Postoperative Management: Type I and III Endoleaks

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The purpose of this article is to help the reader understand the importance of imaging findings and treatment strategies for type I and III endoleaks. Although the appearance of these leaks on computed tomography can be somewhat unremarkable and similar in appearance to type II endoleaks, it is critically important for the treating physician to make the correct diagnosis, as these endoleak types signify an incompletely treated aneurysm. Once the diagnosis of a type I or III endoleak is made, the next step in treatment is to identify the cause of the endoleak. Incomplete initial graft expansion, further arterial dilation, endograft migration, component separation, and tears within the graft fabric are all possible causes of type I and III endoleaks. A combination of computed tomography, plain film radiography, and diagnostic angiography may be necessary to make the diagnosis and identify the underlying cause of the complication. Once all of these factors have been determined, a decision has to be made of whether the endoleak can be treated through additional endovascular means or if endovascular therapy has failed for the patient, making open surgical revision necessary to treat the aneurysm. Illustrative cases of all endoleak types and their treatments are the focus of this article.

Type II endoleaks remain the most common type of post-stent-graft implantation complication. However, type I and III endoleaks remain a significant concern in the postoperative period.[1-3] Whereas type II endoleaks may be treated conservatively, type I and III endoleaks represent a failure of endovascular therapy and must be treated if the patient is going to be protected from aneurysm rupture. The work-up and treatment strategies for these endoleaks are the focus of this article.

Type I endoleaks arise from an attachment site and occur at a rate of 1% to 2%. For further specificity in description, type I leaks are subclassified as either IA or IB. Type IA leaks arise from the proximal attachment site, whereas type IB leaks arise from distal attachment site(s).

Type I Endoleaks

The treatment of an immediately identified type I endoleak has been covered in another article in this issue ("Troubleshooting Techniques for Abdominal Aortic Aneurysm Endograft Placement: When Things Go Wrong," by Fox and Powell). This article focuses on type I leaks that are discovered in the postoperative period. These postoperative type I endoleaks can be caused by 1 of 3 factors. The first is an immediate endoleak that either went unrecognized at the time of implantation or for which a decision was made to limit the procedure time and address the problem at a later date. The second is a leak that is a result of further arterial dilation at one or more of the attachment sites. This dilation then leads to a loss of sufficient graft apposition to the arterial wall and an incomplete attachment site seal. Lastly, as the aneurysm remodels, the stent-graft can be subjected to forces that result in stent-graft migration and the potential for subsequent loss of attachment site integrity. Figure 1 shows the effects of aneurysm remodeling and the subsequent inferior migration of the stent-graft. When a type I endoleak is suspected, it is imperative that a treatment plan is quickly made. A patient with a type I endoleak has an essentially untreated aneurysm that continues to pose a risk of rupture.

Once a type I endoleak is suspected, it is first necessary to examine the implantation images to see if the leak was present at the time of implantation and went unrecognized. After this, computed tomography (CT) scans and plain film images should be obtained to determine if the graft has migrated or if there has been further dilation at one or more of the attachment sites. The value of standard abdominal radiographs cannot be stressed enough. Although a keen eye can detect a subtle inferior migration of the endograft or its individual components on CT scans, it is frequently difficult to appreciate the migration and the resultant angulation on CT images alone. These findings are readily apparent on the more global views that standard radiographs provide.

Finally, it may be necessary to perform diagnostic angiography to determine the site and type of endoleak. Figure 2 shows the value of selective injections in the determination of endoleak type and location. In this case, a standard abdominal injection showed an endoleak, but the exact type and location of the leak remained uncertain. A selective retrograde injection was then made into the right limb. With this injection, it became clear that the leak was in fact a type IB leak arising from the distal right attachment site. It is important to note that care must be taken to limit the force on these retrograde injections. If the contrast is injected too forcibly, the contrast will flow into the proximal part of the graft. This will make it difficult to pinpoint the leak location, as was the problem with the original aortic injection.

