Case Report

# A Case Report of Stent-Assisted Coiling with One-and-a-Half-Lap Approach for Basilar Artery Fenestration Aneurysm

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**Objective:** Fenestrated basilar artery aneurysms (fBA-ANs) typically arise at the proximal bifurcation of the fenestration limb. It is reported that endovascular treatment with conventional coil embolization or balloon-assisted embolization techniques is often challenging and associated with a high complication rate, especially for wide-neck fBA-ANs. We present a case of fBA-AN successfully treated with stent-assisted coil (SAC) embolization using a novel one-and-a-half-lap approach with an open-cell stent, ensuring reliable neck coverage while preserving parent artery patency.

**Case Presentation:** A 33-year-old man with a history of an unruptured fBA-AN, previously treated with coil embolization via the double-catheter technique 6 years ago, presented with coil compaction and aneurysm recurrence. DSA revealed an fBA-AN measuring 8.7 mm in diameter, requiring retreatment. Under general anesthesia, SAC was performed using a one-and-a-half-lap approach. A Neuroform Atlas stent (Stryker Neurovascular, Fremont, CA, USA) was deployed via a 2.4 Fr microcatheter, positioned in a clockwise direction from the left loop fenestration to the right loop across the aneurysm neck, followed by coil embolization. Postoperatively, the patient remained free of ischemic complications, and follow-up imaging showed no recurrence of the fBA-AN.

**Conclusion:** This case demonstrates the efficacy of SAC with a one-and-a-half-lap approach using an open-cell stent for the treatment of complex fBA-ANs. This technique provides a viable treatment option for wide-neck fBA-ANs, ensuring durable aneurysm occlusion while maintaining parent artery patency.

**Keywords** one-and-a-half-lap approach, horizontal stenting, stent-assisted coil embolization, basilar artery fenestrated aneurysm, open-cell stent

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## Introduction

Basilar artery fenestration (fBA) is a rare but recognized vascular stent-assisted coil (SAC), most commonly located in the proximal basilar trunk, and is sometimes associated with cerebral aneurysms.[1)] The reported prevalence of Basilar artery fenestration (fBA) ranges from 0.6% to 2.33%.[2)] Fenestrated basilar artery aneurysms (fBA-ANs) account for 0.33% of all intracranial aneurysms but represent only 7% of fBA cases.[3)] Direct surgery for basilar artery aneurysms is challenging due to the complex surrounding anatomy, proximity to the lower cranial nerves, and the presence of perforating branches supplying the brainstem.[4)] Consequently, neuroendovascular treatment (NET), including simple coil embolization, balloon-assisted coil (BAC) technique and stent-assisted coil (SAC) technique, has become the first-line therapeutic options for managing fBA-ANs,[5)] demonstrating favorable technical outcomes.[5–7)] However, Korkmaz et al.[6)] reported a relatively high complication rate of 8%–10% in a literature

