



Review Article

ADDRESSING METABOLIC DYSFUNCTION-ASSOCIATED STEATOHEPATITIS (MASH) THROUGH PANCHAKARMA: AN EVIDENCE-BASED REVIEW

Trishla Chopra¹, Mamata Nakade^{2*}, Govind G N³, Rekha¹

¹PG Scholar, ²Professor and HOD, ³Assistant Professor, Department of Panchakarma, Dr. D. Y Patil College of Ayurved and Research Centre, Dr. D. Y. Patil Vidyapeeth, (Deemed to be university), Pimpri, Pune, Maharashtra, India.

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ABSTRACT

Metabolic dysfunction-associated steatohepatitis (MASH, formerly NASH) is an inflammatory progressive liver disease that arises from metabolic dysfunction and hepatic steatosis, carrying risk of fibrosis, cirrhosis, and hepatocellular carcinoma. Lifestyle change is first-line prevention, but complementary approaches such as Ayurvedic *Panchakarma*, a system of individualized detoxification and rejuvenation therapies are increasingly investigated for prevention and early management of steatotic liver disease. This review synthesizes current understanding of MASH, maps it to Ayurvedic pathogenesis, reviews the putative mechanisms and available clinical/experimental evidence for *Panchakarma*, and proposes a pragmatic framework for integrating *Panchakarma* into prevention strategies while highlighting research gaps and safety considerations.

INTRODUCTION

Metabolic dysfunction-associated steatotic liver disease (MASLD) is the contemporary term for liver disease characterized by hepatic steatosis plus metabolic risk factors; its progressive inflammatory form is called MASH (metabolic dysfunction-associated steatohepatitis). The new terminology highlights the metabolic basis of the disease and reclassifies it in line with cardiometabolic risk factors, rather than focusing solely on the exclusion of alcohol use. [1,2] It develops from hepatic fat accumulation (steatosis) driven by insulin resistance, adipose tissue dysfunction, dyslipidaemia, oxidative stress, mitochondrial dysfunction, and chronic low-grade inflammation. Steatohepatitis develops when lipotoxicity and inflammatory signalling induce hepatocyte damage, trigger cell death, and activate stellate cells, ultimately resulting in fibrosis.

Cardiometabolic comorbidities suggests presence and progression. [3] In classical Ayurvedic terminology, fatty liver and its complications are interpreted as *Yakrit* (liver) disorders and classified under *Medoroga* or *Santarpanajanya Vyadhi*-conditions stemming from overnutrition and *Kapha-Meda* (adipose tissue) vitiation, accompanied by impaired *Agni* (digestive-metabolic fire) and *Srotodushti* (obstruction of bodily channels). From this perspective, interventions that diminish excess adipose tissue and metabolic stagnation, restore *Agni*, and clear obstructed channels are considered logical approaches for prevention and early management.[4] MASH carries substantial morbidity and stands as one of the leading causes of chronic liver disease worldwide, making early prevention a critical global priority.[1,2] Panchakarma is one of the treatment modalities in Ayurveda which helps achieve the above-mentioned preventive aspects.

Panchakarma- Rationale for Prevention

Panchakarma, comprising the five main therapies along with preparatory and supportive measures seeks to dislodge and expel *Ama* (metabolic toxins) and vitiated *Dosha*, revive *Agni*, and regulate tissue metabolism. Among its methods, the following are particularly relevant for MASLD/MASH prevention:

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1. **Vamana Karma** (Therapeutic Emesis): Induces controlled vomiting to eliminate excess *Kaphadi dosha* and *Ama* through the upper gastrointestinal tract. This procedure is particularly beneficial for conditions characterized by metabolic stagnation and adiposity, such as MASLD/MASH. By removing accumulated toxins through the upper gastrointestinal tract, *Vamana* enhances *Agni*, improves lipid metabolism, and supports liver function. Clinical studies have demonstrated significant reductions in oxidative stress markers and improvements in lipid profiles following *Vamana* therapy, underscoring its role in metabolic health. [5]
2. **Virechana Karma** (Therapeutic Purgation): *Virechana Karma* involves the administration of purgative substances to eliminate vitiated *Pittadi dosha* and accumulated toxins through the lower gastrointestinal tract. This procedure aids in detoxifying the hepatobiliary system, reducing fat accumulation, and improving lipid metabolism crucial for preventing the progression of MASLD to MASH. [6]
3. **Basti Karma** (Medicated Enema): *Basti Karma* is a key Panchakarma therapy for regulating *Vatadi dosha* and managing metabolic disorders. It involves the rectal administration of medicated oils i.e. *Sneha Basti* or decoctions i.e. *Niruha Basti*, allowing absorption into the colon and systemic circulation. In MASLD/MASH, *Basti* aids detoxification by eliminating accumulated *Ama* and reducing hepatic burden. Formulations like *Lekhana Basti* help modulate adipose tissue and improve lipid metabolism. By normalizing *Vata* and supporting metabolic balance, *Basti* indirectly promotes liver health, reduces hepatic fat accumulation, and may prevent disease progression. Clinical studies have reported improvements in lipid profiles, body weight, and metabolic parameters, underscoring its role in managing lifestyle-related metabolic disorders. [7,8,9]
4. **Nasya Karma** (Nasal Administration): *Nasya Karma* involves the administration of medicated oils or herbal preparations through the nasal passages. This therapy primarily targets head and neck channels but indirectly modulates systemic *Dosha*, improves metabolism, and assists in detoxification beneficial in the early stages of MASLD/MASH. [10]
5. **Raktamokshana Karma** (Therapeutic Bloodletting): Involves the controlled removal of vitiated blood to reduce *Pitta*-mediated inflammation and systemic toxicity. In MASLD/MASH, where hepatic inflammation and hepatomegaly are common,

Raktamokshana helps lower oxidative stress, modulate inflammatory mediators, and reduce hepatic congestion, thereby supporting liver function and metabolic balance. Clinical observations indicate that this therapy can alleviate hepatomegaly, improve liver enzyme profiles, and mitigate symptoms associated with early-stage liver dysfunction. [11,12,13]

Panchakarma's multimodal effects like metabolomic modulation, anti-inflammatory effects, improved insulin sensitivity through weight and body composition changes, and stress reduction form a plausible mechanistic basis for preventive impact in MASLD/MASH.