Once the location and the cause of the endoleak have been determined, a decision must be made of whether the leak can be treated by further endovascular intervention or if conversion to open surgical repair is warranted. Successful endovascular repair can be achieved for cases in which the graft may have been initially underdilated. This type of leak may be repaired by further balloon inflation at the attachment sites. Additionally, for cases in which there is a sufficient

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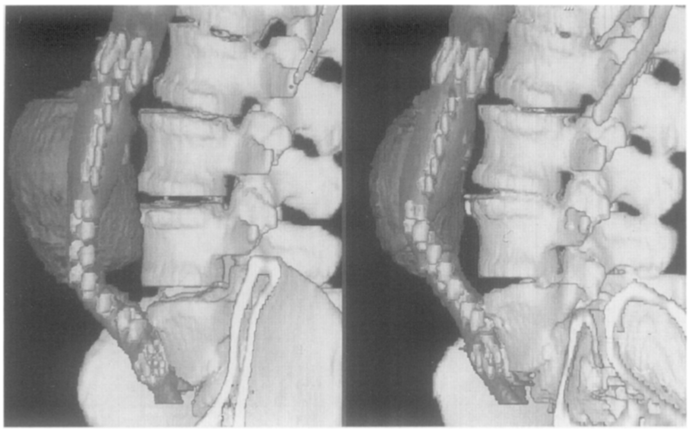


Fig 1. The effect of aneurysm remodeling on the stent-graft. Notice that with the reduction in aneurysm size there is greater anterior angulation of the stent-graft. Additionally, the point of angulation has moved superiorly. These factors can lead to graft migration and possible subsequent type I endoleak development.

additional anchoring area, an additional component may be added to achieve a complete seal. Figure 3 shows such a case. An additional component has been added to the distal right iliac attachment site, with successful treatment of the leak. An additional case is shown in Fig 4. Here, a tube graft has been placed inside the existing graft for treatment of a type IA endoleak. In those cases in which an additional anchoring area is not available or the graft has migrated significantly, surgical conversion may be warranted.

Type III Endoleaks

Type III endoleaks are classified as leaks arising from a defect within the graft itself. They are the rarest form of endoleaks and occur at a rate of less than 1%. This type of leak can be

Fig 3. Treatment of type IB endoleak. Images from the same patient as shown in Fig 2. after the deployment of an additional extension into the right common iliac artery. The leak is now sealed. It should be noted that the particular design of this extension has uncovered metal at the inferior aspect, so that while metal struts were placed across the origin of the hypogastric artery, graft material was kept above the origin of the internal iliac artery.

the result of 1 or 2 defects. The first of these is component separation and resultant endoleak. The second is a tear in the fabric material itself. To be more specific in the description of these 2 kinds of type III endoleaks, we propose the use of a subclassification system, as is used for type I endoleaks. We