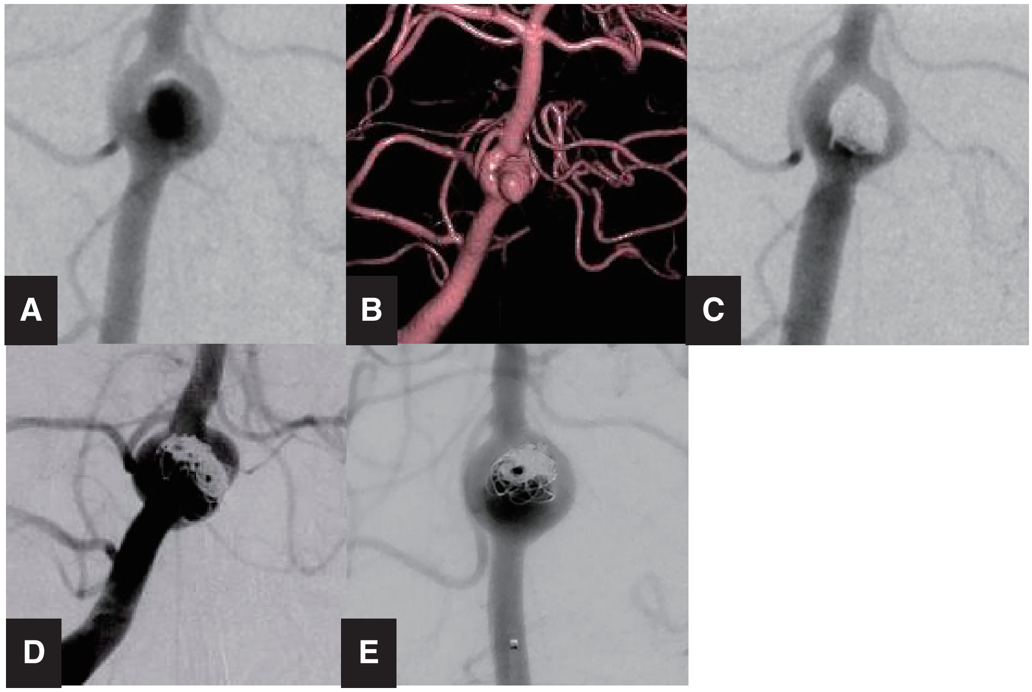


**Fig. 1** (**A**) DSA and (**B**) virtual imaging before the initial treatment. (**C**) DSA after treatment of an unruptured 8-mm fBA-AN using the double-catheter technique 6 years prior. (**D**) Anteroposterior view and (**E**) Waters view of DSA before the second procedure, showing coil compaction and aneurysm recurrence, now measuring 8.7 mm. fBA-AN, fenestrated basilar artery aneurysm

review, and Trivelato et al.[7] suggested that conventional treatment may be particularly challenging for wide-neck fBA-AN. Herein, we report a case of a wide-neck fBA-AN successfully treated using a one-and-a-half-lap approach.

## Case Presentation

A 33-year-old man presented with an unruptured 8-mm proximal fBA-AN, which had been previously treated using the double-catheter technique 6 years earlier (**Fig. 1A** and **1B**). Follow-up angiography revealed coil compaction and aneurysm recurrence, necessitating additional treatment. On examination, the patient was neurologically intact. DSA confirmed an fBA-AN measuring 8.7 × 5.6 × 5.2 mm, with a fenestration loop circumference of 25.6 mm (**Fig. 1C** and **1D**). The fBA-AN had a wide neck encompassing both fenestration loops and was slightly biased toward the right loop. The fenestration loop was shorter on the right side than on the left. Additionally, the left vertebral artery (VA) was hypoplastic, while the right VA was incorporated into the aneurysm neck. No perforating arteries were angiographically detected around the neck.

### Intervention (Fig. 2)

The patient received dual antiplatelet therapy 1 week before the procedure, with a therapeutic response confirmed using platelet function assays (350 aspirin reaction units, 104 P2Y12 reaction units [baseline 200, inhibition 48%]). Under general anesthesia, a 7 Fr Roadmaster 90 cm catheter (Goodman, Aichi, Japan) was placed in the right VA. A 3.2 Fr Tactics Plus 120-cm high-flow microcatheter (Technocrat Corporation, Aichi, Japan) and a Rebar18 153 cm microcatheter (Medtronic, Dublin, Ireland) were coaxially advanced into the left fenestration loop using a 0.014-inch Venture 14 200 cm microguidewire (Mizuho Medical, Tokyo, Japan) (**Fig. 2A** and **2D** [schema]). The Tactics microcatheter was used as a distal access catheter (DAC) and positioned in the proximal left loop to improve support for stent deployment. The Rebar18 microcatheter was advanced over the wire into the distal left loop by rotating the fenestration counterclockwise using a one-and-a-half-lap approach (**Fig. 2B** and **2E** [schema]). A Phenom 17 microcatheter (Medtronic) was then advanced into the aneurysm using a 0.014-inch ASAHI Chikai Black 200 cm microguidewire (Asahi Intecc, Aichi, Japan). The first coil, a Target-360-XL coil (7.0 mm × 20 cm) (Stryker Neurovascular, Fremont, CA, USA), was deployed within the aneurysm without detachment. Horizontal stenting (HS) was performed by placing a Neuroform Atlas (NFA) stent 3.0 × 21 mm (Stryker Neurovascular), deployed clockwise from the left loop to the right loop across the aneurysm neck (**Fig. 2C**, **2F** [schema], and **2G** [virtual image]).

