Bone and joint infection: Tackling as a rural surgeon

One thing that every surgeon dreads about is infection. Even with availability of the best of the techniques and drugs, it cannot be ascertained with full assurance that it may not happen. The fear of its happening has taken a toll on the peaceful sleep of millions of people. And if it happens, it is a near disaster for the whole surgical team and a total disaster for the patient. The age-old dictum which we learnt in our textbook still holds true, i.e., "breathe over a bone and you are looking at infection." It just shows the vulnerability of bone and joint biological environment.

The burden of such infection is huge and is estimated to be annually running into billions and billions of dollars. It is still extremely conservative estimation, if we consider that it excludes the cost spent on all the failed preventive measures. In today's modern hospital setting, huge amounts are spent on building operation theaters (OTs) and ancillary systems to minimize the risk. On their part, surgeons also resort to every possible way to bring down any possibility of infection. Antibiotics and air control are two highly favored ways. Hence, different antibiotics are freely used, with varying doses, route of delivery, and duration, including systemic, local, implant incorporated, etc., Similarly, laminar flows, exhaust suits, and many other possible ways are being researched and resorted to. May I dare to state that the issue is almost pushed to the level of paranoidism, and in this pursuit, things are being pushed beyond enough evidence and taking a toll on the resources so much so that many such costly interventions are being looked at with very high level of skepticism?

Most of the rural population around the world is still deprived of such modern infrastructure and techniques. There is wide gap in the availability of such operation suites and technology across the globe. Whenever and wherever it is available, the affordability by such masses at large remains questionable. Also, lot of standardizations are still to happen in terms of antibiotic therapy too.

Many surgeons are convinced that if such high technological interventions are not available, the operation suites are insecure, and many, on the other hand, in such possession are brimming with overconfidence that nothing can go wrong. Such underconfidence and overconfidence both are dangerous. Underconfidence affects the timely and adequate accessibility to the needy. Overconfidence has led to false sense of security and over-prompt indulgence, many a times ignoring the very basics of prevention and managing infection. So, the basic question that looms is "How much is enough to ensure a predictable outcome and keep the post-surgical infections under acceptable norms and limits?" This is very difficult to answer due to lack of enough evidences, consensus, and variability of effective practices.

The best way I can answer is through the experiences I gained to organize myself while working at a tertiary care rural center for the last 15 years and developing sub-speciality care including in total joint replacements and spine and deformity corrections, making efforts to keep the delivery of such care within local resources as well as to minimize the risk of infections. These efforts have not been huge, but have been effective to minimize the infection rate to well within 1% of my elective surgery.

For me, the answer lies in streamlining all the processes involving the surgical care. It includes preoperative assessments and care, placement of patient in the ward, scrubbing and gloving techniques, adequacy of scrubbing and wearing suitable gowns, preparation and draping of parts, surgical techniques, discipline inside the operation suite, control of air environment and room temperature, choice of antibiotics, and postoperative care including investigating and managing early signs of infections.

Also, if infection happens, critical decisions need to be taken in controlling it by various means, such as using local relook procedures including mechanical/pulse lavages, single-stage or two-stage debridement, with or without retention of implant, use of spacers or gap fillers, and choice of antibiotics in the presence of implant (especially in the light of the concept of biofilms getting developed over both implant and bone surfaces).

A set of protocols, well known to the whole team, is the most efficient way of handling the prevention than technology. If the simple hand hygiene protocol introduced by Jospeh Lister almost 200 hundred years back could bring down the sepsis by 50% than with the present-day aspetic liquids such as sterillium, usage is bound to one of the most effective ways of controlling infection in the wards amongst the patients. This had been my choice along with usage of a clean bed with well-washed linen for my preoperative positioning of patient. In our settings which are not air-conditioned, I would still prefer my patient to be by the side of window with access to natural clean air and away from any infected/potentially infected patient.

The pre-screening assessment includes estimation of hemoglobin, WBC, platelet count, total leukocyte count (TLC), erythrocyte sedimentation rate (ESR), urine microscopy, blood sugar, liver function tests (LFT), and kidney function tests (KFT). The patients would be clinically screened for any oral and dental infections, ear and throat infections, and dermatological conditions. Any significant history of probability of infection of any site would be more intensely looked for, e.g., if pus cells are seen in urine, then urine culture and sensitivity would be done. In cases where active infections are present, I avoid performing surgery, unless and until it is a life-/limb-threatening situation.

