Ring-Down versus Comet Tail: Two artifacts uncovered

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Learning objectives

- To recognize these artifacts in ultrasound.
- To learn the physical basis that support in order to discriminate them.
- To guide the possible underlying pathology thanks to the correct interpretation of these artifacts.
Background

From the standpoint of radiologic imaging, we can define the term artifact as an image we cannot correlate with real anatomical structures.

In ultrasound, artifacts can produce structures that appear in the image but they are not present anatomically, although structures which are present anatomically may be completely absent. But that is not all, because artifacts can even show structures that are present but incorrect in location.

In our daily practice it is very usual to find them, and we can say they are a double-edged sword because they can interfere in a correct interpretation of the image, even they can be very useful to help us to do a precise diagnosis.

Therefore, there are many reasons to know, even not necessary with much depth, the physical bases that are underneath these phenomena. If we do not exercise often, we can easily forget, some of the less unknown artifacts. The fact is that if we understand, at least once, its production mechanism, it will be much less arduous its evocation in subsequent occasions.

To understanding the differences between the two, in first place we have to keep in mind their common aspects, considering that both artifacts are caused by multiple echoes.

We are going to describe below in a precise and concise way, the production mechanisms that underlie both artifacts.
COMET TAIL ARTIFACT

We can consider this phenomenon as a form of reverberation:

We assume that sounds travels in a straight line, at constant speed. Therefore, we can determinate the origin of an echo that goes back if we quantify the time it takes to return. In the presence of two reflective interfaces, the echoes generated from the main beam may be repeatedly reflected, in repeated trips before go back to the transducer, where they may be detected.

Each echo is received erroneously transcribed as a band located at a greater depth, so we may see multiple parallel lines of decreasing intensity and equidistant from each other (Fig. 2 on page 6).

In this artifact, the two reflective interfaces, and therefore the generated echoes are closely spaced. In the image, sequential echoes can be so close together that the individual signals cannot be seen.

In addition, delayed echoes have lower amplitude, secondary to attenuation process; this decrease in amplitude is shown as a width of echoes increasingly diminished. The result is an artifact caused by the principle of reverberation, but with a conical or triangular shape.

This phenomenon occurs when the beam comes into contact with metal objects (Fig. 3 on page 6) such as metal clips of suture, needles, foreign bodies… or calcification (granulomas, cholecystolithiasis (Fig. 4 on page 7), calcified myomas, nephrolithiasis…). A classic example is cholesterolosis of the gallbladder wall (Fig. 5 on page 8).

RING-DOWN

In the past, it was thought this artifact was a variant of the previous. This statement was based in the similar appearance both artifact exhibit.
However, it is known that Ring-Down appears mostly due to gas (rather than metal, as in the case of comet tail). We need multiple gas bubbles to produce it. When the ultrasound beam reaches the gas bubbles, it is capable of exciting the liquid trapped between the bubbles, which causes the liquid resonates. These vibrations create a continuous sound wave which is transmitted back to the receiver. This phenomenon is shown as a line or series of bands extending parallel after the image corresponding to gas (Fig. 6 on page 9).

Some examples we can found in our daily practice are abundant gas in the colon structure (Fig. 7 on page 10) or those produced after surgery, such as aerobilia after cholecystectomy or hepaticojejunostomy (Fig. 8 on page 11), air bubbles after injections (Fig. 9 on page 12) or in pathological processes for example in Fournier gangrene, where the display of gas adjacent to the scrotum is characteristic of the disease (Fig. 10 on page 13).

Considering air is the cause of this artifact, seen as "dirty shadows" in the image, it is possible to think this phenomenon is not useful, because you can hide deeper structures. Nothing is further from the truth.

If you find air in the thickness of the gallbladder wall, or in the context of pyelonephritis, this artifact can help us to diagnose emphysematous cholecystitis (Fig. 12 on page 15) or pyelonephritis. Likewise, if we visualize the Ring-Down in the thickness of a fluid collection we probably are in the face of an abscess (Fig. 11 on page 14), or if we see that image in the peritoneal cavity is probably we are in front of a perforated hollow viscera.
Fig. 2: Physical basis of comet tail artifact

In the presence of two reflective interfaces, the echoes generated from the main beam may be repeatedly reflected, in repeated trips before go back to the transducer, where they may be detected. Each echo is received erroneously transcribed as a band located at a greater depth, so we may see multiple parallel lines of decreasing intensity and equidistant from each other.

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Fig. 3: Endoprosthesis.

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Fig. 4: Microlithiasis

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**Fig. 5:** Cholesterolosis polyps inside the gallbladder.

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**Fig. 6:** Physical basis of Ring-Down artifact

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Fig. 7: Gas in duodenal frame

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**Fig. 8:** Aerobilia after hepaticojejunostomy.

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Fig. 9: Gas after intravitreal injection.

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Fig. 10: Fournier gangrene.

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Fig. 11: Intrahepatic abscess with gas.

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Fig. 12: Emphysematous cholecystitis

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a) We can see a gallbladder with increased wall thickness (green arrow) and a linear image corresponding to "dirty shadow" (red arrow) and echogenic content (blue arrow).

b) Detail of gallbladder wall with linear high frequency probe.
Conclusion

Comet tail and Ring-Down artifact usually are used as synonyms, due to their similar appearance on ultrasound. But their physical basis are completely different and the mechanism that produce them:

- Comet tail artifact is a form of reverberation; therefore it has the same production basis, i.e, repeated trips between the transducer and two reflective surfaces.

- Ring-down artifact occurs when the ultrasound beam excites the liquid trapped between gas bubbles, producing the liquid to vibrate or resonate.

- Metallic elements/calcifications cause comet tail artifact, being thus useful for diagnosing from foreign bodies, metal clips of suture, catheters… to calculus or granulomas.

- Gas is responsible for Ring-Down artifact. Its display can translate from gas than can be found in physiological situations (for example inside bowel), after surgical procedures (aerobilia after cholecystectomy or hepaticojejunostomy) or pathological processes (pneumatosis intestinalis, emphysematous cholecystitis…). It is necessary to emphasize that knowledge of clinical data and patient history are essential to guide in the ethiology.
References


