Letter to the Editor

Foreseeing the microbiology of bespoke 3D printed medical devices.

Sir,

To paraphrase Criswell, the future fascinates us because it is, after all, where we will spend the rest of our lives. Previously considered futuristic, technology-enabled tools for patient monitoring, imaging, diagnosis, and robotic surgery are becoming commonplace. 3D printing is at the fore of medical device innovation and it has been proposed that, in the near future, early adopters of 3D printing will accelerate its use beyond patient-specific prostheses and anatomical models to provision of rapid solutions for hospitalised patients requiring customised medical devices. Recently, we reported such contingency use, whereby 3D printing allowed us create a bespoke repair of a percutaneous endoscopic gastrostomy (PEG) tube where surgical replacement was not possible and where the manufacturer could not provide a solution. The tube had been inserted endoscopically five years previously using the pull technique, and its integrity had deteriorated to the point of fracture and leakage. Our repair lasted 205 days before the process was repeated, allowing us the opportunity to collect the component parts of the first 3D printed unit to perform microbiology analysis.

Some 3D printing processes use extruded thermoplastics exposed to pressures and temperatures in excess of those needed for Ultra-High Temperature (UHT) and High-Temperature Short-Time pasteurisation, effectively reducing or removing the microbial burden of finished products. We used an alternative process involving a photopolymer material that hardened on exposure to UV light. Upon completion of the printing process, conventional microbiology confirmed that our PEG tube repair was sterile.

Our repair was based on a design similar to haemostasis valves that “clamp” over the leak but would result in some exposure of the 3D printed unit to contents of the PEG tube. In the absence of infection, the sparse microbial growth observed was identified using MALDI-TOF MS (Bruker) as Candida krusei, Candida albicans, and Staphylococcus epidermidis. Predominant gastrointestinal flora were absent, although our results to an extent mirror previous reports of PEG tube colonisation by Candida species and possible association with degradation of gastrostomy devices.

As bespoke 3D printed medical devices become more ubiquitous, it is comforting to know that their microbiology does not seem to differ greatly from mass-produced devices. While it is possible that factors intrinsic to 3D printing or the materials used influence fungal rather than bacterial colonization, the complications of percutaneous endoscopic gastrostomy are well understood with bacteria rather than fungi
considered the greater risk for infection causation as PEG-related candidiasis is reported rarely \(^8,^9\). Indeed, the risk of bacterial infection can be mitigated even further through inclusion of antimicrobial agents (e.g., silver) or structural modifications of 3D printed device surfaces \(^10\).

Having been provided an opportunity to assess the microbiology of a 3D printed medical device used in real-world hospital conditions, albeit a single case, we hope that our preview of the future is more accurate than Criswell’s visions. Clearly, beneficial advances in technology will result in devices that allow new tasks be performed and/or existing tasks be performed better, or safer. We suspect, however, that the microbial risk is no worse than before.

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**REFERENCES**


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