Airway gastric fistula (AGF) is a rare but dangerous complication following esophagectomy for esophageal cancer, with an incidence rate of 0.3–1.9%. For AGF, the primary goal is closure of the fistula between the digestive and respiratory tracts to avert ongoing soilage of the airway. Although surgical repair remains the definitive treatment, it is associated with a mortality rate of 32%. With the development of interventional therapy, airway stenting has become an effective palliative treatment for AGF. Dumon™ (Novatech, France) stents have been successfully used to treat AGF for years.

We conducted this retrospective study to explore the value of these devices to treat AGF. This study was approved by the Ethics Committee and Medical Records Management Section Institution of the No. 2 Hospital Xiamen (Fujian Province, China). The medical records of all AGF patients who were treated with Dumon™ stents in the department between July 2014 and December 2015 were reviewed. Given the retrospective nature of the study and the use of anonymized data, requirements for informed consent were waived. Preoperatively, the size and location of the lesion were estimated using flexible bronchoscopy; the appropriate shape of Dumon™ stent was then selected accordingly.

Although there are no uniform standards for assessing treatment efficacy, the criteria for complete fistula closure are as follows: no leakage of contrast medium after digital radiography, no cough symptoms upon drinking water, and clinical symptoms resolving without recurrence. Patient self-evaluation and mental condition are also important assessment indicators.

After stenting, the patients were followed up using bronchoscopy according to different schedules. Patient characteristics, fistula site, stent type, and follow-up results were recorded. Descriptive statistics were used to analyze the data.

A total of 16 cases (14 males, 2 females; mean age: 59.6 ± 8.9 years [range: 43–78 years]) were ultimately included. All patients had esophageal carcinoma and had undergone previous transthoracic esophagectomy surgeries. Among the patients, five (31.25%) had thoracogastric-tracheal fistulas, nine (56.25%) had thoracogastric right main bronchial fistulas, and two (12.50%) had thoracogastric left main bronchial fistulas. Patient characteristics are summarized in Supplementary Table 1.

All the stents were successfully implanted using rigid bronchoscopy under general anesthesia. The 16 stents placed included 13 “Y” shaped, one hourglass shaped, and two straight stents. According to the assessment criteria, complete fistula closure was achieved in 13 (81.25%) patients, in whom oral intake resumed within one week after the operation; patient self-evaluation was satisfactory with improved mental condition. Fistula closure failed in the other three (18.7%) cases, and the symptoms progressed.

Stenting was well tolerated in all patients, and no fatal, procedure-related complications occurred during the surgeries. Patients were followed up for 2–12 months after the operation.

Key words: Airway Gastric Fistula; Complications; Dumon™ Stent; Efficacy
The frequency of follow-up bronchoscopy was based on each patient’s condition, and ranged from three times/week to once/month. All patients experienced retention of secretions and varying degrees of granulation tissue formation. Stent migration occurred in one case, in which the original straight stent was replaced with an hourglass-shaped Dumon™ stent, with no subsequent migration. One case required replacement of the original stent with a longer stent due to fistula dilatation. The three patients in whom fistula failure occurred experienced exacerbation of their original infection. Two of these three patients died from serious infection 32 days and two months after stent placement, respectively.

Since the Dumon™ stent has been applied in clinical practice, it has become a promising tool for treating airway stenosis and fistulas. However, the use of the Dumon™ stent in AGF has only been described in sporadic case reports. The main stent types used to treat airway fistulas are metal and silicon. Metal stents often have self-expandable properties, which can adapt very well to tortuous airways. Although metal stents can be inserted easily, they are difficult to remove. Various types of covered expandable metallic stents have been used for the treatment of AGFs and have been reported to induce complete closure in 67–100% of cases.[4] Moreover, our team achieved an objective response rate (ORR) of 89.58% with covered metallic stents in a previous study.[5] However, metal stents are associated with membrane damage and metal fatigue. Since the Dumon™ stent has the advantages of durability and easy removal, the application of these stents has attracted an increasing attention. It achieved good efficacy in the present study (ORR: 81.3%), which is noninferior to the metal stent. Furthermore, complications, such as retention of secretions and varying degrees of granulation tissue formation, were mitigated with the Dumon™ stent. Therefore, the Dumon™ stent is an acceptable choice.

