Shootdown solution

Although counterintuitive to helicopter pilots, flying high may be the best protection against shootdowns

BY COL. JIM SLIFE

Helicopter pilots flying in the lethal environment of Iraq are faced with a dilemma — one that may prevent them from seeing the world as it is and instead lead them to see it as they've been told it would be.

Years of intensive training, institutional knowledge and safety procedures have prepared our pilots to be the best low-level pilots in the world. When combat requires that they change their tactics, however, that mind-set can become a fatal attraction.

Low-level flight is demanding and exciting. In a threat environment in which radar-guided missiles and anti-aircraft artillery predominate (such as Korea, Cold War Europe, China, pre-2003 Iraq or Iran), low-level tactics would likely be the most survivable for helicopters. Without ejection seats and with a limited ability to glide, helicopter pilots are often most comfortable when near the ground. At the first indication of mechanical trouble, helicopter pilots can land without the need to find a runway and can troubleshoot from the relative safety of solid ground. Furthermore, in combat zones with unregulated airspace, it is common for airspace authorities to deconflict slow-moving helicopters from high-speed fixed-wing aircraft via altitude "blocks," with helicopters staying below a certain altitude and fixed-wing aircraft staying above that altitude, generally about 3,000 feet above the ground. When combined with the powerful, subtle narcotic of repetitive, exciting training, helicopter pilots are predisposed to fly low because — in the absence of any better reason — "that's just the way we do it." This approach may blind them to alternatives that might be less lethal.

Interestingly, fighter pilots in fixed-wing jets suffered from the same myopia for years.

During much of the Cold War, the prevailing belief among fighter pilots — supported by the familiar security blanket of intensive training, specialized equipment, and extant doctrine and tactics — was that the best way to defeat a modern integrated air defense system (IADS) was to fly low and fast. The 1973 Yom Kippur War began to disabuse some of that notion. Israeli fighter attrition against the Soviet-built IADS of the Arab countries was unacceptably high, and in the aftermath of that war, some fighter pilots began to re-evaluate their fundamental assumptions about altitude tactics. Despite the strong evidence to the contrary, however, there remained a heavy emphasis on low-altitude tactics both during training and during the rigorous "Red Flag" exercises — the belief being that low-altitude tactics were more difficult and thus should remain the focus.

In mid-1978, the new commander of the U.S. Air Force's Tactical Air Command led a shift in fighter tactics, training and equipage that has proven remarkably effective in the intervening 30 years. Gen. Bill Creech, convinced of the futility of attempting to overfly modern IADS en route to other targets, began to advocate the suppression or destruction of IADS as the first order of business for modern air war. Whether done from low altitude or high, once the IADS threat was defeated, friendly aircraft could focus on cementing their control of the skies and executing aerial attack missions without the deadly threat of surface-to-air-missiles (SAMs) or anti-aircraft artillery (AAA).

In support of this shift in tactics and doctrine, the Air Force led the world in fielding precision-guided munitions, which could be delivered from medium-to-high altitudes (above 20,000 feet), and the requisite targeting capabilities. Training exercises shifted away from low-altitude scenarios such that by the mid-1990s, fighter units were no longer employing the navigation pods that enabled terrain-following low-level flight and had removed them from many of their aircraft.

The validation of this shift away from low-altitude tactics, training and equipment came during the 1991 Persian Gulf War, when the Air Force's percentage of precision-guided munitions employed exceeded that of the Navy (the next closest service) by a factor of three and a half, with a correspondingly low loss rate. In fact, the U.K. Royal Air Force lost Tornado fighters employing low-altitude tactics at a rate 11 times greater than the Air Force's loss of comparable F-15E fighters with similar missions flown from medium to high altitudes. Each of these components — doctrine (thinking), training and equipment — was a crucial part of the comprehensive cultural shift that took place in the 1980s and persists to this day.

THE IRAQ THREATS

How does all of this relate to helicopters today? In Iraq, there are essentially six threats to low-flying helicopters: terrain, wires/power lines, towers, rocket-propelled grenades, small arms/light machine guns and man-portable air defense systems (MANPADS — shoulder-launched heat-seeking missiles). Notably absent is the threat from deadly radar-guided SAMs and AAA, which render high-altitude helicopter flight inadvisable. Given the existing threat and the well-documented successes insurgents have achieved over low-flying helicopters recently, a review of helicopter tactics seems to be in order.

High-altitude helicopter tactics, although not a panacea for the lethal threats presented in Iraq, offer significant advantages over the low-altitude tactics currently being employed. The first three —natural and man-made environmental features — are clearly degraded with altitude. Flight above 500 feet is generally sufficient to avoid terrain, wires/power lines and towers. However, the enemy-directed threats listed above are still problematic — although not insurmountable. Rocket-propelled grenades are out-ranged above about 1,500 feet, and small arms/light machine guns can routinely be overflown

above 3,000 feet. It is the MANPADS threat, with ranges exceeding the service ceilings of virtually all helicopters, that presents the most difficult tactical problem for helicopter crews in Iraq today.