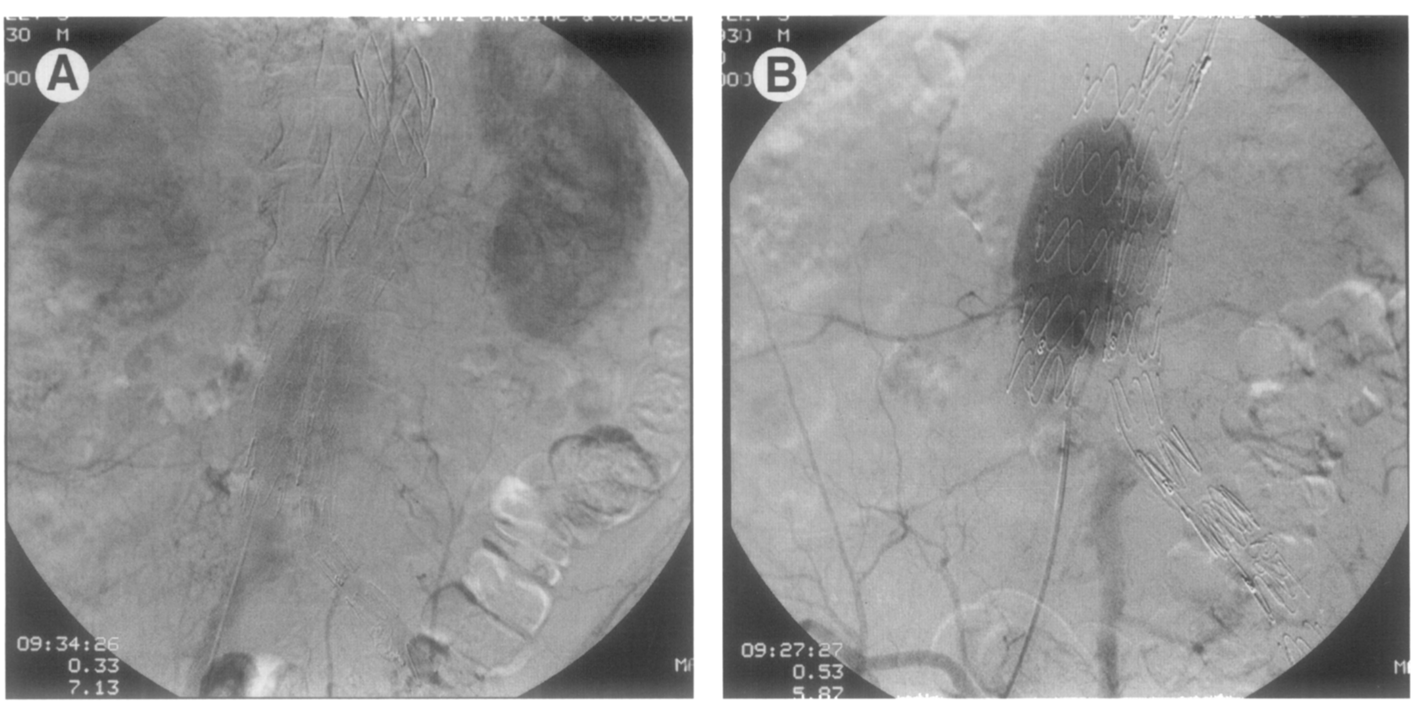
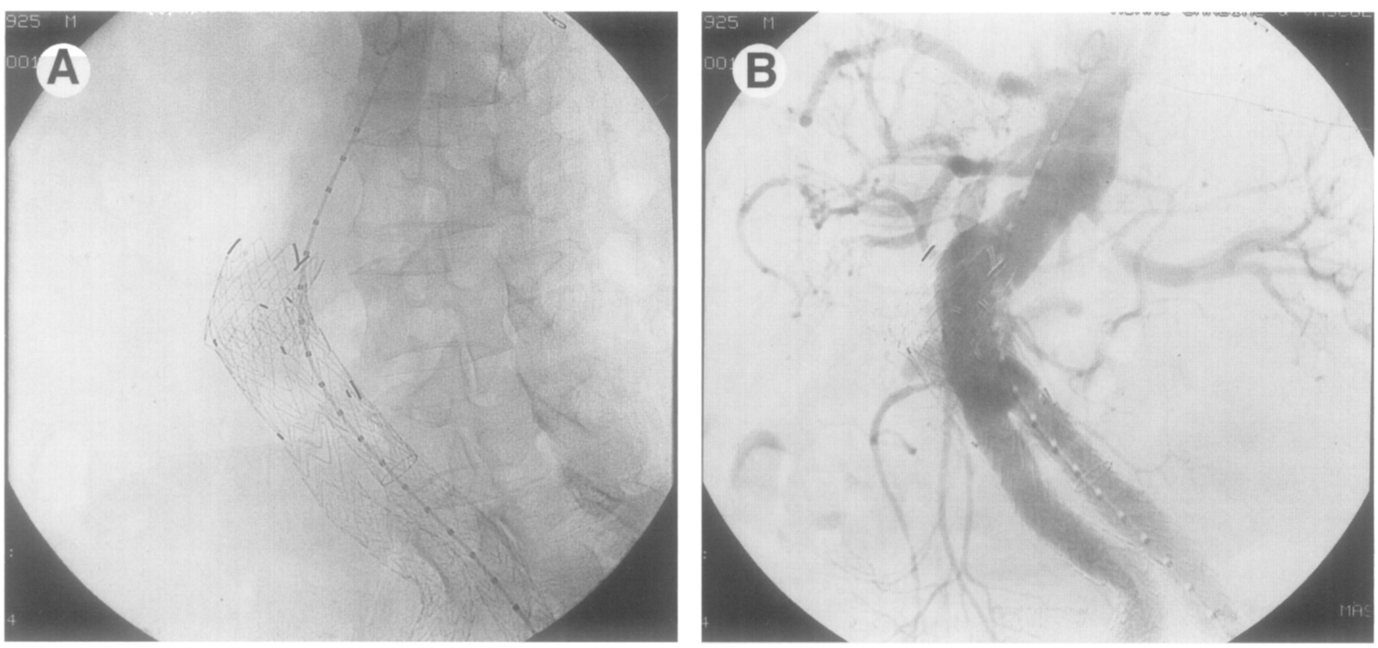