Evidence Summary- Clinical & Experimental Data

1. Clinical trials, pilot studies, and controlled studies- A controlled clinical study demonstrated that *Virechana* markedly lowered triglyceride levels, while *Lekhana Basti* reduced cholesterol in patients with dyslipidaemia, indicating favourable effects on lipid parameters implicated in MASLD pathogenesis. This randomized controlled study highlights the metabolic benefits of Panchakarma interventions. [14]
2. Case Reports and Case Series- Multiple case reports/case series describe reversal or improvement of fatty liver on imaging and biochemical markers after individualized Ayurvedic therapy packages including Panchakarma, herbs, and lifestyle interventions. While promising, such reports are limited by sample size and lack of controls. [15,16]
3. Herbal Adjuncts- Polyherbal formulations (e.g., *Sharapunkhadi* powder and other hepatoprotective/herbo-metabolic combinations) have shown benefit in pilot clinical studies when combined with lifestyle modification. These are commonly used with *Panchakarma* protocols in clinical practice. [17]

Overall evidence assessment: Early clinical evidence supports beneficial effects of *Panchakarma* modalities on metabolic and hepatic surrogate markers relevant to MASLD/MASH.

Practical Protocol Considerations for Prevention

1. Screening & Target population: Individuals with MASLD risk factors (central obesity, insulin resistance, dyslipidaemia, prediabetes) and early imaging evidence of steatosis but without advanced fibrosis may be considered for preventive *Panchakarma* interventions alongside lifestyle change.
2. Recommended *Panchakarma* focus:
 - Mild-moderate metabolic risk/steatosis: Ayurvedic regimen emphasizing *Lekhana* (scraping) therapies,

dietary corrections i.e. *Mandagni* correction, and periodic *Virechana* or *Lekhana Basti* as indicated.

- When inflammation indicators present (early MASH): consider *Virechana* under careful monitoring; combine with hepatoprotective internal Ayurvedic formulations and lifestyle therapy.
- 3. Preparatory measures: Adequate *Snehana* (internal and external oleation) and *Swedana* to mobilize tissue toxins before elimination therapies.
- 4. Post-procedure rehabilitation i.e. *Samsarjana*: Gradual dietary advancement, monitored caloric restriction aligned with Ayurvedic post-Panchakarma dietetics.
- 5. Adjuncts: Tailored herbo-mineral formulations with demonstrated hepatoprotective/metabolic effects and yoga/exercise programs to sustain improvements.
- 6. Monitoring: Baseline and follow-up liver function tests, lipid profile, fasting glucose/HbA1c, anthropometry, and liver imaging (ultrasound/elastography) where available; monitor for adverse events.

Limitations of Current Knowledge & Research Gaps

- Heterogeneity in protocols (different formulations, frequencies, and techniques) makes pooled meta-analysis difficult.
- Small sample sizes and short follow-up in many studies; prevention requires demonstration of durable benefits on hard outcomes (fibrosis progression, cirrhosis incidence).
- Lack of histologic endpoints in most clinical reports (liver biopsy or validated non-invasive markers of fibrosis are needed).
- Mechanistic biomarkers (inflammatory cytokines, insulin resistance indices, hepatic fat quantification by MRI-PDFF) are underutilized.
- Need for multicentre, randomized, adequately powered trials comparing *Panchakarma* + lifestyle vs lifestyle alone or standard medical care.

Policy and Integration Recommendations

1. Integrative care pathways: Encourage collaborative models where Ayurvedic *Panchakarma* is offered adjunctively with modern metabolic risk management (diet, exercise, glycaemic control), with shared monitoring.
2. Research support: Fund randomized controlled trials with standardized *Panchakarma* protocols, pre-specified imaging/biochemical endpoints, and long-term follow-up.
3. Training & accreditation: Standardize training and quality controls for *Panchakarma* centres to ensure safety and reproducibility.

4. Patient education: Emphasize *Panchakarma* as an adjunct, not a replacement for lifestyle interventions and medical care for metabolic disease.

CONCLUSION

Panchakarma therapies, combined with appropriate pre- and post-procedure dietary regimens and herbal adjuncts demonstrates mechanistic rationale and early clinical potential for the prevention and early management of MASLD/MASH. These interventions may improve metabolic regulation, lipid metabolism, and the inflammatory environment. Nevertheless, current evidence is limited, and high-quality controlled trials with standardized protocols and meaningful clinical endpoints are needed to establish definitive recommendations. Meanwhile, *Panchakarma* can be considered a complementary, individualized preventive approach when administered by trained practitioners alongside conventional measures such as weight management, exercise, and glycaemic and lipid control.

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Address for correspondence*Dr. Mamata Nakade**

Professor and HOD,
 Department of Panchakarma,
 Dr. D. Y. Patil College of Ayurved and
 Research Centre,
 Dr. D. Y. Patil Vidyapeeth, (Deemed to
 be university), Pimpri, Pune,
 Maharashtra, India.
 Email: mamta.nakade@dpu.edu.in

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