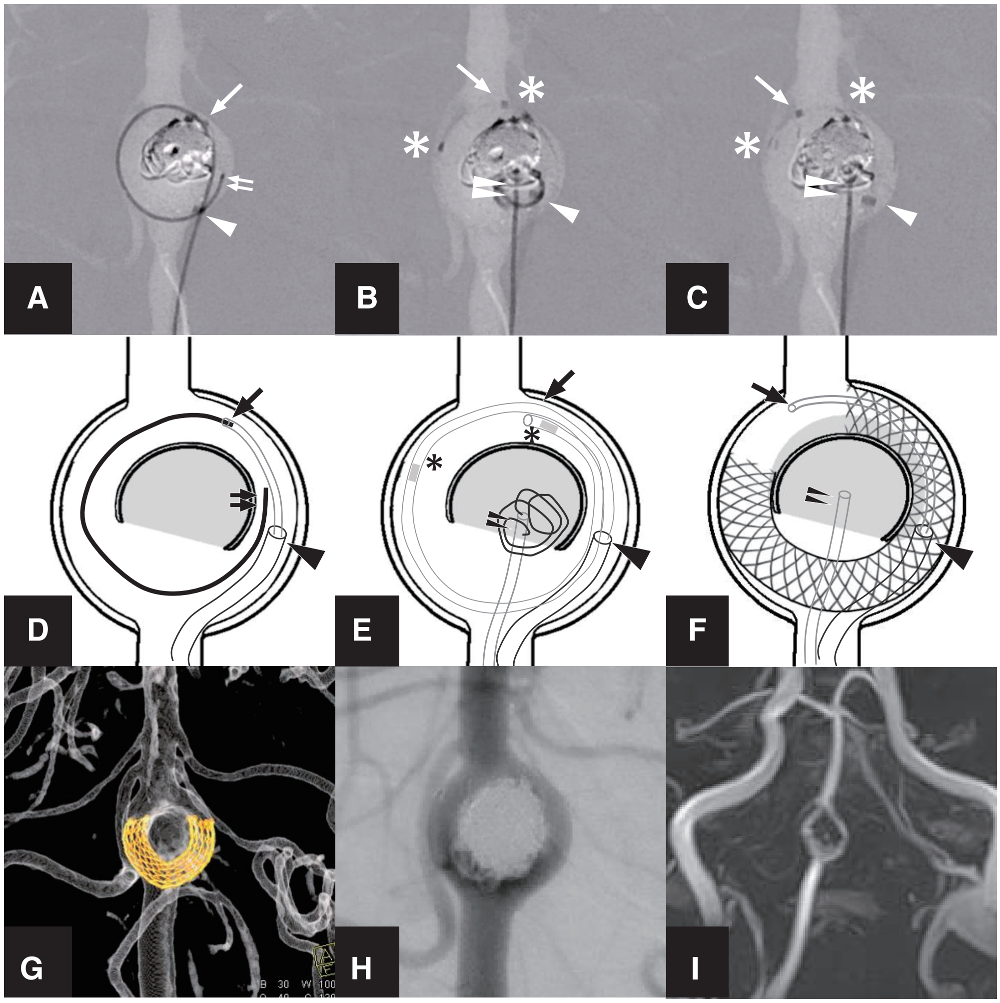


**Fig. 2** (**A** and **D**) The coaxial system (Rebar18/Tactics Plus/Roadmaster) was positioned in the proximal left fenestration loop (arrow, Rebar18; arrowhead, Tactics Plus; double arrow, Venture). (**B** and **E**) The Raber18 was advanced using a counterclockwise one-and-a-half-lap approach to rotate within the fenestration. Target-360-XL was deployed by semi-jail technique (asterisk, proximal and distal marker of Neuroform Atlas; double arrowhead, Phenom 17). (**C**, **F**, and **G**) HS was performed with a Neuroform Atlas stent. (**H**) Post-procedure angiography revealed a tiny neck remnant. (**I**) MRA at the 2-year follow-up demonstrated complete obliteration of the fBA-AN. fBA-AN, fenestrated basilar artery aneurysm; HS, horizontal stenting; Neuroform Atlas, Stryker Neurovascular, Fremont, CA, USA; Phenom 17, Medtronic, Dublin, Ireland; Rebar18, Medtronic; Roadmaster, Goodman, Aichi, Japan; Tactics Plus, Technocrat Corporation, Aichi, Japan; Target-360-XL, Stryker Neurovascular; Venture, Mizuho Medical, Tokyo, Japan

The first coil was then placed in the aneurysm using the semi-jailing technique. Finally, SAC was performed using 13 detachable coils. Angiographic evaluations revealed a tiny neck remnant (**Fig. 2H**). The patient was discharged on postoperative day 3 with no evidence of neurological deficits. Two years after the procedure, MRA confirmed complete obliteration of the fBA-AN (**Fig. 2I**).