Such patients would be put through the treatments with appropriate antibiotics.

The preoperative preparation that I prefer includes shaving of the part only if necessary and, that too, in the secure environment of OT immediately before surgery or if too much hairs are present, rather than useing clippers or hair removal creams. The choice of scrubbing the part would be initially with a surfactant agent such as savlon, but not vigorously; and then it is wiped it with sterile gauges, followed by thick painting of iodophor compound preparation (2% preferably betadine* type), letting it dry for 5 min, and then applying 70% alcohol just before the incision and letting it evaporate, leaving the field dry.

The drapes would be at least in three layers, with the lowermost being of impermeable material, followed by two layers of synthetic mixed cotton drapes. I take all precautions to keep these draping dry throughout the surgery, and if at any time they tend to get wet, I change them immediately. Pre-sterilized disposable drapes are used, as desirable, but not essentially in our protocol.

I would prepare myself by wearing a clean and washed cotton-mixed synthetic clothing (which can breathe), with above-elbow exposed arms, full head gear cover, and masks. Though recently wearing of mask as an essential gear is being questioned, it is an inexpensive precaution, which in my opinion, should be adhered to. The footwear would be full toe covered plastic shoes which have been recently washed with water (if not by ultrasonic cleaner) and dried.

I would scrub in the standard manner for 2-3 min with soap and water and then scrub with iodophor scrub solution and air dry the same, and lastly vigorously rub below elbows with sterillium. I prefer wearing gowns which are of mixed cotton and synthetic material, and If lot of wetting is anticipated than wear a sterile plastic apron, underneath the gown. The role of exhaust suits with positive air is still not very clearly evidenced to be part of standardized gear and may be used in resource-rich environments. Wearing two pairs of ordinary latex gloves would be the standard practice, with changing of outer gloves after draping is over. Similarly, I would prefer all the assistants to do so.

The operation suits are spacious, well laid with clean and washable walls and floors, and the temperature is controlled with air-conditioner to around 18°C-20°C. The OT walls are totally seamless, floors epoxy coated, and air flow regulated and filtered through high-efficiency particulate air (HEPA), with positive flow of air through laminar control, though there is still no very firm evidence of outright benefits arising out of such OTs. It is more important to keep the operation suite clutter-free, with so many machines around; this is a tough call, but I tend to organize every bit of it, so that such machines are kept farthest from the OT table. Also, the discipline of each theater worker is more important, which includes minimal talking and moving. It is recommended that the door opening during surgery should not be more than 4-5 times, and loud talking and bad traffic (especially moving across the table) inside OT is a bigger threat when working without laminar flow. I have always found overhead OT lights to be obstructing the smooth flow of laminar flow over the OT tables, but then it is almost an unavoidable situation. Vertical laminar flow could be the answer, but then, the surgical team would be the obstruction. So, I have my own skepticism as to how much to rely on air flow.

I prefer to keep the implant trolley totally separate and covered, and to be uncovered only at suitable time.

Unnecessary long incisions, too much handling of tissues including stretching, and too much of cautery use are essentially avoided. I prefer to give a gentle 20 cc syringe wash before closure and avoid pulsatile lavaging. It has a risk of pushing and forcing the contamination inward, if not handled properly. There is no evidence of using antibiotic-mixed lavage or wash for controlling the infection environment or lowering the risk.

I prefer delaying the stabilization by internal implant in compound fractures till I am reassured of wounds not getting worse, and putting external fixators, if urgent need arises.

I prefer closure with unbraided smooth threads, preferably Ethicon, or use staples. I avoid use of braided silk at any cost. Similarly, I also avoid using catguts inside due to the unpredictability of them getting absorbed and later leading to problems. The sutures would be just firm enough and neither too tight nor loose, so that good healing is encouraged at the margins with no threat of margin necrosis, etc., A sterile iodophor ointment dressing over the suture line is used, as the ointment tends to form a thin film, sealing the wound completely.