Fig 2. The value of selective angiography. Images from an aortic injection (A) only show a faint endoleak overlying the inferior aspect of the graft. However, it is not possible to discern the location of the endoleak. A selective retrograde injection (B) with the catheter in the right external iliac artery shows a large type IB endoleak arising from the distal right attachment site.

Fig 4. Treatment of type IA endoleak. A new tube graft has been placed within the pre-existing graft for the treatment of a persistent proximal attachment site endoleak shown along the right lateral aspect of the aneurysm.

use "IIIA" to denote an endoleak arising from component separation, whereas "IIIB" describes an endoleak arising from a hole in the fabric. Although the goal of this article is not to discuss the merits of the different graft designs and fabrics, it should be pointed out that type IIIA endoleaks are not possible in 1-piece grafts, although type IIIB leaks remain at least a theoretical concern for all endograft designs.

As is the case with type I endoleaks, one of the keys to proper type III endoleak management lies in the proper identification and location of the type III endoleak. Frequently, postprocedure CT scans only show a new endoleak. Although this is a clue that this might not be a typical type II endoleak, the CT appearance can be nearly identical to that of a delayed type II endoleak. As with type I endoleaks, standard radiographs can provide valuable information. Figure 5 shows such a case. In this patient, a new endoleak was detected on routine postprocedure CT scans. Based on the CT scan alone, it was not possible to classify the endoleak. However, standard radiographs