## Discussion

We performed endovascular treatment of an fBA-AN using a one-and-a-half-lap approach. In our case, the fBA-AN had a wide neck, extending slightly into the right fenestration loop. While the initial treatment was completed using the double-catheter technique, coil compaction progressed after 6 years. Consequently, we successfully performed SAC using the one-and-a-half-lap approach, a technique not previously reported. This approach has several advantages: 1) it allows us to guide 2 microcatheters—1 for stent deployment and 1 for coil embolization—through a single parent artery; 2) it may be a viable option even when the contralateral VA is hypoplastic; 3) the procedure is relatively simple as it requires only 1 access route; and 4) it can be applied to aneurysms with various neck morphologies, including wide-neck aneurysms. However, this approach is not suitable in cases where 1 of the fenestration loops is too thin to accommodate a stent or guide a catheter, or when significant stenosis necessitates catheter wedging for

**Table 1** Characteristics of previous cases of fBA-AN treated by stent-assisted coil embolization

| Author | Year | Age | Sex | Rupture | Dome size (mm) | Neck morphology[9] | Stent | Stent deployment* | Approach side of VA | Follow-up (years) | Result | Complication |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Morrison et al.[12] | 2018 | 61 | M | Unruptured | 7 | 2A | LVIS | A | Ipsilateral | NA | NA | None |
| Gruber et al.[13] | 2010 | 38 | M | Unruptured | 27 | 2B | Enterprise*2 | E | Ipsilateral | 0.5 | BF | None |
| Kan et al.[14] | 2013 | 50 | M | Unruptured | 5 | 2A | Neuroform Atlas/Enterprise | D | Bilateral | NA | NA | NA |
| Alqahtani et al.[15] | 2017 | 65 | F | Unruptured | 20.5 | 2B | LVIS | B | Ipsilateral | NA | NA | None |
| Choo and Lee[16] | 2017 | 51 | F | Unruptured | 16.2 | 2A | Solitaire AB/Enterprise | C/D | Bilateral | 5 | CO | None |
| Park et al.[17] | 2015 | 38 | M | Ruptured | 18 | 2B | Enterprise*2 | C/D | Bilateral | NA | NA | Minor infarction, asymptomatic |
| Nayak et al.[18] | 2024 | 34 | F | Ruptured | – | 2B | LVIS | C/D | Bilateral | 0.5 | BF | None |
| Fujinaga et al.[19] | 2024 | 58 | M | Unruptured | 17.8 | 2B | LVIS*2 | B | Ipsilateral | 3 | CO | Minor infarction, asymptomatic |
| Present | 2025 | 33 | M | Unruptured | 8.7 | 2A | Neuroform Atlas | A | Ipsilateral | 2 | CO | None |

*Based on the scheme shown in **Fig. 3**.
BF, body filling; CO, complete obliteration; Enterprise, Codman Neuro, Raynham, MA, USA; F, female; fBA-AN, fenestrated basilar artery aneurysm; LVIS, Low-Profile Visualized Intraluminal Support, MicroVention, Tustin, CA, USA; M, male; NA, not available; Neuroform Atlas, Stryker Neurovascular, Fremont, CA, USA; Solitaire, Covidien, Dublin, Ireland; VA, vertebral artery

access. In a previous report, Miyata et al.[8] performed HS for aneurysms arising from VA fenestration using NFA. HS is defined as preserving blood flow in both branches of a bifurcation by placing a stent across the aneurysm neck via the circle of Willis.[9] Yamaguchi et al.[10] reported SAC using a single approach for a fenestrated middle cerebral artery aneurysm. In their case, the aneurysm neck was adjacent to 1 loop, making a single-loop stent sufficient. However, in cases such as ours, where the aneurysm neck spans both loops, classified as Trivelato Type 2B (described below), a one-and-a-half-lap approach is preferable to achieve complete neck coverage and successful SAC.

