplantation recipients, and on long-term steroid treatment developing spinal infections. They are often diagnosed too late, mostly presenting with back pain or other neurologic signs or symptoms (65). Prolonged epidural catheterization in such severely compromised patients may be contraindicated (66). However, a series of 350 cancer patients who had prolonged epidural catheterization and were monitored closely for possible infection and promptly treated had no adverse sequelae (67).

Conclusions

The pandemic of AIDS is on the threshold of its third decade of existence. The World Health Organization and United Nations statistics indicate that HIV/AIDS pandemia will get much worse. Women of reproductive age are the fastest growing population with HIV. Common signs and symptoms have become more moderate or subclinical, and new clinical presentations have emerged. It is quite apparent that HIV disease affects multiple organ systems. Advances have been made in elucidating the pathogenesis of HIV. In addition, the molecular technique of viral load determination and the CD^{+}_{4} T-lymphocyte count enable the evaluation of the disease, its prognosis, and its response to therapy. There is limited specific information concerning the overall risk of anesthesia and surgery on HIV/AIDS patients. However, as far as can be determined, surgical interventions do not increase the postoperative risk for complications or death and should therefore not be withheld. There is also little evidence to suggest that HIV or antiretroviral drugs increase the rate of pregnancy complications or that pregnancy may alter the course of HIV infection. General anesthesia is considered safe, but drug interactions and their impact on various organ systems should be considered preoperatively. Regional anesthesia is often the technique of choice. Yet, one must consider the presence of neuropathies, local infection or blood clotting abnormalities.

Anesthesiologists must be familiar with this disease, and prenatal anesthesia consultations and a team approach will optimize treatment for the pregnant woman with HIV.

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