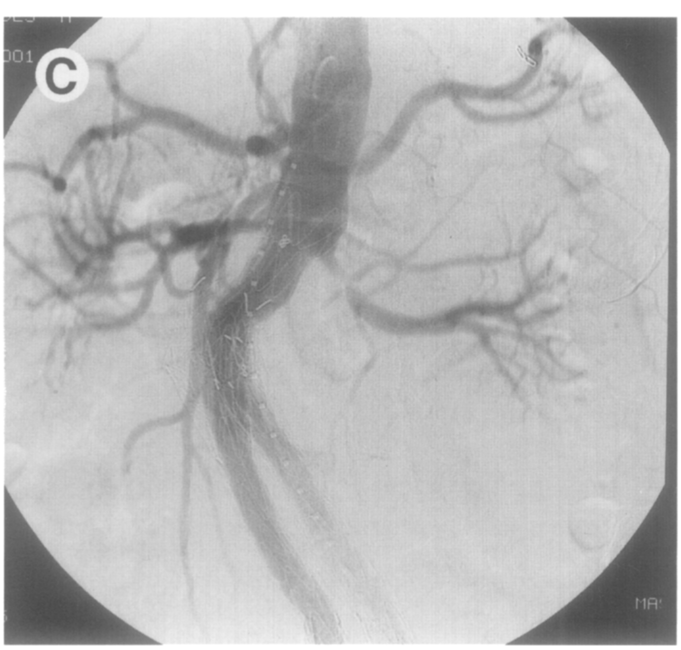


Fig 5. Type IIIA endoleak. (A) The component separation between the main body of the graft and the proximal aortic extension that was placed at the time of initial implantation; the resultant endoleak between these components is shown in part B. (C) After deployment of an additional graft within the graft, the leak has now resolved. An entirely new graft was placed within the graft rather than just a proximal extension because of the rather large distance between the renal arteries and the original graft.

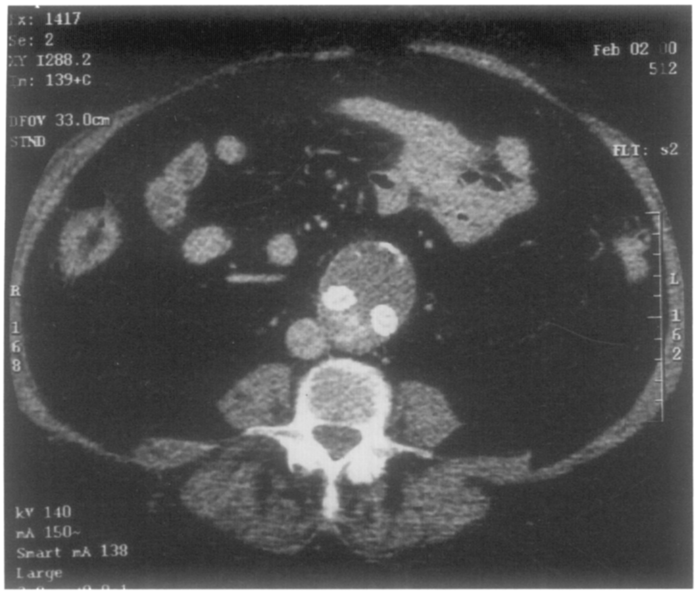


Fig 6. Type IIIB endoleak. Routine follow-up CT image shows a new endoleak within the distal aspect of the aneurysm sac. The image could easily be mistaken for a type II leak. The appearance of a new endoleak may indicate a more significant type of endoleak, and a complete work-up to identify the cause of the leak should be undertaken.

clearly indicated component separation between the main body and a proximal extension cuff that was placed at the time of initial implantation. A diagnostic angiogram was then performed to both confirm the diagnosis and obtain detailed measurements for future repair. Because of the relatively long distance from the renal arteries to the graft, a decision was made to place an entirely new graft within the graft rather than just an extension, as it was felt that an extension alone would not have provided sufficient coverage.

Fig 8. Type IIIB treatment. After the deployment of an additional overlapping extension into the left limb, the endoleak has been successfully treated.

Type IIIB endoleaks can often be quite unremarkable in their appearance. As seen in Fig 6, the CT appearance of this endoleak could easily be mistaken for a type II leak. However, this