The prophylactic antibiotic used is a bactericidal antibiotic, with proven minimum inhibitory concentration (MIC) levels in bone environment and as recommended by the infection control committee. I do not normally add antibiotics for extra coverage of the gram-negative bacterial population (such as Gentamycin or Amikamycin) unless a threat of the same has been realized, and these situations are would lead to long duration of surgery (more than 90 min) or wetting of drapes during surgery, which increases the risk of the surgical site getting contaminated by table/floor organisms. The antibiotics are given IV, 12 h before surgery, half an hour before incision, and continued for four more doses. The antibiotics on the OT table are given before tourniquet inflation. The choice of oral antibiotic is usually variable and depends on the progress and vulnerability of each individual and may range from not at all to 7 days postoperative. The choice is again a bactericidal antibiotic. The local use of antibiotic in the form of mixture with cement is considered and it is restricted to Gentamycin. The usage of other antibiotics such as Vancomycin, Amikamycin, and Tobramycin has not shown any added advantage (in literature as well).

In case of any signs of infection, such as spike of fever in postoperative period, laboratory investigations are promptly done

and include hemoglobin, TLC and WBC, ESR, and C-reactive protein (CRP). If they are abnormally increased, the antibiotics are reviewed and adjusted in accordance, but if they are normal, nothing more is done.

In case the fever does not subside, check dressing is performed under secure environment; and if any signs of abnormal inflammation are noted, IV antibiotics are continued for 5 days. If any discharge is noted, relook surgery is performed with good irrigation and wash of the wound and secondary closure at a later date after at least two check dressings and sight of healing wound. The antibiotic is then changed as per culture and sensitivity.

In case the infection does not tend to be controlled, decision of retaining the implant has to be critically reviewed. It is an established fact that the biofilms get formed over implant and bone surfaces, and are the real barriers for effective antibiotic penetration in the local environment. The way to tackle such situation includes the following.

One-stage solutions: Giving a mechanical irrigation after removing the implant from the local site, along with adequate debridement, and re-inserting the implants after treating them, which may be by immersing them in iodophor solutions for an adequate time (it has been shown to be most beneficial) or irradiating them or subjecting them to "sonification." We do not have facilities for irradiation and sonification and have never resorted to such means. Immersing in aseptic solution and reusing them immediately has also not been adopted by us.

Two-stage solution: It involves a good debridement, putting up temporary spacers/external stabilization, and subsequently in the second stage, putting up a new implant. This is a costly option and the spacers used are customized of bone cement and antibiotic-loaded ones.

Perhaps the one-stage option is more patient-friendly, and as evidence would gather for its predictable outcome, it will be the procedure of choice in future. Similarly, the role of bioglass particles is being researched into and they may be used, especially to fill up small defects and cavities. The bigger defects created due to sequestrectomy have been built upon with the help of distraction histogenesis and bone transports in long bones and bone grafting in short bones.

The choice of antibiotics in such cases would be entirely based on the culture growth and sensitivity. The duration of such antibiotic treatment would be at least for 3-6 weeks. The dilemma of selecting the appropriate antibiotic gets more when sensitivity is inconclusive. In such cases, I would prefer taking multiple biopsies and cultures from multiple sites, from the same wound. In cases where methicillin-resistant *Staphylococcus aureus* (MRSA) is reported, the choice would be Vancomycin, and in all other cases where retaining the implant is preferred, the choice would be Rifampicin as it is the only antibiotic which is able get across biofilms. Overall, I do not panic with the choice or step up the antibiotics unnecessarily and would get blood cultures done to evolve a good strategy of antibiotic therapy.

In addition, I usually try building up the immunity of patients through diet and, in India, by taking the help of Ayurveda (refer to ayurved physician for herbal immune-modulator).

Over time, this set of approaches has been a very cost-effective solution for our rural population in such difficult situations. Definitely prevention is better than cure, and what actually helps is clear understanding of the biology of both microorganisms and patient, and the pharmacology of antibiotics. To control the infection, essentially team approach with strict discipline and set of standardized protocols is needed more than the dependence on machines and tools. A safe and predictable outcome can be ensured with just adequate measures with no compromise on the essentials. Heavily relying on the environment of operation suites may not be the best policy. Basics of hand hygiene, adequate OT discipline, and appropriate and judicious usage of antibiotics are more important for safer outcomes.

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