From our experience, it is important to select the appropriate type of stent for achieving satisfactory efficacy. Stent shape should be chosen on a case-by-case basis and dependent on the fistula site. Y-shaped stents are most commonly used because they fit closely to the wall of fistulas. However, when the fistula is in the high proximal airway (generally located >20 mm beyond the carina), straight and hourglass-shaped stents are chosen. In general, the stent should be 10–20% larger in diameter than the internal airway adjacent to the fistula orifice. It can be adjusted to a specific length during the operation to make it 10 mm longer than the edge of fistula. In addition, a professional team is needed to complete the operation, which includes a pulmonologist trained in interventional bronchoscopy, experienced anesthesiologists, and well-trained nurses.

Although the initial clinical success rate of airway stenting for the treatment of AGF is favorable, long-term clinical results are not positive. Our experience suggests that initial results may significantly influence long-term results. As we all know, multiple factors may influence prognosis, and primary disease is among the most important.

In conclusion, Dumon™ stenting appears to be a safe and effective procedure to seal AGFs, and is a reasonable approach to the initial management of AGF.

Supplementary information is linked to the online version of the paper on the Chinese Medical Journal website.

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Conflicts of interest
There are no conflicts of interest.

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| Patients' number | Age | Gender | Disease         | Previous treatment | Lesion location | Shape of stent | Effect       | Follow-up time (months) | Follow-up result |
|------------------|-----|--------|-----------------|--------------------|----------------|---------------|--------------|------------------------|-----------------|
| 1                | 65  | Male   | Esophageal cancer | RT and CTx         | RMB            | Y             | Complete closure | 18                      | Live            |
| 2                | 78  | Male   | Esophageal cancer | RT                 | Trachea        | Y             | Complete closure | 1.8                     | Dead            |
| 3                | 56  | Male   | Esophageal cancer | CTx                | Trachea        | Y             | Complete closure | 16                      | Dead            |
| 4                | 49  | Male   | Esophageal cancer | NA                 | RMB            | Y             | Failure        | 0.2                     | Dead            |
| 5                | 57  | Female | Esophageal cancer | RT and CTx         | RMB            | Straight      | Complete closure | 6.1                     | Dead            |
| 6                | 52  | Male   | Esophageal cancer | RT and CTx         | Trachea        | Y             | Complete closure | 8                       | Live            |
| 7                | 63  | Male   | Esophageal cancer | RT and CTx         | LMB            | Y             | Complete closure | 2.4                     | Dead            |
| 8                | 63  | Male   | Esophageal cancer | NA                 | Trachea        | Y             | Complete closure | 4.2                     | Live            |
| 9                | 43  | Male   | Esophageal cancer | CTx                | RMB            | Y             | Complete closure | 3                       | Dead            |
| 10               | 63  | Male   | Esophageal cancer | RT and CTx         | Trachea        | Straight      | Complete closure | 5.6                     | Dead            |
| 11               | 47  | Male   | Esophageal cancer | RT and CTx         | Trachea        | Hourglass     | Complete closure | 2                       | Dead            |
| 12               | 60  | Male   | Esophageal cancer | RT and CTx         | Trachea        | Y             | Failure        | 0.3                     | Dead            |
| 13               | 68  | Male   | Esophageal cancer | CTx                | LMB            | Y             | Complete closure | 6.1                     | Live            |
| 14               | 63  | Male   | Esophageal cancer | RT and CTx         | Trachea        | Y             | Failure        | 0.3                     | Dead            |
| 15               | 58  | Female | Esophageal cancer | RT and CTx         | Trachea        | Y             | Complete closure | 6                       | Dead            |
| 16               | 68  | Male   | Esophageal cancer | NA                 | RMB            | Y             | Complete closure | 8.2                     | Lived           |

RMB: Thoracogastric-right main bronchial fistulas; LMB: Thoracogastric-left main bronchial fistulas; NA: Not available; CTx: Chemotherapy; RT: Radiotherapy.