Essibayi et al.[11] conducted a literature review on NET outcomes for 175 cases of fBA-AN, reporting a complete occlusion rate of 76.7% and a retreatment rate of 7.3%. Korkmaz et al.[6] analyzed treatment outcomes for NET by procedure type, demonstrating a technical success rate of 97.4%, a complication rate of 9.0%, and a clinical success rate of 91.0% for coil embolization. In contrast, for SAC/BAC, the technical success, complication, and clinical success rates were 91.2%, 8.3%, and 91.7%, respectively. Although these studies highlighted favorable outcomes, they did not account for variations in aneurysm size or neck morphology.

**Table 1** summarizes previously reported SAC cases for fBA-AN,[12–19] including our case. Among the 9 documented SAC cases, the average patient age was 47.6 years, with 3 out of 9 being female, and 2 cases presenting with subarachnoid hemorrhage. According to Trivelato's classification,[7] 4 cases were recognized as Type 2A, while 5 were classified as Type 2B. In 5 cases, 2 stents were used, including 5 Low-Profile Visualized Intraluminal Support (LVIS) stents (MicroVention, Tustin, CA, USA), 6 Enterprise stents (Codman Neuro, Raynham, MA, USA), 1 Solitaire stent (Covidien, Dublin, Ireland), and 2 NFAs, amounting to a total of 14 stents. At follow-up, 2 out of 5 cases showed body filling, while 3 exhibited complete occlusion. We opted for a one-and-a-half-lap approach for SAC due to its ability to optimize aneurysm neck shaping, as shown in the schema (**Fig. 3**). This technique has been rarely applied to fBA-ANs, and we further discuss its surgical considerations. Alternative SAC techniques were evaluated. A single stent (**Fig. 3B**) was deemed unsuitable because it provides minimal metal coverage, potentially resulting in inadequate aneurysm neck coverage. The double-barrel or T-stent configuration (**Fig. 3C**) may pose a risk since it might leave a neck remnant between the 2 stents. The kissing stent (**Fig. 3D**) was not selected due

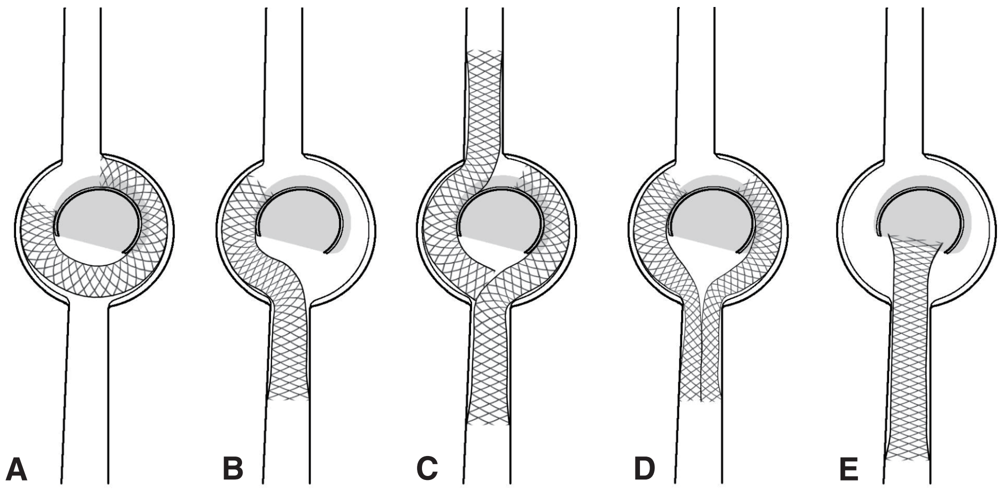


**Fig. 3** Schematic representation of different stent-assisted coil embolization techniques for fBA-AN: (**A**) horizontal stent, (**B**) single stent, (**C**) double-barrel stent, (**D**) kissing stent, and (**E**) waffle cone technique. The gray area represents the aneurysm dome. fBA-AN, fenestrated basilar artery aneurysm

to the flare structure at the end of the NFA, which could result in reduced mesh coverage at the aneurysm neck. Kan et al.[14] successfully employed a double-barrel stent technique feasible in a case with symmetric bilateral VA, a condition not present in our patient. Moreover, the waffle cone technique[13] (**Fig. 3E**) was unsuitable for our case due to the wide-neck morphology, which could lead to insufficient coverage. Another disadvantage of this technique was the direct inflow from the VA into the aneurysm, which may increase the risk of recurrence.