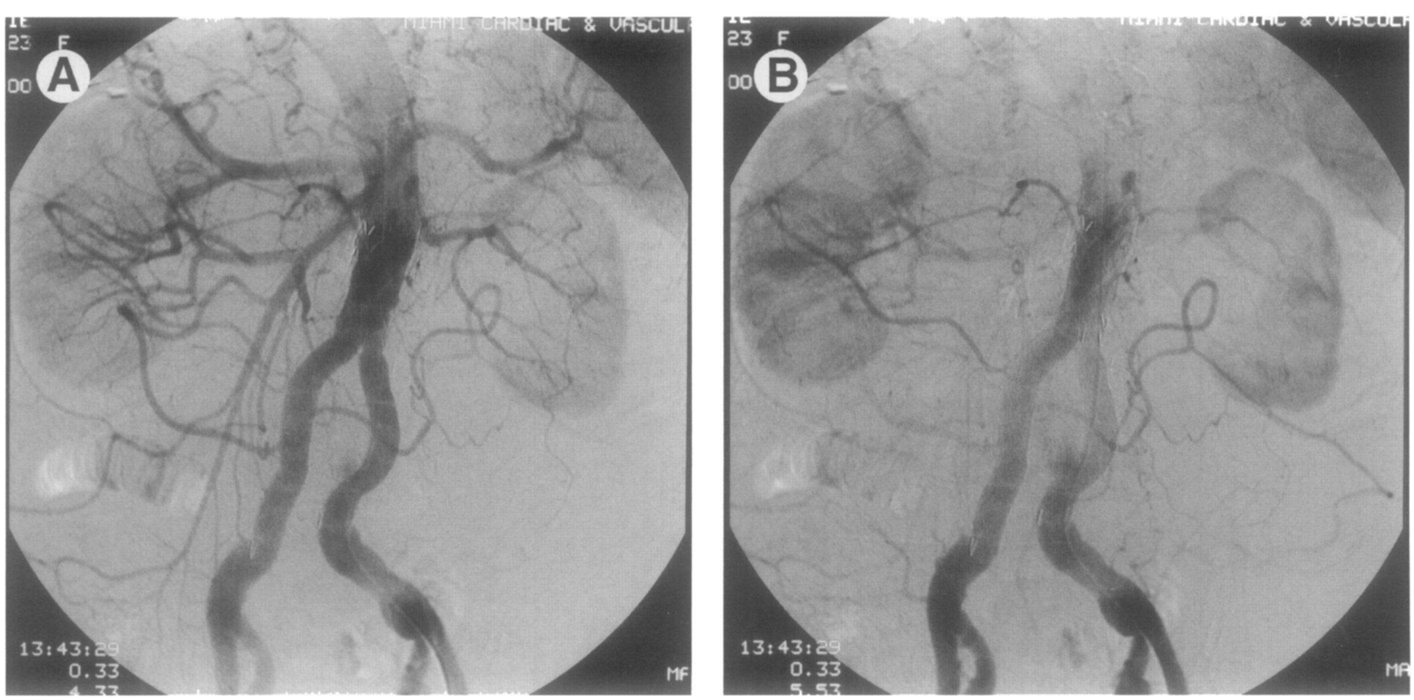


Fig 7. Early (A) and late (B) images from a diagnostic angiogram in the same patient as shown in Fig 6. Notice the progressive accumulation of contrast adjacent to the left limb of the graft. The diagnosis of a type IIIB endoleak can sometimes only be made with certainty by excluding all other causes for the endoleak. It is clear that the leak is remote from the attachment sites. Furthermore, no collateral vessels are seen that could have caused the leak. Lastly, the junction of the components was several centimeters superior to the site of the endoleak. Therefore, the diagnosis of a type IIIB endoleak can be made.

leak was not present on the previous study, thus increasing the suspicion for a non–type II endoleak. A diagnostic angiogram was performed (Fig 7), which confirmed a leak arising from a hole in the fabric of the left limb. This leak was then treated by placing an additional extension that overlapped the original (Fig 8).

Summary

Although type I and III endoleaks occur at a relatively low rate, their recognition and treatment remain a paramount concern in the postoperative period. It is critically important to recognize and treat these leaks because their presence leads to potential aneurysm rupture. Performing routine follow-up CT scans remains the mainstay of postoperative surveillance. However, it can sometimes be difficult to distinguish these endoleaks from type II leaks based on the CT scan alone. The role of standard abdominal radiographs cannot be overlooked. Frequently, these radiographs provide a more global view of graft migration and/or component separation. With proper identification, these potentially dangerous leaks can frequently be managed by further endovascular methods.

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