The commonly accepted wisdom is that the higher helicopters fly, the more vulnerable they are to MANPADS. Thus, when insurgents employ MANPADS, the classic tactical response is to fly lower, fly faster and vary the navigation routes to prevent predictability. Although the latter two actions are clearly appropriate, flying lower not only increases the vulnerability to the other five threats illustrated above, but also renders helicopters more — not less — vulnerable to MANPADS. In short, if long-standing helicopter employment thinking is wrong, then habit and inflexibility will result in dead Americans.

Flying higher to degrade the MANPADS threat is a more appropriate response than flying lower, for four reasons:

• The geometry of the MANPADS engagement envelope. MANPADS, with a range of roughly three to four miles, create a lethal envelope that can be (approximately) thought of as a hemisphere with the missile launch occurring at the center of the circle that forms the base of the hemisphere. By flying at the surface (500 feet and below), helicopters may be engaged out to the maximum range of the MANPADS. At 10,000 feet above the ground, the surface area from which the helicopter can be successfully engaged is reduced by roughly 20 percent to 30 percent.

• Increased reaction time. MANPADS travel at a speed of about 1,500 miles per hour. When launched from close range (one-half mile) with the helicopter at low altitude, the pilot's reaction time is about one and a half seconds. At the same horizontal range with the helicopter at 10,000 feet above the ground, the pilot's reaction time is nearly five and a half seconds. This increased reaction time is crucial if the helicopter crew is to successfully defeat the engagement. At low altitude, even assuming the helicopter crew sees, identifies, processes and reacts to a MANPADS launch within the first second, any defensive maneuvers and/or countermeasures have only half a second to work, leaving no time to attempt a second countermeasure sequence. From high altitude, several countermeasure sequences can be employed to defeat the missile in-flight.

• Increased total energy. An aircraft's ability to maneuver is most directly affected by its total energy state. Total energy is the sum of the potential energy (a function of altitude) and kinetic energy (a function of speed). Assuming speed is constant regardless of altitude, a helicopter's energy is completely a function of its altitude, and more is better. That is to say, a helicopter at 500 feet has less ability to maneuver than a helicopter at 10,000 feet. Whereas the crew operating at low altitude can only trade speed and excess power for the ability to turn, the crew at high altitude can also trade altitude. Put plainly, the crew at high altitude can lose a lot of altitude while maneuvering before it worries about hitting the ground.

• Ability to reduce the infrared signature of the aircraft. Virtually all MANPADS use some variant of an infrared heat seeker to identify and track their targets. The most prominent infrared energy sources on helicopters are the engines, and engine heat is directly proportional to the power applied. At low altitude, the helicopter pilot must keep power applied to the engines while maneuvering to avoid excessive airspeed loss or unacceptable loss of altitude. By contrast, the pilot of a high-altitude helicopter can afford to reduce the power applied to a minimum and accept the accompanying loss of altitude as the helicopter is maneuvered. The ensuing reduced infrared signature of the helicopter makes other countermeasures much more effective.

Thought of another way, to successfully shoot down a helicopter, a MANPADS operator must detect and engage the helicopter. With the exception of a narrow class of missions, detection is irrelevant if engagement is avoided. Regarding engagement, the measure of effectiveness is not MANPAD launches but, rather, MANPADS "hits." Although the surface area from which a MANPADS can be successfully launched decreases with altitude, even were one to assume a helicopter at high altitude may be engaged as often as a helicopter at low altitude, the benefits listed above accrue to the helicopter crew and decrease the probability of a successful engagement.

There are, of course, a great number of practical reasons why helicopter crews are reluctant to fly at high altitude. In addition to training and habit, there are at least five other nontrivial factors to consider.

• Mission requirements. Some missions require lower-altitude flight than others. Close-air support from a helicopter platform, for example, could not be conducted from 10,000 feet above the ground. However, with training, it would be possible to fly a part of the close-air support mission from altitudes above 3,000 feet. In Iraq, this would eliminate the environmental obstacles, as well as the small arms, light machine gun and rocket -propelled grenade threats, and would reduce the MANPADS threat marginally. Attack helicopter pilots could still benefit from the increased MANPADS reaction time at higher altitude and significantly improve their total energy states.

• Weather. Although weather with heavy clouds or other visual obscurants benefits the helicopter crew (if you can't see the ground, those on the ground can't see — and shoot — you), most helicopters are not equipped with the requisite avionics to maintain formation while in such weather and lack the ability to climb over most weather systems. Because helicopters tend to operate in formations of two or more and are unable (because of the spinning rotors) to get close enough together to maintain visual contact while in clouds, the inability to reliably maintain one's position relative to another helicopter becomes problematic. Additionally, helicopters are usually not equipped with anti-icing systems robust enough to enable routine flight in icing conditions. Fortunately, weather is seldom a significant factor in Iraq.