We selected NFA, an open-cell stent, due to its advantages, such as comfortable adhesion to the parent artery, stable deployment, and precise stent size selection. NFA features a design where its cells expand and adapt to the contours of the parent artery, even in tortuous vascular segments, allowing for a circular stent placement. In addition, we utilized the trans-cell technique in cases where the jail technique was not feasible or when additional embolization was needed due to aneurysm recurrence. Morrison et al.[12] performed HS for fBA-ANs using the LVIS Jr stent. Though the LVIS Jr stent has the advantage of higher metal coverage, it has the disadvantage of a greater shortening rate (NFA 10%–11% vs. LVIS Jr. 15%–22%).[20] These characteristics allowed us to deploy NFA at the intended location without experiencing stent shortening, despite the novelty of our technique (**Fig. 2B** and **2C**). A key limitation of open-cell stents is their inability to be re-sheathed once deployed. In this report, we outline strategies to address this challenge. DACs play a crucial role in improving stent deployment operability. We selected the Tactics high-flow microcatheter (Technocrat Corporation) as the DAC, which allowed for seamless SAC execution via the 7 Fr guiding catheter. The accessibility of the Tactics microcatheter enabled precise navigation to the fenestration loop, facilitating stable operation of the Phenom microcatheter (Medtronic) and enabling the one-and-a-half-lap rotation within the fenestration loop.

We planned to place the stent only within the fenestration area to maintain neck patency and prevent ischemic complications. Selecting the correct stent size was crucial: an overly long stent risked deviating into the distal BA, while a short stent might fail to provide adequate support. To ensure precise placement, we measured the diameter of the fenestration and simulated stent deployment using angiographic software (ARTIS icono; Siemens Healthineers AG, Erlangen, Germany). For optimal stability, we deployed the stent in a clockwise direction, considering that the left fenestration loop was longer while the right loop had a wide neck. We found that positioning the distal end of NFA in the longer left fenestration loop would enhance stent deployment stability. NFA was deployed just distal to the left fenestration loop to prevent its proximal end from outflowing into the BA. During deployment, we carefully adjusted both the unsheathing and stent push to ensure that the proximal end remained within the shorter right fenestration loop. Excessive unsheathing could have led to stent bypass of the fenestration loop. Due to the potential risk of neck remnant resembling “a dog ear,” long-term follow-up was deemed essential.

Trivelato et al.[7] classified fBA-ANs into 4 types based on the anatomical relationship between the aneurysm neck and the fenestration loops: Type 1A has a narrow neck, symmetrically located at the bifurcation; Type 1B have a wide neck, involving both loops; Type 2A has a narrow neck, sparing 1 loop; and Type 2B has a wide neck, sparing 1 loop. In their review of 63 cases with fBA-AN, the distribution was as follows: Type 1A (25 cases), Type 1B (3 cases), Type 2A (21 cases), and Type 2B (2 cases). The total occlusion rates for Types 1A, 1B, 2A, and 2B were 96%, 100%, 53%, and 100%, respectively. In particular, 24% of Type 2A cases required adjunctive techniques. Types 1A and 1B were more commonly treated without stenting, while in Type 2B cases, a single stent was generally sufficient to cover the aneurysm neck (**Fig. 3B**). However, for Type 2A aneurysms, such as in our case, adjunctive techniques need to be considered, as previously unreported strategies may be required for effective treatment.

## Conclusion

This case demonstrates the efficacy of SAC with a one-and-a-half-lap approach using an open-cell stent for the management of complex fBA-ANs. This technique offers stable neck coverage while preserving parent vessel patency, making it a viable option for treating wide-neck aneurysms. Further studies are warranted to evaluate long-term outcomes and procedural refinements.

## Disclosure Statement

The authors declare that they have no conflicts of interest.

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