EDITORIAL

In Search of the Ideal Tracheobronchial Stent: Metal or Silicone?

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Jean François Dumon, master teacher of interventionist endoscopy, recently taught his final course when he retired at the end of last year. The occasion provides us with the opportunity to consider, once again, the question asked by many pulmonologists when choosing a tracheobronchial stent, "Which is better, metal or silicone?" The answer, at least in Europe, is relatively clear: we prefer silicone stents. This preference is closely linked to the intensive and pioneering work carried out by Dr. Dumon at Santa Margarita Hospital in Marseille and by some of his outstanding students—now teachers themselves—such as Dr. Pablo Díaz Jiménez in Barcelona. Dr. Dumon created a school of thought and was also the first to design, back in 1989, a tremendously useful, simple, and inexpensive tracheobronchial stent.[1] The inadvisability of using metal stents in the airways was practically taken for granted this past autumn in Marseille, and this is not surprising considering Dr. Dumon's extensive experience and long dedication to teaching. The drawbacks of metal stents were discussed at length: the feared complications that result from the abundant granulomatous reaction to the metal; the inexorable tendency of the metal to fracture and fatigue (progressive deterioration of the material caused by the application of repetitive force); the fact that their placement is irreversible; and their cost.

Nevertheless, these stents exist and are used daily. The answer to why that is the case is clear: in the absence of a well-designed, randomized, multicenter clinical trial providing another reason, it must be assumed that some pulmonologists lack the skill in handling a rigid bronchoscope that is necessary for inserting a Dumon stent. Others learned to place stents in the United States of America, where some pulmonologists use metal stents almost exclusively, far from the influence of the French school.[2] Certainly, judging from the experience of those who use metal stents, the results are not usually as bad as might be expected, especially for malignant obstructions. Unfortunately, it is difficult to find any systematic comparison of silicone and metal stents. Indeed, Dr. Dumon is against participating in such a study for reasons of principle, and most of his outstanding students likely feel the same. Under the circumstances, it is clear that—for the moment—we must rely on consensus and common sense, both of which suggest that the best approach is to avoid metal stents in the immense majority of benign cases. An exception to this rule is the treatment of anastomotic complications in lung transplant recipients, in which case metal stents have many advocates and their use is supported by evidence from several recent studies.[3-5] For malignant obstructions, the best approach can be decided on a case by case basis.

In any case, leaving aside the current debate between supporters of silicone or metal stents, it would be interesting to consider another question, "What characteristics would the ideal tracheobronchial stent have?" To put it another way, if one could choose, "What would one look for in a tracheobronchial stent?" Let us start with the obvious: the ideal tracheobronchial stent does not exist, nor is it ever likely to exist. Nearly everyone agrees on this, for the simple reason that the airways are designed to expel foreign bodies, not host them. Paradoxically, the rigid bronchoscope was originally used by pioneers such as Gustav Killian or Chevalier Jackson as a "life-saving" instrument capable of removing foreign objects from the tracheobronchial tree, whereas now it is used for the opposite purpose (to insert stents, valves, and brachytherapy catheters).[6] Fortunately, our collective experience inserting tracheobronchial stents over the past decade has taught us much, providing us with a set of basic criteria to guide the development of new stents.

In our opinion, an effective tracheobronchial stent must meet the following requirements:

1. Biocompatibility. The stent should be manufactured of material that is tolerated by the airways without causing excessive inflammatory reactions. Both nitinol and silicone meet this requirement and have proven useful. Likewise, biodegradable stents with seemingly excellent biocompatibility are being developed.[7]

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2. Impermeability. Particularly in cases of malignant obstruction with bronchial airway involvement, the stent must prevent the tumor from growing through it. This property is perhaps more important than the radial force of the stent since, as Dr. Dumon often says, no silicone stent has ever been crushed by the external pressure of a tumor; the meshwork of many metal stents, however, has been penetrated, resulting in the growth of the tumor inside the stent and recurrence of the bronchial obstruction. The greatest disadvantage of covered stents is that secretions are not evacuated and can therefore obstruct the lumen. This complication is very common and has been described as symptomatic in up to 38% of cases.[8] In benign obstructions, one advantage of uncovered metal stents—at least in the short term—is the avoidance of this complication.

3. Dynamism. The ideal stent should be dynamic, capable of adapting itself at all times to a tracheobronchial wall that is far from static. The tendency of metal stents to fracture from the fatigue caused by constant airway movement is well-known.[9] Silicone stents, on the other hand, usually hold up well for more than a year after insertion.[10]

4. Stable placement. The ideal stent would not migrate from its initial position. One of the most frequent complications of silicone stents is their tendency to shift in the airway; this occurs in 10% to 19% of cases.[10,11] This complication is more common with inexperienced bronchoscopists who make measurement errors prior to stent insertion—such errors decrease as the pulmonologist gains experience.[11,12] In this regard, metal stents are far superior because they generally attach to the bronchial wall without difficulty.

5. Removability. The ideal stent would be removable, especially in cases of benign obstruction. In this aspect, silicone stents are superior to metal stents. Metal stents cannot be easily removed because they attach to the tracheobronchial wall in a matter of weeks. If complications arise, patients with metal stents often require multiple laser treatments or electrocautery to treat recurrent granulomas caused by an irritative reaction to the metal.

Although there are other reasons why an ideal stent should be removable, the principle one is the empirical nature of stent insertion. In other words, stent placement is not an exact science and errors may be made with respect to size, diameter, or location. Moreover—despite all expectations—the insertion of a stent may not always benefit the patient, in which case removal is best.

6. Low cost. Cost is another significant advantage of silicone stents. If metal stents were clearly superior, cost would not necessarily be an obstacle. However, given the current state of the debate and the limited resources of the health care system, the cost differential is significant.

7. Ease of insertion. Finally, the ideal stent should be easy to insert. At times, the patient requiring a stent is found *in extremis* and needs a rapid intervention to resolve a severe airway obstruction. Even though both silicone and metal stents are, in principle, easy to maneuver (once the pulmonologist is familiar with their use), lack of familiarity with the rigid bronchoscope usually presents a serious obstacle for many endoscopists when a silicone stent needs to be inserted quickly and efficiently. On the other hand, with the help of a fiberoptic bronchoscope, metal stents can be easily inserted in the intensive care unit without having to transfer the patient to the operating room or remove breathing tubes.

We conclude this editorial, it seems, with the initial question left unanswered, perhaps because all comparisons are odious. The solution may be to combine metal and silicone, as is already being done, or to develop biodegradable stents. In any case, the enormous usefulness of tracheobronchial stents should be evident, and comparison of one with the other is difficult because they are so often used in emergency or palliative settings. However, we must not forget that familiarity with the stent we choose is essential and that a removable stent is always preferable when lesions are benign.

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