• Defensive systems. Many helicopters are equipped with defensive countermeasure systems that are optimized for operation at low altitudes and may lack the ability to provide full coverage at high altitudes. Although companion systems

may provide some ability to compensate for these coverage "holes," the existing systems may require modification to retain full effectiveness at high altitudes.

• Performance. Helicopter lifting performance is reduced with altitude. To maintain the same power output available at low altitudes, the turbine engines powering helicopters today are required to run much hotter. There are mechanical limits to how hot an engine can run, and this serves to reduce the available power at high altitudes. In addition, the aerodynamic performance of the rotor systems falls off in thinner air. Nevertheless, even with limited performance, any effort to get above 3,000 feet will pay dividends — the higher the better.

• Blind spots. At low altitude, helicopter crews have a virtually unobstructed view of their surroundings. At high altitude, there is a cone under the helicopter that can't be visually scanned, providing enemy gunners a vulnerability to exploit. Several slow-moving fixed-wing aircraft have this same vulnerability, however, and have compensated by installing floor windows to enable crewmembers to scan the vulnerable underbelly. Additionally, other aircraft successfully employ a wingman protection scheme in which two or more aircraft continually scan each others' vulnerable areas to warn of impending threats that may be unseen to the target.

This discussion is not theoretical. Some elements of the U.S. military have begun to employ high-altitude helicopter tactics with great success. However, these tactics are only part of a solution that will involve modifications to equipment and training. Among the most pressing requirements today are:

• Further dedicated tactics development testing (and accompanying tactics, techniques and procedures) to determine helicopter vulnerability to threat systems at various altitudes, as well as identify the best departure/climb-out and descent/arrival tactics. En-route cruise flight is only one element of the tactical problem.

• Avionics and/or tactics, techniques and procedures to enable nonvisual in-flight formation positioning.

• Avionics and/or tactics, techniques and procedures to enable descent through the weather for a visual approach and landing to unimproved areas.

• Modifications to existing countermeasures systems to fill coverage gaps.

• Fundamental changes to existing airspace procedures to enable high-altitude helicopter flight to be procedurally deconflicted from fixed-wing aircraft and unmanned aerial vehicles.

• Improved helicopter anti-icing and de-icing systems.

• Turbine engines capable of powering helicopters at higher altitudes.

• Changes to training and evaluation syllabi for both initial and recurring tactical training to teach, practice, evaluate and ingrain the full spectrum of altitude tactics.

VEXING CHALLENGES

Perhaps — like the fighter transformation — the requisite changes will be championed by one service and rapidly adopted by the other three services after having proven their worth. Or, perhaps the post-Goldwater-Nichols environment will enable a joint solution to the vexing challenges of helicopter vulnerability. In any event, difficult work lies ahead, undoubtedly made more difficult — and more urgent — by the fact that all four services are engaged in combat with their helicopter platforms. Like the successful transformation in fighter employment throughout the 1980s, any change in helicopter employment will be fully successful only with simultaneous changes in doctrine, training and equipment. However, these changes will have to be made on the fly, without the benefit of a decade's worth of Cold War during which to develop, refine and rehearse the needed changes. Further, helicopter tacticians must face a difficult challenge that their fighter counterparts were spared: arrival and departure tactics development in the threat environment.

High-altitude helicopter tactics will not produce a permanent advantage. A shift to high-altitude helicopter flight may provide the upper hand for a period of time, but the enemy will eventually react and further innovation will be required to stay ahead. However, it is clear we have not innovated as fast as our enemies, and history should have provided ample warning.

Ironically, U.S.-funded insurgents achieved great successes against low-altitude Soviet helicopter forces with MANPADS in Afghanistan in the mid-1980s. Although the Soviets learned from these experiences, they didn't innovate fast enough to ensure the dominance of their helicopter force. After the Yom Kippur War, it took five years for the U.S. Air Force to begin transforming fighter employment in response to the threat seen in a proxy war. What have we done to transform helicopter employment in the 20 years since the proxy war in Afghanistan and the lessons of low-altitude helicopters vs. MANPADS? Beyond fielding some evolutionary new countermeasure technology, the answer is, regrettably, "very little." Innovation in helicopter employment has severely lagged the fixed-wing model over the past 25 years. Fielding improved countermeasures is a start, but the transformation will not be complete until we change each of the elements described above — doctrine, training and equipment. Aviators of all services must engage on this issue; each has a stake and owns a part of the solution set. It is time to address helicopter employment with the collective expertise residing in the U.S. military and do it with our eyes wide open.